THE NEW ZEALAND

CHINESE GOOSEBERRY EXPORT INDUSTRY

AND ITS FUTURE DEVELOPMENT

A thesis presented in partial fulfilment

of the requirements for the degree of

Master of Agricultural Science in Agricultural Economics

at

Massey University

D.W. Milne

1972

CONTENTS

ACKNOWLEDGEMENTS

Abbreviations used in this thesis

N.Z.D.A.   :   New Zealand Department of Agriculture

A.N.Z.   :   Australia and New Zealand

N.D.C.   :   National Development Conference

S.A.C.   :   State Advances Corporation

H.M.A.   :   Honey Marketing Authority

F.M.C.   :   Food Marketing Corporation

CHAPTER I

INTRODUCTION

New Zealand's dependence on the traditional exports, meat, wool, butter and cheese for the major overseas earners is well documented, (see (1)). New Zealand is one of the world's most efficient producers of these commodities but market access and short term political and social expediency has tended to reduce the gains of economic rationalization.

During the last year (1971) butter and cheese have been placed in long term jeopardy due to Britain's impending union[1] with the European Economic Community. Wool suffered a serious price reversal in 1967 and although a price revival has occurred in the past year it is doubtful if this will be a long term recovery. Lamb exports to the U.K. are experiencing greater competition than ever from other meats, especially cheaply produced poultry. The beef quota for the U.S.A. cannot be considered safe as it depends to a large extent on seasonal production variations in the U.S.A. and the strength of the U.S.A. farm lobby.

The existence of tariff and non-tariff barriers to trade, together with low price and income elasticities of demand for primary exports has placed emphasis on manufactured exports and import substitution in New Zealand, but many attempts at such diversification are often misdirected.[2] Condliffe (5) has a cautionary note about this:

"It is necessary to aim at competitive production for the world market rather than protected production for a small local market."

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1. This is not an unexpected development. Britain first applied for membership in 1961 and was rejected in 1963 – negotation restarted in 1966 and entry will date from the 1/1/73. However, the provisions of the Common Agricultural Policy will not come into force until 1/1/74.

2. An obvious example of this in New Zealand – The Automobile Industry. (see The World Bank Report on the New Zealand Economy 1968) though the farming industry has some protected sectors also. New Zealand has no absolute or comparative advantage in citrus production, hop production, wheat production – consequently all are protected by trade barriers in common with many other countries.

Scarce resources should be allocated to those industries in which an absolute or comparative advantage exists. A radical swing away from agriculturally based industries is not necessarily the correct path because New Zealand has many environmental advantages for the production of a large number of foodstuffs besides meat, wool, butter and cheese.

The New Zealand climate enables production of a multitude of fruits but only a few appear to have reasonable export prospects; apples, pears, berry fruits and Chinese gooseberries. However, the future prospects for apple and pear exports are poor as no safeguards exist when Britain joins the E.E.C. The export trade for fruitgrowing is complicated by:

(a) the perishable nature of fruit

(b) unpredictable biological vagaries

(c) stringent and sometimes unreasonable quarantine regulations

(d) increasing domestic production in many countries.

New Zealand's problems are added to by:

(a) remoteness from world markets creates higher costs (freight, administration, market intelligence)

(b) lack of suitable transport space when required.

On the positive side for New Zealand are the overseas market opportunities in the Northern Hemisphere for off-season fruit. However, this advantage is being continually eroded due to improved cool storage techniques enabling extension of the northern hemisphere fruit season.

The two major factors inhibiting fruit exports from New Zealand are that

(a) other countries can produce and market the same or similar fruit at lower cost.

(b) other countries prohibit fruit imports for political and social reasons.

Neither of these two factors operate against the export of Chinese Gooseberries nor are they likely to in the forseeable future.

New Zealand appears to have a comparative advantage (and possibly an absolute advantage) in producing Chinese Gooseberries and nowhere else in the world has this fruit achieved such commercial prominence[3]. With rapidly expanding production and export sales, commercial production of Chinese Gooseberries has moved from relative obscurity to national prominence within the Horticultural Industry in the past decade. The

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3. According to Fletcher and Schroder (2) Chinese Gooseberries can also be grown with varying degrees of success in parts of England, Japan, Belgium, France, India, Germany and Russia, Australia, United States and the Netherlands.

impetus for the expansion has come from the export demand.

To be aware of existing problems and to enable future problems to be anticipated makes an economic review of the industry desirable.

Too many times in the past New Zealand industries[4] have run into serious difficulties due to inherent competitive weakness which has resulted in political intervention to ensure the survival of these industries. This has been achieved by regulation and market intervention. This thesis consists of a broad review of the Chinese Gooseberry Industry in which certain important problems are dealt with in depth.

The second chapter deals with the history and a description of the Chinese Gooseberry vine and fruit, a review of industry statistics and an indication of potential production areas. Chapter three discusses some potential industry problems and the theory of economics of size is outlined. Chapter four describes the method of cost curve analysis used to investigate cost-size and profit-size relationships on Chinese Gooseberry orchards. In Chapter five cost-size and profit-size relationships for specific situations are presented. The sixth chapter is concerned with the marketing sector of the industry, covering the current marketing process, economies of size of packing and grading installations and a discussion on the desirability of statutory intervention. Chapter seven comprises the conclusions and recommendations for this thesis.

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4. e.g. Whangarei Glass, Nelson Shipping.

CHAPTER II

THE HISTORY AND DESCRIPTION OF THE CHINESE GOOSEBERRY VINE, GEOGRAPHICAL LOCATION OF VINE CONCENTRATIONS AND ASSOCIATED STATISTICS

2.1   History and Description of the Vine

2.1.1   Historical background relevant to New Zealand.

The Chinese Gooseberry[1] (Actinidia Chinensis Planch) is a member of the family Actinidiaceae and indigenous to China where it occurs as a deciduous fruiting vine, commonly found climbing up tall trees on the forest margins along the Yangtse Valley in the north-west Hupeh and Szechuan provinces at elevations from 1,800 feet to 7,000 feet above sea level (approximately 30°N latitude). There are about twenty species in the genus, all of East Asian origin, and seven are known to be cultivated in different parts of the world for their attractive vines, but only three species A. Chinensis, A. Arguta and A. Kolomikta produce edible fruits. A. Chinensis and A. Arguta are better known for their edible fruits alone and A. Kolomikta is used for jam and wine making in the Amur forests of Siberia.

The earliest known description of A. Chinensis is to be found in Old Chinese Literature, Chiu Huang T'sao in the 15th Century (3). A. Chinensis was first described to the Western World in 1847 from specimens sent to England by Robert Fortune, collector for the Royal Horticulture Society. The plant was not grown outside of Asia until seeds were sent from China to the U.S.A. and these were successfully established. The species was given an award of merit by the Royal Horticultural Society in 1907, and flowered for the first time in England in 1911. The plants introduced into the U.S.A. flowered but were all males.[2] Subsequent plantings of the vine have successfully fruited in the U.S.A.

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1.   Also known as Kiwi Fruit, Yang Tao and Mao-erh-tao; The name Kiwi Fruit is used to some extent in New Zealand and commonly in the overseas markets. Both Kiwi Fruit and Chinese Gooseberry are used interchangeably throughout this thesis.

2.   Chinese Gooseberry is dioecious.

The vine was first introduced into New Zealand at Wanganui on to the property of a Mr Allison. It is thought that he was given the seed by James McGregor who obtained it while on a visit to China. Vines from these seeds first fruited in 1910. After Allison's vines fruited several keen horticulturalists became interested in the culture of the species. Among these were Wightman of Awahuri, Gorton and Mason of Feilding and Just of Palmerston North. For the next thirty years there was very little interest in the plants.

The vines took up a large amount of space in the orchard and some growers had waited for many years for seedlings to flower only to find them to be non-bearing males. Over this period a body of knowledge on the cultivation of the vine was accumulated by a limited number of grower enthusiasts throughout New Zealand.

Just was mainly responsible for promoting the Chinese Gooseberry within New Zealand. He raised large numbers of seedlings, many of which were planted out in his own nursery, and when these fruited he selected several types which were propagated and sold as grafted plants. These selections were much superior in fruit size and uniformity to the seedlings then grown. Just did not name any of his selections and they were sold by him and other nurserymen under labels such as: large fruited, giant and long. Most of the varieties grown commercially today were developed by Just and Wright[*].

2.1.2   A Description of the Vine and fruit

A detailed description of the species and its taxonomy is unnecessary as these aspects are covered in several previous publications[3] by qualified botanists. Only a brief description of the distinguishing features of the main commercial varieties is included here.

A large amount of confusion concerning the identity of the different types existed up until 1958 when a comprehensive survey (4) of Chinese Gooseberry plantings was carried out by Mouat and variety names were published for types which showed the most promise for commercial production.

The main varieties at present being grown commercially are 'Abbott',

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3.   see (2) (4).

*   Mr Hayward R. Wright was a nurseryman who was instrumental in developing the Hayward variety.

'Bruno', 'Monty' and 'Hayward'.

2.1.2.1 Description of the main varieties.

(a) 'Abbott' : One of the earliest flowering and earliest maturing
varieties. The medium size oblong fruit is covered with dense
hairs which are longer and softer than those of 'Bruno'.

(b) 'Bruno' : Flowers later than 'Abbott' but earlier than 'Monty' and
'Hayward'. Its elongated fairly large fruit cannot be confused with
that of any other variety and is covered with very dense short,
rather bristly hairs.

(c) 'Monty' : This variety and 'Hayward' are the latest varieties to
bloom. 'Abbott' may almost be at the petal fall stage when the
'Monty' and 'Hayward' varieties are just opening their flowers.
'Monty' is a very prolific variety with a tendency to overcrop which
adversely affects fruit size. If the fruit set is heavy, hand
thinning is generally required to develop a good sized fruit. When
"well-grown" the fruit is similar in size to the 'Abbott'. It is
oblong in shape but tapers slightly to the stem and is more angular
at the stylar[4] end than the 'Abbott'.

(d) 'Hayward' : A very late flowering variety which can be identified
easily by its very large broadly oval fruit which are often
slightly flattened laterally. The fruits are a pale greenish brown
and are densely covered with fairly fine silky hairs. The variety
is superior in flavour and keeping quality to all other types at
present available. These qualities have made the 'Hayward' variety
the most popular for commercial production, despite a tendency to
produce lighter crops than other varieties. Close planting of
'Hayward' vines, which are often less vigorous than other varieties,
largely offsets the lower yield per vine.

Chinese Gooseberry vines and fruit are usually classed as Haywards
or Standards in New Zealand. The Standard classification refers to all
varieties other than Haywards.

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4. End furtherest away from the vine.

(e) A. Chinensis is a dioecious species, the male sex organs are not found on the same plants as the female sex organs, consequently only the female plants produce fruit. For commercial yields there must be both sexes in close proximity to each other and they must flower concurrently.

There has been some selection of appropriate pollen-bearing male clones[5] which are now available. One is a long flowering all-purpose pollinator which is already quite widely distributed and appears to be suitable for all the present commercial fruiting varieties. This clone seems to have been one of the males originally selected and distributed from the nurseries of Just of Palmerston North. To identify the clone it has been given the name 'Matua'. Tomuri is another less floriferous clone but with a late flowering season and is a useful pollinator for 'Hayward' and 'Monty' fruit varieties.

2.1.2.2 Desired environmental conditions.

Local conditions now considered[6] desirable for commercial cultivation are; shelter from wind, land with northerly facing aspect, well-drained soil, no soil moisture deficit at any time of the year, frost free from approximately the 26th of August until the 31st May each year and a low rainfall during late October early November each year (a pollination requirement). One is most likely to find all these conditions met on small ridges lying between 300 and 600 feet above sea level in the upper half of the North Island.

2.1.2.3 A description of the fruit - general for all varieties.

Most fruit marketed lies within the range of 65 - 125 grams (0.14 - 0.27 lb) and is brown with short bristly hairs. The flesh of the fruit is a light green colour and in cross section exhibits a pattern of lighter coloured rays interspersed with numerous dark seeds radiating from its centre. When ripe the fruit has a rich flavour and can be eaten fresh or put to a large variety of culinary uses. It is thought that

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5. Clones: group of genetically identical plants produced vegatatively from one original seedling or stock.

6. N.Z.D.A. recommendations.

FIG. 2.1
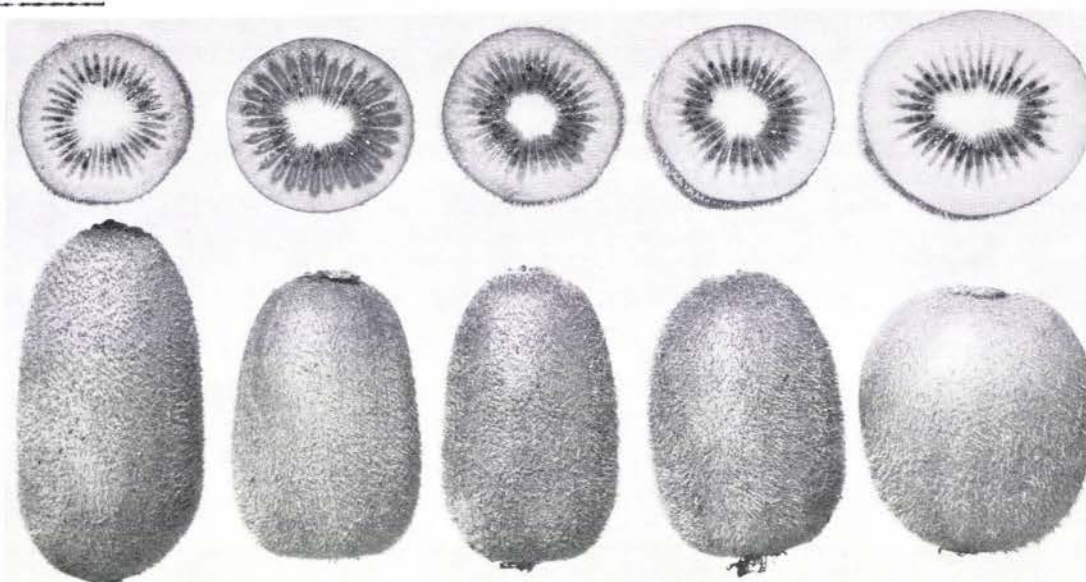
Above: Five varieties of fruit - Bruno (left),
Monty, Abbott, Allison, and Hayward (right).

FIG. 2.2
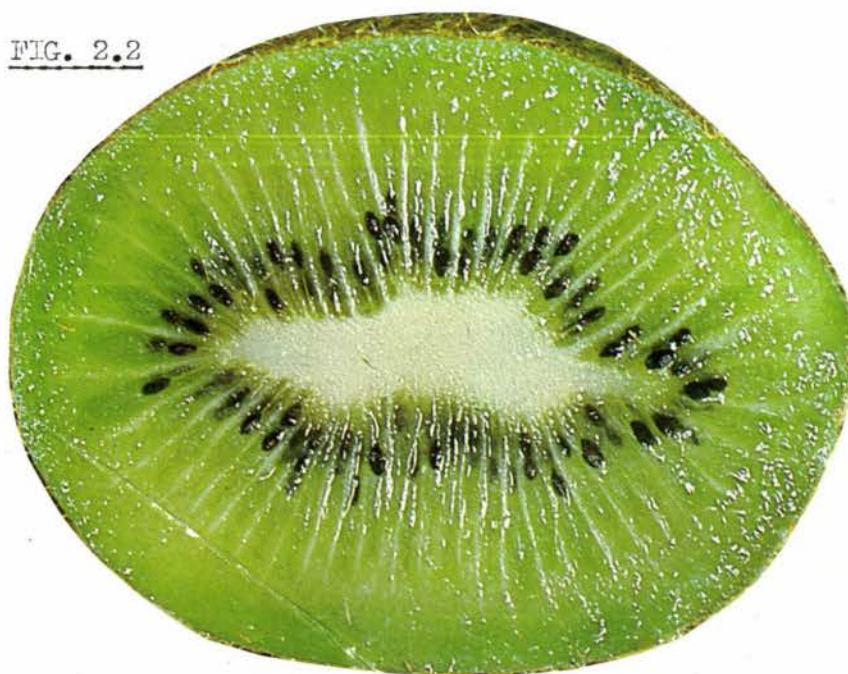
Hayward

Above: "Blown up" crossection of a fruit showing
colour and texture.

the main reason for its rapid increase in popularity overseas is the unique flavour and the unusual characteristic of the flesh being 'green' when ripe. However, the author is unaware of any formal market research and product evaluation survey.

It has been confirmed (8) that Chinese Gooseberries are rich with Vitamin C.

VARIETY:

Bruno	150 - 156 mg %	Vitamin C
Hayward	82 - 83 mg %	" "
Abbott	51 - 62 mg %	" "
Citrus Fruit	50 mg %	" "

Another analysis by Arcus (9) indicates that the fruit (variety not specified) contains:

9.0 - 10.2%	total sugar
1.29%	acid
1. 6%	protein
.95%	tanins
18%	dry matter

The analysis included seeds but not skin. The analysis also suggested that as Chinese Gooseberries mature and soften their Vitamin C content increases slightly.

Arcus found that incorporating raw Chinese Gooseberries in table jellies prevents them from setting. He found that this is due to the presence of a hitherto undescribed proteolytic enzyme which attacks gelatine. He proposed the name actinidin for this enzyme. This enzyme also has the ability to tenderise steak – achieved by rubbing the flesh of the fruit on to a raw steak and leaving it for 5 - 10 minutes before cooking. It remains active as a powder extract hence has potential as a commercial meat tenderiser. (This development will not be considered further in this study, which is restricted to the production of fresh fruit for sale).

The raw fruit can be stored satisfactorily for at least three to four months if kept at a temperature of $31 - 32^{\circ}F$ (see (17)). This.

factor enables the fruit to be marketed as "fresh fruit" in distant
markets using conventional sea transport.

2.2   Industry Statistics

    2.2.1   Introduction.

    Time series and cross sectional data concerning the location of
vines, acreage of vines, vine numbers and production of fruit exports
is presented in this section.   Accuracy of data available prior to 1960
appears to be somewhat suspect, especially concerning production and acre-
age.   For example, according to the New Zealand Year Book the tonnage
produced in 1959 was 543, but the Agriculture Department gave 400 tons as
the production for that year.   Another example of discrepancy was for
export of fruit in 1965;   An A.N.Z. Bank report[7] used the figure of
103 tons whilst an NDC report[7] stated exports of 120 tons for that year.
The basis for estimating planted acreage has altered through time.
In 1953 estimates[8] of acreage were based on the assumption of 120 vines
per acre but with the recent increase in the more closely planted Hayward
variety, acreage estimates are now based on 172 vines per acre.   It is
of small importance however that the data on the industry in its formative
years may be slightly inaccurate or that estimation methods have changed
a little, as long as the general trends over this period can be noted.
New Zealand Agriculture Department data has been mainly used as this is
considered to be the most reliable source by the author.

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7.   Personal communication by the author.
8.   Refer to The Orchardist of N.Z. Aug. 1954 p.25.

TABLE 2.1

Vine Numbers by District Over Time

	1952[9]	1957[10]	1962[11]	1967[12]	1969	1970	1971	ACRES 1971**
Northland	3912	3890	3619	2804			5030	28
Auckland	3153	1836	2187	2845	8826*	11000*	6130	39
Bay of Plenty	5003	10222	21145	38928	97561	148006	204180	1177
Poverty Bay	24	63	19	159			10870	–
Other Districts	424	317	541	651				
TOTAL N.Z.	12561	15328	27511	45387	106387	159006	226210	1302

* All Districts other than the Bay of Plenty

** Approximately at August

Explanatory notes to Table 2.1

9/ Data obtained from the official survey of the Fruit Growing Industry of New Zealand 1953 compiled from the report for the New Zealand Government by the Department of Agriculture (Horticulture Division) by J.H. Watt, Horticultural Economist. The survey was carried out during winter and spring 1953. Only commercial production was considered and very small orchards were excluded. The age of the vines was taken from year of planting. Other districts comprise Nelson, Hastings and Palmerston North.

Age Structure of Vines in 1953 (actual number of vines in each age group)

Age in Years	0/10	11/20	21/30	31/40	Total
Northland	3849	63			3912
Auckland	2663	470			3153
Bay of Plenty	4515	488	20		5003
Poverty Bay	24				24
Other Districts	344				344
TOTAL N.Z.	11395	1021	20		12436

Eighty-two percent of vines were considered to be in a vigorous and healthy condition.

10/ A supplementary survey to the Official Survey conducted by N.Z.D.A. Horticulture Division 1953 was carried out during the winter and spring of 1958, with the same terms of reference as 1953. It revealed an increase in vine numbers of approximately 40% since 1952.

11/ Supplementary and based on the Official Surveys in 1953 and 1958 by N.Z.D.A. Horticulture Division. Minimum size of orchard included 50 trees. It showed that a 50% increase had occured since 1957.

12/ Official Survey of the New Zealand Fruitgrowing Industry of New Zealand 1968. Minimum size of orchard included was 100 trees.

12/ Continued:

Age and Variety Structure of Vines 1967-68

Age in Years	0/5		6/10		11 upwards		TOTAL	
District	H	S	H	S	H	S	H	S
Northland		173	157	107	264	2103	421	2383
Auckland	727	704	230	102	221	485	1178	1208
Bay of Plenty	12556	6387	4635	8090	1804	4656	18995	19133
Poverty Bay	140					19		159
Other Districts	170	275	60	198	25	131	255	604
TOTAL N.Z.	13453	7649	5082	8497	2314	7594	20849	23487

H = Hayward variety

S = Standard Variety - (Bruno, Abbott, Monty)

The data on vine numbers from the surveys has been taken as applicable to the year before the survey was carried out because they would not include all the vines in the ground by the end of the survey year therefore the data has been considered more indicative of the previous year.

TABLE 2.2

Some General Industry Statistics (1968)

District	Variety	Acreage	Number Vines	Vines/ acre	No. Growers	Acres/ Grower
Bay of Plenty	Hayward	132.9	18995	142.8	135	2.1
	Standard	151.5	19933	131.5		
Moutueka	Hayward	0	0	–		
	Standard	.53	122	230	1	.53
Northland	Hayward	3.29	421	128		
	Standard	16.62	2383	143.38	39	.51
Auckland	Hayward	8.6	1178	136.97		
	Standard	8.3	1459	171.04	34	.497
Franklin	Hayward	.31	30	96.7		
	Standard	1.75	178	197.7	2	1.03
Nelson	Hayward	.38	75			
	Standard	.17	34	200	2	0.275
Poverty Bay	Hayward	0	0	–		
	Standard	1.01	159	145	3	.33
Taranaki	Hayward	1.25	150	120		
	Standard	2.01	270	134.32	2	1.62

Source of data: 1968 Orchard Survey N.Z.D.A. Hort. Division.

TABLE 2.5

Previous[13] and Projected[14] Acreage and Production for N.Z.

PLANTED		BEARING ACREAGE		LIKELY YIELDS (Tons)	
Year	Acreage	Full	Part	Max.	Min.
1953	96				
1956	128				
1959	130				
1962	185				
1963	185				
1964	210	See Figs. 2.5 and 2.6			
1965	230				
1966	295				
1967	330				
1968	420				
1969	650				
1970	990				
1971	1300	185	145	2330[15]	
			Projections		
1972	1400	185	235	2770	2005
1973	1500	210	440	3535	2465
1974	1600	230	760	5975	3335
1975	1700	295	1005	6925	4635
1976	1800	330	1070	8780	6080
1977		420	1080	10460	7560
1978		650	950	11940	8840
1979		990	710	13290	9990
1980		1300	600	14400	10900

13. Data source W.A. Fletcher H.A.O. N.Z.D.A.

14. See next page for discussion.

15. Production from commercial orchards in 1971 (N.Z.D.A. data)

District	Production (Long Tons)
Kerikeri	70
Auckland	50
Bay of Plenty	2150
Gisborne	6
	2330

Explanatory notes for Table 2.3

This table is based on data supplied by W.A. Fletcher, H.A.O., N.Z.D.A. The acreage figures up to 1971 are the same as those supplied by Fletcher, but the projections for acreage and yields are a modified version of his. The modification was carried out on the advice of Fletcher because his projections were made in 1970 and proved to be significantly astray for 1971. His projections assumed a conservative 100 acre increase of vines per year, but the increase for 1971 was 500 acres. The author has adhered to the conservative estimate of the 100 acre increase per year after 1971 and has made appropriate modifications to the acreage and yield projections for the previously unpredicted 200 acres planted in 1971. Maximum and minimum yield projections are shown to indicate the range each year's production will fall into. Vines are assumed to begin bearing four years after planting and reach full bearing nine years from planting. Assumed yields (long tons per acre) are shown below.

Vine Age (years)	Minimum Yield	Maximum Yield
3	0	0
4	1	2
5	2	4
6	4	6
7	5	7
8	6	8
9	7	9

Fig 2.3   1971 Geographical Distribution of Commercial Chinese
           Gooseberry Production in New Zealand

Key

 one dot (·)
quals 1000 vines

●   represents a
       town or city

Bay Of Plenty District

Tauranga

Te Puke

Whakatane

Rotorua

170W

180W

40S

All
New Zealand

Key

o   Main areas of commercial
       production.

Fig 2.4
Changes in vine numbers
since 1952

All New Zealand
Bay of Plenty

Other Districts

Fig 2.5
Changes in acreage
since 1952

All New
Zealand

...... projected

Compound rate of increase 53 → 59 - 5.2%
                            59 → 65 - 10.%
                            65 → 71 - 33.5%

Fig 2.6
Total New Zealand production
from 1952

...... projected

High
Low

[Figs 2.4, 2.5 and 2.6 are semi-log time series graphs.]
Source of data N.Z.D.A.

2.2.2   Discussion on Trends

Since 1967 the Haywards variety has been used almost exclusively
for all new plantings therefore by 1975 all the present vines of standard
varieties of Chinese Gooseberry should be full bearing.   According to
Fletcher the acreage of standard varieties has stabilised at approximately
200 acres.   Production of standard fruit will consequently not increase
after 1975, and increases in production after then will virtually all be
of the Hayward variety.   By 1980 production from the Hayward variety will
have increased to between 9,300 and 12,500 tons.

This production range is used because of the unknown rate of vine
planting that will occur in the next few years coupled with yearly
production variations.

2.2.3   Export History

The first exports were made in 1950 to England and Australia by the
New Zealand Fruitgrowers' Federation.   North America and Europe are the
main export markets at present.   Approximately half of the export fruit
is sold in North America and the major proportion of the complement is
sold in England, Germany, France and Holland.   Two other major export
markets are Japan and Australia.   Minor markets are Fiji, New Caledonia,
Tahiti, Samoa, Singapore, Malaysia and Hong Kong.

The name of the fruit was changed from Chinese Gooseberry to
Kiwi Fruit partly to establish the fruit's image as that of an exotic
and therefore attractive to the high priced luxury market.   The name
was also changed to overcome trade restrictions which apply to many
fruits with the name of 'Gooseberry' or 'berry'.   The Hayward variety
is the most sought-after for the export market.

Fig 2.7
Changes in total New Zealand production since 1953 showing
the proportion of fruit exported.
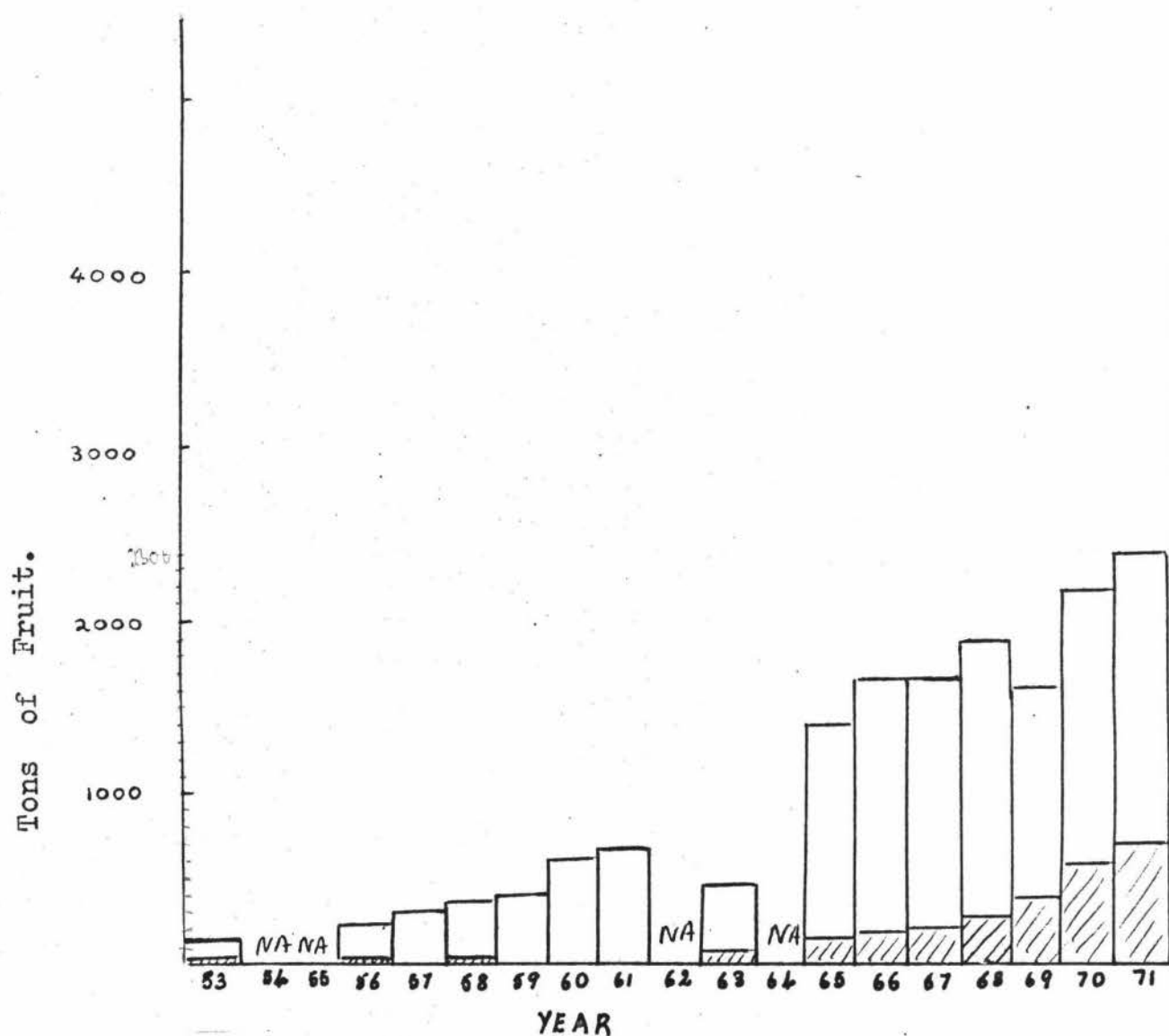
Total N.Z.
Production {⬜} } tons exported
N.A. — Data inconsistent or not available
Data Sources — New Zealand Year Books
and   N.Z.D.A.

2.2.4   A Review of the Main Kiwi Fruit Production Areas

2.2.4.1   Bay of Plenty.

The Bay of Plenty area (see Fig 2.3) contains approximately 95%
of the total commercial acreage in New Zealand.   The planting rate
of vines in this area has surpassed all previous expectations, and
there is no doubt that the suitable climate is one of the main reasons.
Other factors that explain the regional dominance of the Bay of Plenty
in Chinese Gooseberry production are discussed below.

Until recently, almost all Chinese Gooseberry production on any
one farm was carried out in conjunction with one or several other
subtropical fruit crops, the notable exception being a handful of growers
who specialised in Chinese Gooseberry production some years ago.   This
latter group persisted with one variety of Chinese Gooseberry (Haywards)
and successfully silenced the pundits who forecast both market and
production problems with a one crop enterprise.

It was soon apparent that the increased risks run by orchardists
relying on Kiwi Fruit as their major or only source of income were easily
balanced by the relatively large profits being obtained in comparison
with other sub-tropical fruits.

As one would expect the initiative was first taken by other sub-
tropical growers in the Bay of Plenty and as the profitability of the
crop became more widely known, people from all walks of life entered
the industry.   Another of the crucial factors for the rapid expansion
in the area is the large area[16] of suitable land available in the form
of sheep and dairy farms throughout the Bay of Plenty, even though much
orchard land has already been encroached on by housing (Otemoutai,
Te Puna districts).

Other factors currently of lesser importance[17] for the expansion in
this area are:
(a)   The close proximity of two major ports, Auckland and Mt Maunganui.
(b)   The proximity to the most densely populated region of New Zealand, which

16.   As distinct from Auckland and Kerikeri.
17.   These factors will probably become increasingly important as
production expands.

(i) permits cheaper access for second grade local market fruit
(shorter distance to travel), and suggests that;

(ii) Labour requirements for seasonal operations will probably be
more easily fulfilled.

(c) Possible external economies[18] of size in the industry (co-operative
packing and cool storage).

(d) Internal economies of size, due to land availability, with the
establishment of larger vine areas, which would not be possible in
the other traditional areas of Auckland and Kerikeri.

TABLE 2.4

Details[19] of Chinese Gooseberry Vines in the
Bay of Plenty in 1970 and 1971

		Vine Numbers	Acres of Vines	Number of Growers	Acres per Grower
1970	Tauranga District	33447	209	109	1.91
	Te Puke District	114600	712.5	98	7.26
1971	All the Bay of Plenty	204180	1177	N.A.	N.A.

2.2.4.2 Northland

In 1952-53 the number of vines in Northland[20] was slightly less than
in the Bay of Plenty, but since that time until 1970 there had been a
steady decrease, whereas in the latter area the vine numbers have increased
approximately thirty fold.   Vine numbers have now increased slightly in
Northland mainly due to the efforts of a few Dargaville dairy farmers, but
nothing comparable to the increase in the Bay of Plenty vine numbers.

A combination of factors is suggested as the cause of stagnation in
Northland.

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18. See Heady (12) p 363

19. Data compiled by C.S. Rondel N.Z.D.A. Horticultural Inspector,
Tauranga.

20. Northland Kiwi Fruit production has been almost entirely derived
from the Kerikeri district.

(a) Many Northland growers think that they are at a climatic disad-
     vantage in comparison to Bay of Plenty growers so they have been
     slowly moving out of Kiwi Fruit and into citrus[20] production in
     which they consider they have an advantage. It is thought that
     the winter is often too mild for the vines to achieve dormancy,
     which subsequently results in excessive vegetative growth. Irrig-
     ation is often an essential production input during the summer
     whereas in the Bay of Plenty this is seldom needed.

(b) The growers interviewed considered that one must make Chinese
     Gooseberry growing the farm's main enterprise, i.e. specialisation
     is best. With a mixed orchard, operations of crucial timelines
     tend to clash, e.g. Chinese Gooseberry pruning and apple pruning.

(c) The relatively small amount of suitable orchard land (especially
     young red brown loam soil around Kerikeri) is being greatly
     reduced by residential subdivision.

(d) Most of the leading growers are situated in the Bay of Plenty, and
     their presence has directly influenced other horticulturists in that
     area before other areas. As the acreage in the Bay of Plenty expand-
     ed it tended to become the primary source of new cultural techniques
     and other pertinent information which has tended to diffuse to other
     districts slowly. (especially Northland).

(e) Exporters are not keen on dealing with a few small lines of fruit,
     the sum total of which could all be bought off one grower in the
     Bay of Plenty with less effort and expense (higher freight costs
     and often only partially filled refrigerated trucks).

Half of the orchardists interviewed said they would cease Chinese
Gooseberry production in the next five years due to one or several of the
above reasons.

Contrary to the current thinking by many of the established growers
in this area the local Horticultural Advisory Officer is optimistic about
the future of the crop in Northland. He doesn't consider that Kerikeri is
at a climatic advantage and considers that Dargaville may prove to be the
best Place in New Zealand for their culture. He points out that Northland

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20. Especially oranges.

fruit is usually ready for export picking 2-3 weeks earlier than the
Bay of Plenty fruit and consequently has the opportunity to catch the
earliest available export shipping space.   In line with the views of
the Northland Horticultural Advisory Officer, recent[22] plantings have
occurred in the Kerikeri and Dargaville areas.

2.2.4.5 Developments in Dargaville

A group of dairy farmers who wish to diversify their interests are
experimenting with Chinese Gooseberry production.   It is thought that
the Dargaville district has a slightly better climate than Kerikeri for
commercial production of Chinese Gooseberries, because there is normally
no rain[23] when flowering occurs resulting in better pollination.

The vines are being planted in a variety of soils and less than a
dozen farmers intended to go ahead at the time of the author's visit
(January, 1971).   One farmer intended to plant seven acres of vines.
Planting density intended was 80 vines per acre (172/acre in the Bay of
Plenty)[24] because they would use the tractors which were already part of
their dairy farm operation.[25]   There is a low opportunity cost for land
involved in Chinese Gooseberry production since the investment is already
made and one acre represents a loss of approximately one cow's annual
butterfat production.   The single wire method is being adopted and it is
envisaged that if the vines (Hayward variety) can be successfully cultured,
ten acres of vines will be operated in conjunction with a farmer's dairy
enterprise.

It appears fairly likely that this area could become second only to
the Bay of Plenty in total production.

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22.   Within the last twelve months.

23.   According to local Horticultural Advisory Officer, N.Z.D.A.

24.   This does not include shelter belts or the headlands of blocks of
      vines.   The figure of 140 vines per acre is used in the cost-size
      analysis, see appendix fig. A.6 for idealized vine layout.

25.   Tractors used for the dairying operation tend to have a wider
      wheelbase than those normally used on a Kiwi Fruit orchard, also,
      spraying equipment and trailers used on a dairy farm tend to be
      too large for the typical row width in the Bay of Plenty, therefore
      wider rows are necessary.

2.2.4.4   Other Districts

Until the last two years the comparatively[26] stable vine numbers in
the Auckland, Nelson, New Plymouth and Gisborne areas were probably due
to similar factors as have operated in the Kerikeri area.   The potential
profitability of this fruit has only just been reflected in increased
grower interest, and subsequent vine plantings (see Fig. 2.4).

2.2.5   Supplementary Survey Data.

This is an analysis of data obtained by New Zealand Department of
Agriculture officers (Economics Division) whilst investigating the
Tauranga County water supply scheme, May 1970.

It was found necessary to obtain data from many orchardists in the
Te Puke area and the author was permitted to incorporate some questions
which would be useful to this study as well as to the N.Z.D.A.   Hortic-
ultural farms were selected for the survey on the basis of whether they
would be incorporated into the intended water supply scheme, consequently
for the purpose of recording the parameters of interest to the author it
could be regarded as a random survey.   The author participated in the
field work and interviewed as many Chinese Gooseberry farmers as was
feasible in the time available.

At the time of the survey there were 25,400 planted vines in the
Tauranga area and 72,561 planted vines in the Te Puke district.   Vines
in the Te Puke district covered by this survey amounted to 38,132, i.e.
52.55% of the total.   Twenty-nine farmers in the survey area were found
to be cultivating half an acre or more of Kiwi Fruit vines.   Histograms
are used to show frequency distributions of:

(i)   Total farm acreage
(ii)   Acres of Kiwi Fruit vines per farm
(iii)   Age of farmer
(iv)   Time on present farm

A chart shows the previous employment of the 29 farmers by type.

2.2.5.1   Noteworthy Aspects

(a)   The predominant age group lay in the 40 to 60 range.

26.   Compared with the Bay of Plenty.

Supplementary Survey Histograms

Fig 2·8

NUMBER of FARMS

ACRES OF CHINESE GOOSEBERRY VINES

Fig 2·9

TOTAL FARM ACREAGE

Fig 2·10

NUMBER of FARMERS

AGE OF FARMER (YEARS)

Fig 2·11

TIME SPENT ON PRESENT FARM (YEARS)
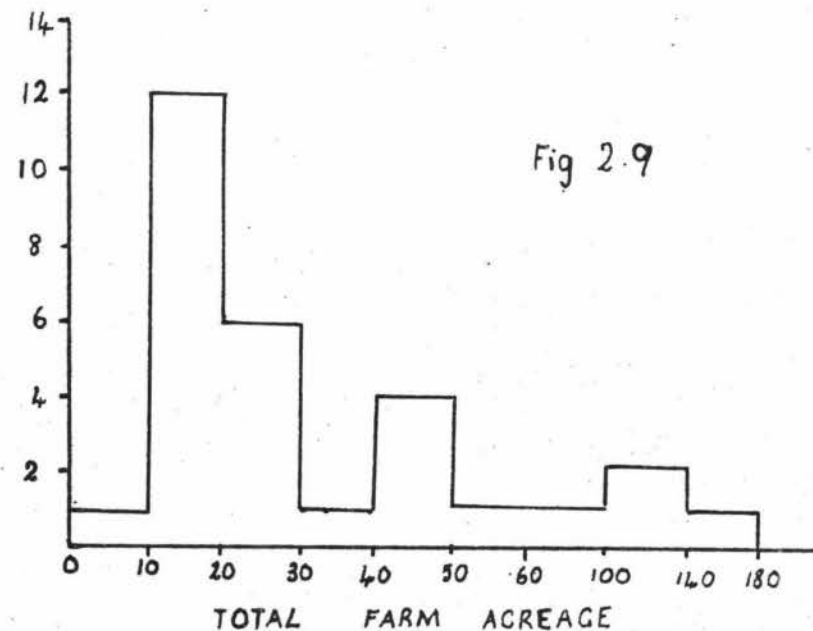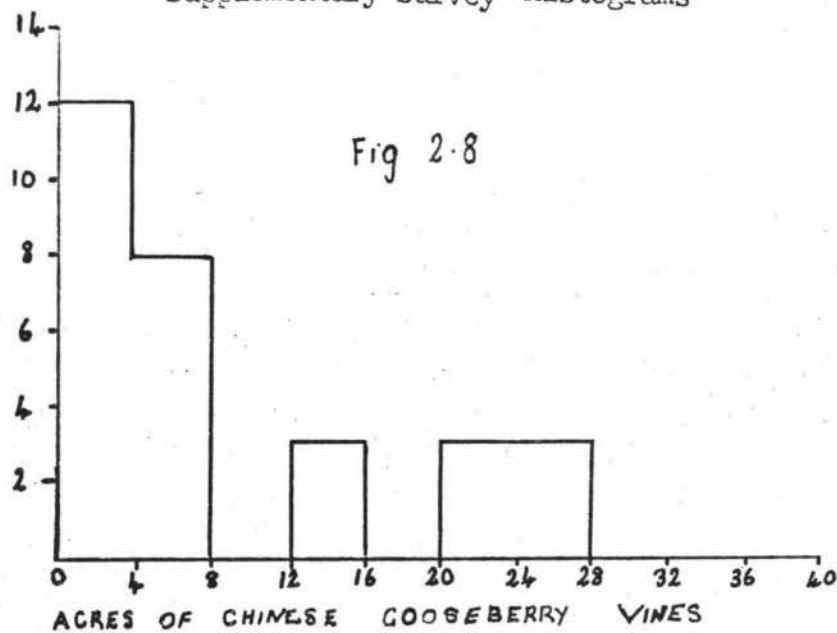
Fig 2.12
Previous occupation of the farmers.

Fig 2.13
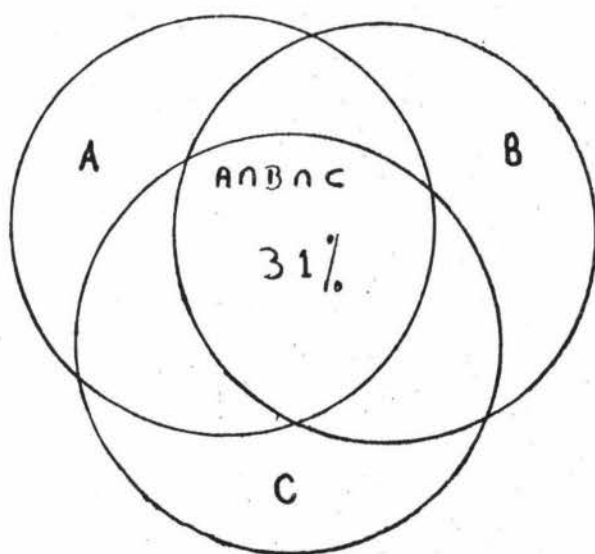
A Percentage of farmers in 40-60 age group.
B Percentage of farmers who have been on their farms for less than 6 years.
C Percentage of farmers who worked as non - horticulture farmers or professionals as their previous employment.

(b)   Seventeen of the farmers have been on their farms for
      less than five years.

(c)   The predominant previous employment was non-horticultural
      farming.

(d)   Nineteen of the farms were less than thirty acres in total area.

(e)   Twenty of the farms had less than eight acres of Kiwi
      Fruit vines.

(f)   A∩B∩C in Fig 2.13 includes 31% of the Kiwi Fruit farms inter-
      viewed.

2.2.5.2   Discussion

Following the above, it appears that there are two
distinct groups involved in this industry;

1.   Those orchardists who rely entirely on their fruit growing
activities for their income, especially on Kiwi Fruit i.e. a group high-
ly vunerable to Kiwi Fruit price fluctuations.

2.   Those orchardists who have accumulated substantial equity
previous to recently starting their orchard operation (see A∩B∩C) and
who tend to regard it as a semi-retirement occupation or superannuation
fund endowment and are consequently less vulnerable to price fluctuations.

This latter group will be less interested in rationalizing resource
use in the industry than the former group since they are not primarily
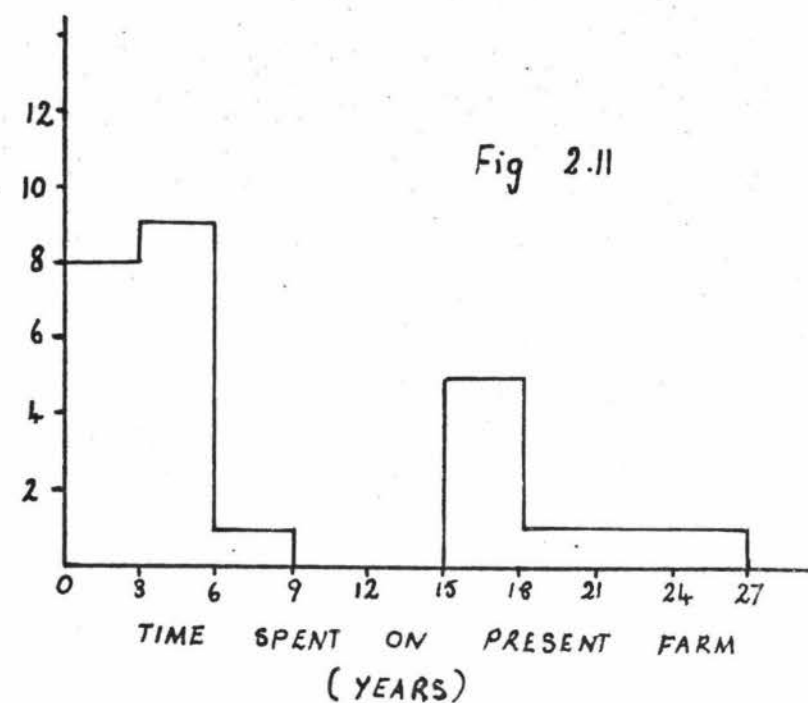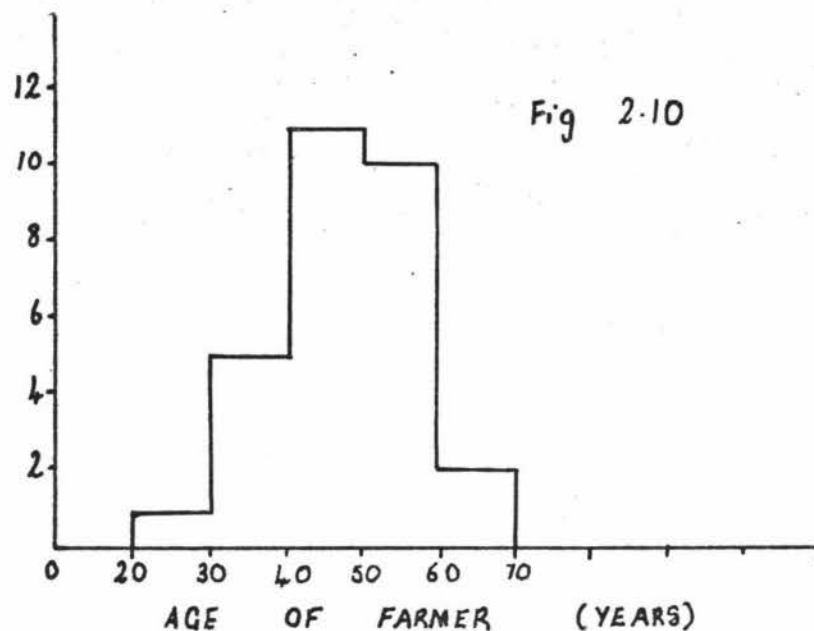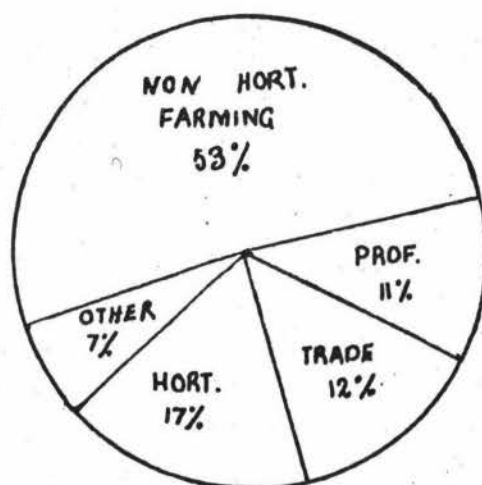interested in maximising profits or efficiency.   The situation could arise
whereby serious price reversals could eliminate the more specialised
commercial producers before the semi-retired group.

2.4   Potential Areas of Production

On the assumption that Chinese Gooseberry production can continue
to develop profitable export markets, (though small in comparison with
other primary products) it is useful to review those areas where there
is likely to be a suitable environment for commercial production.
Good orchard lands sells at about $1000-1500 per acre in the Bay of
Plenty, therefore prospective growers will tend to seek other areas
suitable for Chinese Gooseberry production where the climate may not be
so suitable but land[27] can be bought for approximately one third of the

27.   Dairy or sheepfarming land.

price.

    2.4.1   Climatic Requirements for Commercial Chinese Gooseberry
                Production.

       2.4.1.1   N.Z. Climatology (see (26))

New Zealand is situated in the south-western corner of the Pacific
Ocean lying between 34°S - 47°S (latitude). This position is in a
belt of predominantly westerly airstreams which are characterised by a
sequence of anticyclones separated by zones of lower pressure. The
low pressure zones may deepen into stormy depressions with a clockwise
air movement around the centre. The anticyclones usually come across
the country at intervals of 6-7 days and consequently the air is rarely
still. This factor, and the mountainous configuration of the terrain
with its steep topography results in considerable differences in wind
velocities causing the air to intermix over the country to a substant-
ial height. Cloud layers are therefore seldom maintained for any
length of time, thus allowing for the country to have a high amount of
sunshine (1800-2400 hours per year).

The cold fronts associated with low pressure zones in passing over
the country often produce rain. With the exception of some areas in
the South Island, the rainfall is, on the whole, plentiful and well
distributed throughout the year. At the same time, the combination
of the topography and atmospheric circulation pattern with the vast water
mass of the Pacific Ocean and warm sea currents approaching our western
shores, create an unusually wide range of climates that cannot always
be directly related to the latitude.

Consequently, local climate may not only differ over short distances
but unusual phenomena often occur, such as some South Island areas having
much milder winters than some North Island areas. For these reasons it
is worthwhile examining areas other than the existing concentration for
their potential for commercial production of Chinese Gooseberries.

       2.4.1.2   Climatic Conditions Favoured by Chinese Gooseberries

Because of its deciduous nature, the vine can withstand relatively
hard winter frosts since it is dormant during this period. However, the
young spring growth is readily damaged by even light frosts, causing
growth checks to flower buds, consequently reducing or preventing

fruit set. Even moderately light frosts will damage the fruit which matures on the vines in winter from May to August.

The vine will grow on a wide range of soils, provided they are well drained. A deep friable well drained sandy loam is best. Heavy, wet soils are detrimental to the well-being of the vine.

Protection from strong prevailing winds is necessary to prevent tender young laterals, which grow prolifically in the Spring, from being broken off at their bases. Shelter is also necessary for avoidance of excessive wind rub on the fruit, as they enlarge and mature. Severe wind rub can cause unattractive blemishes on the skin of the fruit, thus excluding it from the export market.

The limitation imposed by frost is the most restrictive factor associated with the successful commercial production of Chinese Goose-berries in New Zealand, as all other necessary environmental require-ments can be artificially achieved to some extent by the grower (fertil-iser application, draining, wind breaks). Production sites, therefore, are generally restricted to the Northern half of the North Island, and are closely associated with other sub-tropicals such as passion fruit, tamarillos and citrus. Kerikeri, Auckland and the Bay of Plenty are the main subtropical fruit growing areas. The land around Te Puke and Tauranga is considered to be particularly well suited for commercial production of Chinese Gooseberries and more than 90% of the present production is obtained from this district. Despite the frost limitation, isolated pockets of land with suitable climate can be found further south; conversely in the Bay of Plenty there are large areas which are not suitable due to local climate conditions.

2.4.1.3   Limits Imposed by Frost

Because the incidence of frost appears to be the most crucial factor for commercial production in New Zealand, the incidence of screen frosts[28] at the various climatological stations is used by the author as

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28. Measured in a Stevenson screen either of standard type or a Bilham modification. The thermometers are exposed approximately 4 feet above ground level. Only the occurrence of a screen frost is likely to affect the production because virtually all of the fruit and flowers are to be found above this level on properly managed vines.

a criteria for selecting districts where suitable local conditions with respect to frost will most likely be found.

In this analysis, any screen frost occurring outside the specified period is assumed to cause a measurable loss in production resulting in a non-viable enterprise.[29] The 1st of June has been chosen as the date for the earliest allowable screen frost and the 26th August as the latest allowable screen frost.

2.4.1.4   Justification of these limits

In selecting the 1st of June as the earliest allowable screen frost, harvesting activities were the main consideration. At present the 1st of May is the date set for export picking to begin, but the exact date is varied from year to year depending on the season. The date selected is more appropriate for the Bay of Plenty than the Northern districts[30] which tend to produce earlier ripening fruit. However, at the moment they too must comply with that date. It is anticipated that eventually each district will have its own appropriate date.

If the end of June is the date by which all fruit must be picked, then what is the minimum period in which export picking can be completed?

The date for the earliest allowable screen frost must be related to a specific size, scale and type of Kiwi Fruit orchard. Farm Size II (page 74) has been selected as a likely typical set of fixed resources that would operate in areas other than the Bay of Plenty, because centralised packing and grading installations will probably not be available anywhere except the Bay of Plenty. It is assumed that the farmer either owns a cool store, or 'off-farm' cool store space is available from a local Dairy Company (quite feasible in most farming areas of New Zealand). It is assumed that the farmer endeavours to extend his set of fixed resources close to their maximum capacity, so twenty acres of the vines yielding 120 lb/vine are assumed to be combined with them. Vine layout and technological relationships are assumed identical to those used for Farm Size II. The initial limiting fixed resource is the packhouse. Maximum capacity is 159 tons(long) in 40 days (8weeks including weekends).

29.   Fruit is picked when hard (not suitable for eating) to extend its cool store life. Frosts will tend to reduce fruit storage life or even reduce it to an unsaleable product.

30.   Auckland and Kerikeri.

Packing and grading operations spread over more than 8 weeks, starting on the 1st of May would jeopardise the chances of the fruit arriving at export markets at the required time. It is desirable to have fruit graded, packed and waiting in cool stores as soon as possible after the 1st of May in order that full advantage is taken of all available shipping space.

If the picking rate is greater than the packhouse rate then the fruit would have to be cool stored before packing and grading.

As the picking period is shortened to less than 8 weeks the picking rate per day will have to increase and the amount of cool stored, ungraded fruit will increase. One of, or a combination of the following factors would eventually jeopardise the viability of the enterprise.

(a) inadequate picking labour during a short period

(b) inadequate cool storage space for ungraded fruit

(c) cool storage cost prohibitive

(d) transport costs of fruit to and from cool store prohibitive

(e) fruit not ready for export picking before first screen frosts

In the districts of Northland and Auckland, fruit is usually ready for export picking much earlier than the 1st of May and the likelihood of a screen frost occurrence before the 1st of June is highly unlikely, thus it is not doubted that suitable local minimum temperature conditions exist there for the commercial production of Chinese Gooseberries.

As one moves into the higher latitudes (further South) two factors work concurrently in reducing the time available for the picking operation.

(a) The fruit will tend to be ready for export picking at a later date.

(b) The first screen frost will tend to occur at an earlier date.

If the picking period for this typical farm is reduced to 4 weeks or 20 days suitable for picking (allows for wet weather,[31] weekends) then an average of 6.56 tons would need to be picked per picking day in order that the crop be harvested in the required period. This would require at least 5 people for the picking operation for 20 days. Another ten people would have been employed in the packing shed for the first 20 days. At the end of the first four weeks there would be approximately 60[*] tons of ungraded, unpacked fruit stored in a cool store. Under these conditions inadequate cool storage would be a possibility and fruit transport costs to and from the cool store may be prohibitive.

At the higher latitudes the fruit would less likely be ready for export picking by the 1st of May. One month for picking the crop seems to be the minimum period allowable if some flexibility is to be left in the sequence of operations.

Selection of the 26th August as the latest permissible screen frost is based on the start of spring growth which is very susceptible to frost. Spring growth normally starts in September or October and this date allows a certain safety margin for annual variations.

The data source is the New Zealand Meteorological Service and consists of averages for varying numbers of years of the dates for the first and last screen frosts. The reader should bear in mind that this technique is claimed to be neither sophisticated nor extremely accurate, but designed to give an approximate guide. Table 2.5 lists recording stations at which the average dates for the first and last screen frosts are between the 31st of May and the 27th of August. All recording stations have been marked on Fig 2.14 and a distinction is made between those that fall between the dates specified above. Fig 2.15 shows the current distribution of commercial Kiwi Fruit production and the approximate areas where commercial production is probably feasible. Fig. 2.16 is included to show the close association the projected commercially feasible areas have with those regions in which the mean temperature ^{o}F is $\geqslant 55^{o}$.

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31. Picking wet fruit is not advised since they are unsuitable for packing and grading.

* This is because the picking rate is assumed faster than the packing and grading rate.

TABLE 2.5

Climatological Stations at which

Average Dates of First and Last Screen Frosts

Fall Between 31st of May and the 27th of August

Climatological Station	Length of Record	AVERAGE DATES	
		First	Last
Te Paki	1932–1949	13th July	29th July
Waipukurau	1943–1948	10th June	12th August
Kerikeri	1945–1949	28th July	23rd August
Waipoua S. F.	1929–1949	30th June	28th July
Dargaville	1943–1949	12th June	15th August
Whenuapai	1946–1949	15th June	15th August
Wharekawa	1935–1949	7th June	20th August
Maioro	1940–1949	5th June	5th August
Tauranga	1913–1949	15th June	16th August
Gisborne	1937–1949	11th June	24th August
Onepoto	1935–1949	5th July	20th August
New Plymouth	1922–1949	15th July	28th July
Napier	1924–1949	18th June	26th August
Moumahaki (Waverly)	1905–1924	26th June	18th August
Wanganui	1937–1949	9th July	3rd August
Ohakea	1940–1949	27th June	25th July
Wellington*	1862–1949	19th July	25th July
Thorndon	1912–1927	13th July	13th August
Nelson	1921–1949	7th June	20th August
Akaroa* (Onowe)	1937–1949	20th June	1st August
Jacksons Bay	1938–1949	30th June	20th August

Data Source: N.Z. Meteorological Service

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* Wellington and Akaroa have very favourable data with regard to
occurence of screen frosts, however the author thinks that it
may be due to localized phenomena due to proximity to the sea,
and has therefore discounted these areas.

Fig 2.14
Geographical Location of Weather Stations.

Key

x inside frost limits
. outside frost limits
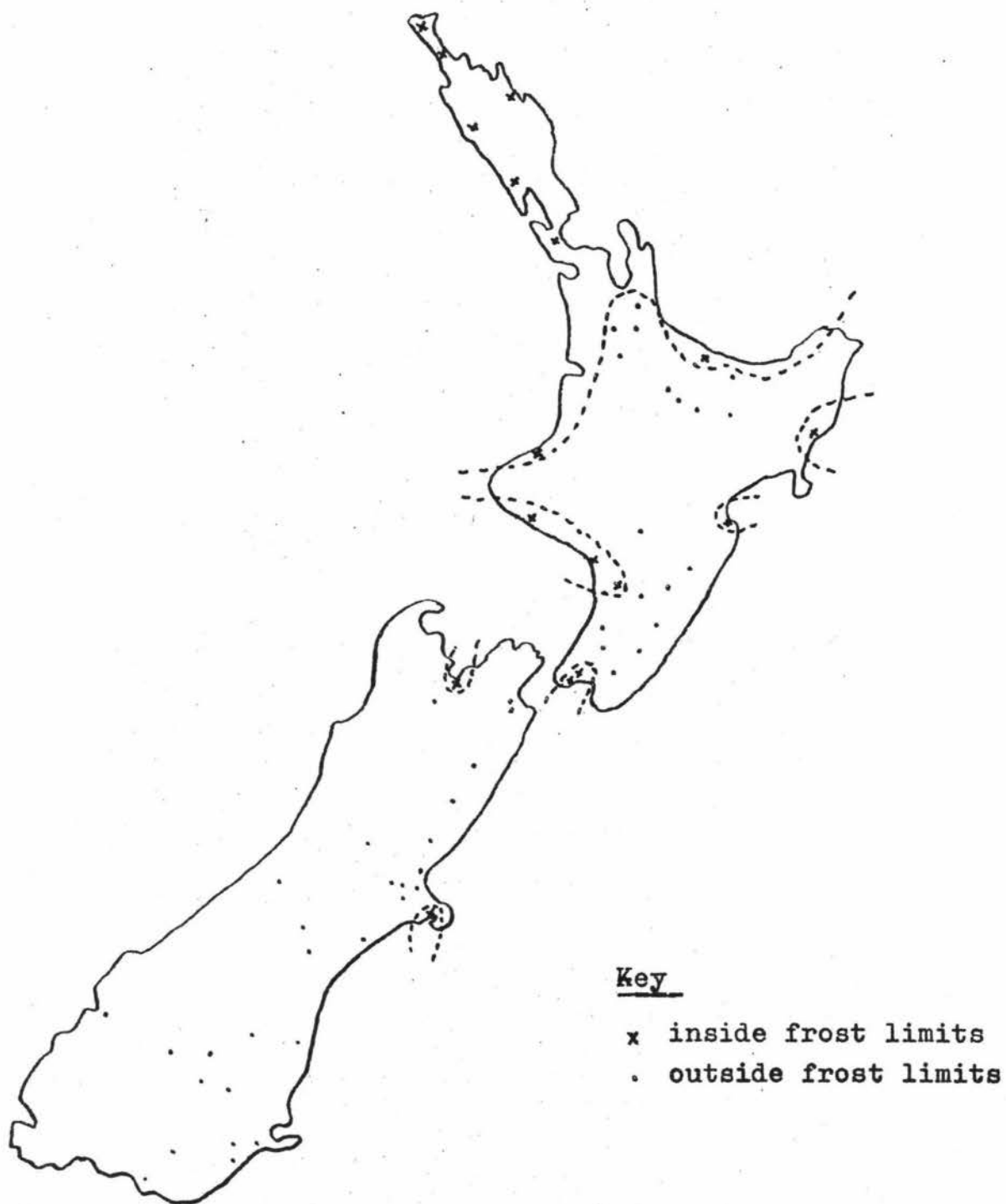
Data supplied by N. Z. MET. SERVICE

Fig 2.15

Map of New Zealand showing the areas in which the required
conditions for commercial production are likely to exist.

Key

⬭ most suitable areas
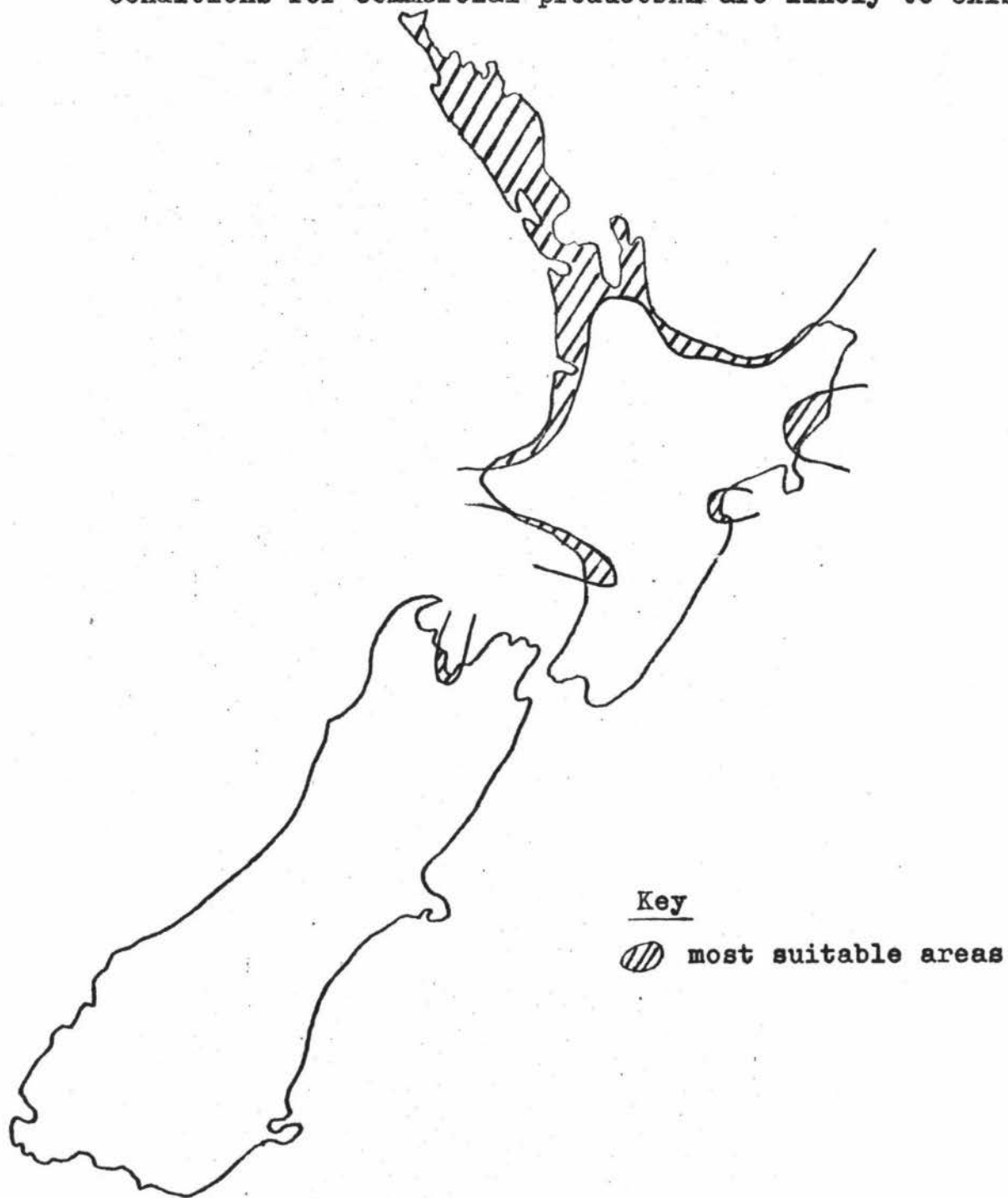
Fig 2.16 Auxillary Data
Map shows the close relationship between the areas of N.Z.
that have an annual mean temperature $\geq 55°F$ and their
suitability for commercial production.

Key
area where annual mean
temperature $\geq 55°F$
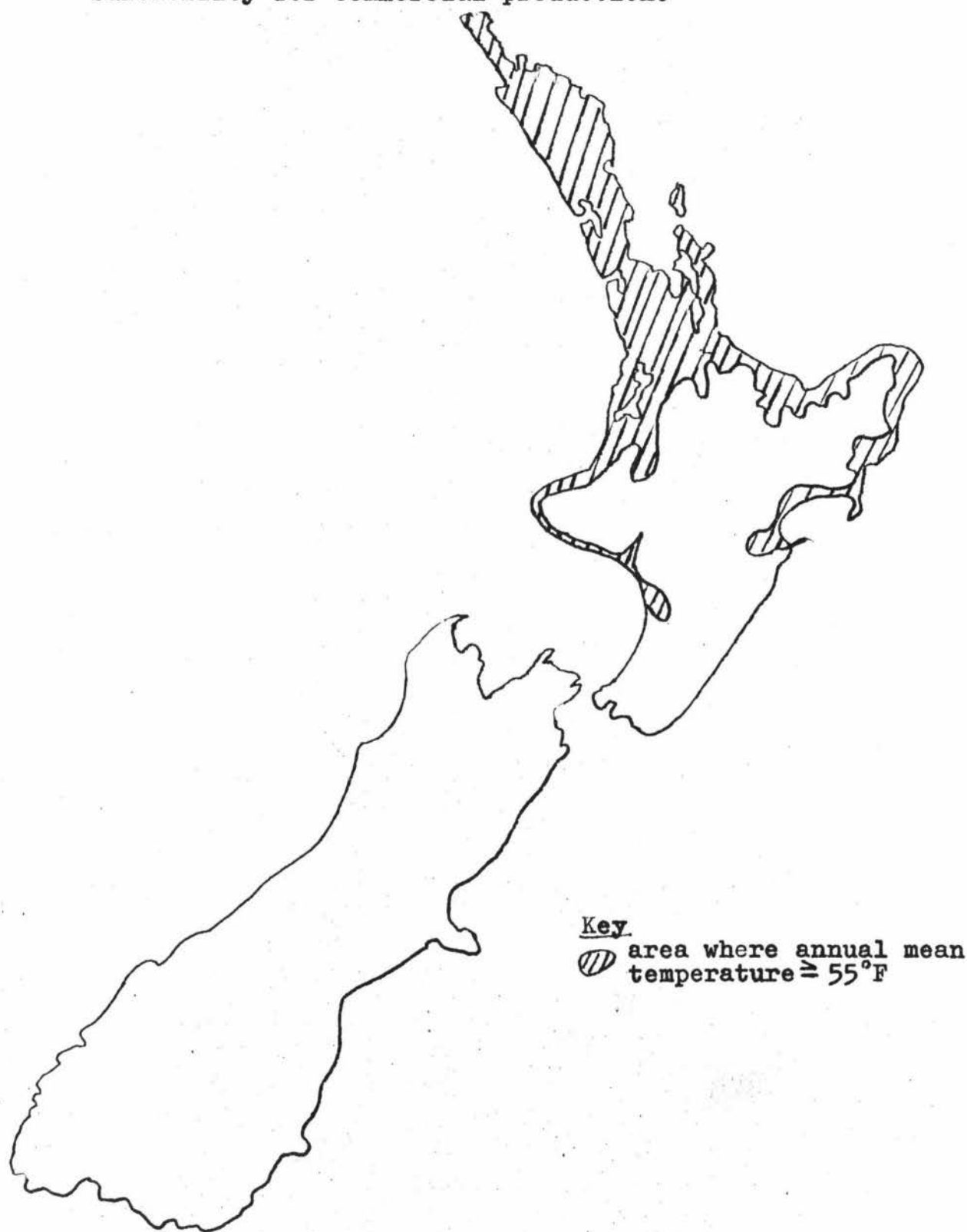
Data Source
N.Z. MET. SERVICE Technical Note No. 158 "The Climate
of New Zealand in Relation to Agriculture." by J.D. Coulter

2.4.1.5 Discussion.

This analysis indicates that south of the Bay of Plenty there are no districts where large tracts of land are likely to be found suitable for commercial production of Chinese Gooseberries. However, small pockets exist around Gisborne, Napier, Hastings, New Plymouth, Wanganui and Nelson. This information is obviously no secret since a few acres of vines are commercially cultured in most of these districts already. Intensive horticulture is already predominant in the Gisborne, Napier, Hastings and Nelson districts, therefore most suitable land would already be allocated for such crops as apples, hops, grapes and stone fruit, raising either the purchase cost or opportunity cost of the land close to the value existing in the Bay of Plenty if a farmer was considering Chinese Gooseberry production. Land around New Plymouth and Wanganui would not tend to have the same pressure on it and therefore would possibly be a better prospect.

Commercial production of Chinese Gooseberries in any of these districts would tend to experience many of the disadvantages that Kerikeri has experienced in the past as a result of spatial isolation from the hub of industry. These disadvantages would probably occur in both the production and marketing operations.

Possible disadvantages:

(a) No co-operative packing and grading facilities. This may not necessarily be a disadvantage as the economies of size analysis [31] has shown that for combinations of fixed resources nearing full capacity there is no substantial difference in average cost per ton output between those with their own packing and grading facilities and those without. Average costs per ton are much more sensitive to yield than fixed costs as maximum capacity is approached. A possible disadvantage in the future for the 'on farm' packhouse is the smaller quantities of each grade of fruit being packed. This will result in greater variations within grades and grading and packing standards differing slightly from the majority of fruit which will probably go through large sized packhouses.

(b) A grower may have to export his own fruit because there is not enough fruit in the district to warrant the exporters interest.

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31. Chapter VI

This would be a distinct disadvantage since it is not likely that a grower would possess the necessary knowledge, expertise and contacts required for exporting.

(c)   Local Advisory Officers would tend to be less familiar with production techniques and problems than those officers working in the Bay of Plenty.

(d)   The possibility of specialised services such as helicopter spraying, contract picking and contract pruning operating in these areas is not as likely as in the Bay of Plenty.

Overall, it would depend on the individual entrepreneur to weigh up all the factors and then decide for himself the chances of success in any of these less favoured areas.   Land in New Plymouth, Wanganui and Nelson districts would probably have a lower purchase price (or opportunity cost) than the Bay of Plenty and the present buoyant export price for Kiwi Fruit would enable a highly profitable venture regardless of the main disadvantages cited above.   However, if the price of export grade fruit drops substantially in the next decade, then farms in these districts would probably be the first to feel the 'pinch' because of the disadvantages cited above.

2.5   Chapter II Summary

The Chinese Gooseberry vine is indigenous to China.   This vine has been very successfully established in several districts of New Zealand.   Its fruit have an unusual flavour and colour.   Due to the high price being currently paid in overseas markets for this fruit, especially the Hayward variety, a phenomenal increase in planted vines has been occurring for the past five years in the Bay of Plenty district of New Zealand where the climate appears to be particularly well suited for commercial production.   A survey showed that a large proportion of new growers were middle aged former non-horticultural farmers who may present a barrier to economic rationalization within the industry.

Commercially feasible areas for production in New Zealand are generally limited to the northern half of the North Island but a few promising areas exist further south.

Bibliography numbers of the publications which were referred to in Chapter two are (2) (3) (4) (8) (9) (17) (21) (26)

CHAPTER III

GENERAL CHARACTERISTICS AND PRESENT STATE
OF THE NEW ZEALAND KIWI FRUIT INDUSTRY

3.1   Introduction

The industry is currently based on the sale of fresh fruit,[1]
in New Zealand and overseas.   This fresh fruit is a perishable
commodity which is produced at a large number of spatially separated
points, during a short time period each year and subject to unpredict-
able annual production variations.[2]

The recent upsurge in plantings is almost entirely due to the
prospects presented by the profitable export market for fresh fruit.
Theproduction process of this fruit involves a relatively long time
period between the initial investment (vine planting) decision and
the final outcome (full production of the vine). New Zealand prod-
uction is committed to increase by approximately 1,000 tons[3] per year
for the next decade, even if no additional vines are planted.   Compared
with most other types of farming in New Zealand, production techniques
vary widely between growers and are changing rapidly through time.

At present the grower has no direct involvement in the exporting
operation.   The purchase of his crop is either negotiated yearly,
going to the exporter with the best offer at the time or sold through
Exporting Agents.   There is no formal, permanent control body to
collect, analyse and disseminate industry information.   However, a
loosely knit group, the Kiwi Fruit Export Promotion Committee (comprising

three growers and three exporters) is making some attempt to advise
on such matters as grades, overseas promotion, overseas market co-ord-
ination, future industry import requirements.   It is also making an
attempt to finance overseas promotion, mainly in the United States.

1. Processing is limited to canning at present and constitutes only
    a small proportion of the total production.

2. Typical characteristic of most agricultural products due to environ-
    mental and biological vagaries.

3. See Table 2.3. National Development Conference working committee on
    Horticulture estimated 2,480 tons would be exported in 1978, a gross
    underestimation in the author's opinion.

The industry will need large injections of finance[4] in the next
decade in order to ensure that the fruit is efficiently packed and
graded, and probably the only major source[5] available for this finance
is the Government who as yet appear unconvinced of the viability of
this promising industry.

The prevailing Government attitude is presumably due to one or
more of the following reasons:

a. The desire for less dependence on primary product exports,
    reflected in Government policy by tending to favour development
    of manufacturing industries.

b. Government lending sources (State Advances Corporation, Develop-
    ment Finance Corporation) lack confidence and interest in this
    industry (and Horticulture in general), partly as a result of
    the poor performance in the early post-war years of small
    horticultural farms[6].

c. Government policy discourages industries in which there are a
    large number of small production units and has preferred to
    channel S.A.C. funds into sheep and dairy farm amalgamations.

d. In terms of economic importance the industry is small compared
    with the sheep, dairy and beef industries.

e. Government policy is discouraging farming dependence on the
    S.A.C. etc. It prefers farmers to borrow from the private
    sector and guarantee the loan if necessary.

3.2   Industry Productivity and Earning Potential

3.2.1. Export Quantities.

Although the Chinese Gooseberry industry is small compared with
the traditional export earning industries it is expanding at a very
rapid rate, (see Figs 2.4, 2.5, 2.6).   In 1970 it was estimated that
of the 2121 tons produced, 680 were exported, 62 tons canned and the

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4. See Chapter 6 - Page 136   Estimations of Capital Requirements.

5. Low equity of new entrants and unfamiliarity with the industry
    has tended to preclude non-Government avenues such as Trading
    Banks, stock and station companies and finance companies.

6. Verified after personal communication with a S.A.C. officer.

rest (1379 tons) consumed on the local market.   In 1971 an estimated 2330 tons were produced, 800 tons of this being exported and by 1980 between 6000 and 8000 tons of fruit is expected to be exported.

    3.2.2   Estimated[7] Export Earnings in 1980 from the Present Acreage[8] Only.

At Current Prices $USM 4.274 to 5.699
At $^{2}/_{3}$ Current Prices $USM 2.402 to 3.20

    3.2.3   Annual Overseas Exchange Yield per $NZ Invested in the Industry.

Once again using the current acreage only, which by 1980 will be in full production and assuming the required investment has taken place in order that the crop is efficiently marketed.   Assume that investment per acre of vines is $3,000[9] giving a total industry investment for the present 1,300 acres, of $NZ M3.9   Taking the lowest expected export earnings of $US 2.402M in 1980, this shows an annual earning ratio for the nation of $US 0.6 for every $NZ 1.00 invested.

    3.2.4   Domestic Cost of Overseas Exchange.

Using the criterion described in the 'World Bank Report on the New Zealand Economy 1968' (pages 51-65), the cost to the New Zealand economy per dollar of foreign exchange earned by Kiwi Fruit on a net basis is determined below.

Imported inputs (mainly imported machinery   and petroleum derivatives) constitute a small proportion of the total cost and are common to all firms, they are, therefore ignored.

To derive a domestic cost, per dollar earned in overseas exchange

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7.   See appendix page 183 for estimation method.

8.   1971- 1300 Acres of vines.

9.   Land $1,300/acre, Vine investment $600/acre, Equipment in $400/acre Packing and Grading $700/acre
                This implies a certain acreage is combined with the typical set of fixed resources.   It is approximate only.

Farm size II [10] is used, and assumed to be operating with 20 acres of vines, achieving 120 lb of fruit per vine and 70% of fruit exported. Seventy per cent of cost common to both export and local fruit are attributed to the cost of export fruit. Costs specific to export fruit have been added individually (Export trays etc.).

Total Farm cost[11] per Export Tray $NZ	0.87
Other Domestic Cost per Export Tray $NZ	0.368
Total Domestic Cost per Export Tray $NZ	1.238
Gross Export Earnings per Tray $US	3.465
Invisibles Cost per Tray $US	.7183
Net Export Earnings per Tray $US	2.7467

Domestic Cost to New Zealand per net US dollar earned

$$= \frac{1.238}{2.7467} = 0.45 \quad (0.73^{*} \text{ for butter production})$$

With the re-allocation of resources, the marginal rate of return rather than the average should be taken into account. Many of the smaller less efficient orchards would not achieve this return of overseas funds for the nation, but the new entrants are tending to specialize in Kiwi Fruit and opt for larger acreages(therefore the selection of Farm size II and 20 acres), with consequent decrease in costs of production (see Chapter V).

3.5 Disposal of Production

Between 70% and 90% of any given crop of the Hayward variety of Kiwi Fruit is suitable for export, consequently a steadily increasing tonnage[12] will be available for disposal on the New Zealand market as fresh fruit, as this decade progresses. The potential of the export market to absorb the projected increases in supply is largely unknown

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10. See page **74** for description.

11. Up to one month in the cool store after packing.

12. Author estimates total N.Z. Production in 1980 to be between 10900 and 14400 tons. Assuming that the 200 acres of standard vines produce no fruit suitable for export and that 70% of the remaining production is exported, 6600-8800 tons, then this leaves approximately 4300-5600 tons for the New Zealand market.

* See Appendix A.3 for derivation.

but it is thought[13] that there is considerable scope for expansion
at present.   (Though not necessarily at current price levels).
Kiwi Fruit are not beset by many of the problems generally associated
with many New Zealand exports and specifically associated with fresh
fruit exports.

Favourable Aspects of Kiwi Fruit as an Export Commodity

1. At present there are no tariffs or significant restrictions
    imposed by importing countries.
2. Negligible competition from other countries.
3. Not highly perishable if kept in cool storage.
4. Large unexploited world markets.
5. Probably able to absorb a relatively large price drop without
    affecting its overall profitability.

3.3.1 Kiwi Fruit Demand Functions.

Demand is considered a function of income, relative prices and
taste.   Three distinct demand functions can be considered to exist
for fresh Kiwi Fruit (see Fig 3.1)An overseas demand function for
export grade fruit, a New Zealand demand function for export grade
fruit[14] and a New Zealand demand function for local grade fruit.

The overall objective for the industry should be to achieve the
same net marginal revenue from each discrete market.

i.e.

Net Marginal revenue export grade overseas market		Net marginal revenue export grade domestic market		Net marginal revenue second grade domestic market.
	=		=	

---

13. Thought by Exporters and hoped by the growers.

14. Assuming local grade fruit cannot be sent overseas but export grade
     fruit can be sold in New Zealand or overseas. A separate demand
     function can be justified for export grade fruit (almost exclusively
     the Hayward variety) sold in N.Z. because they could be considered
     superior and more desirable and therefore a clearly distinct commod-
     ity from the standard varieties.

Classical economic theory provides two paths by which to increase[15] the quantity sold of any specified commodity in the short run.[16]

1. Shift the commodity demand curve outward. This is normally achieved by a change in consumer tastes due to promotion and advertising. Harmston and Hino (20) state that changes in "taste" are very important in the demand for food products.

2. A movement down the existing demand curve. This can be achieved by a decrease in price. (Quantity the dependant variable).

Hypothesis 1

The price elasticity of demand for Kiwi Fruit on the export markets is relatively low at present but will increase over time.

Justification of Hypothesis 1

Kiwi Fruit are presented in the export markets as a unique exotic fruit, therefore there are few close substitutes at present. It is classed as a luxury and generally purchased by the upper income groups. Consumer awareness of the fruit is relatively low compared with other fruits. (However through time the increased familiarity by consumers and consequent decreased uniqueness and increased substitutibility would tend to increase the price elasticity of demand.)

Hypothesis 2

The price elasticity of demand for Kiwi Fruit sold on the New Zealand market is relatively high.

Justification of Hypothesis 2

There are many close substitutes for this fruit on the New Zealand market (e.g. tamarillos, feijoas,) and it is considered neither a luxury

15. Assuming a negatively inclined demand curve.
16. In the long run the population increase will tend to increase quantity sold, even if all other variables remain static.

nor unique or exotic. Kiwi Fruit have been sold in New Zealand as
fresh fruit for the past three decades in steadily increasing quantities.
the most dramatic increase occuring in the past five years. Consequently
the majority of New Zealand consumers are familiar with its appearance and
taste. Evidence of an elastic demand for fresh apricots and fresh cherries
grown in the state of Washington, U.S.A. was found by Price (19). He
found the price elasticity for each of these products to be approximately
$-3\frac{1}{2}$. He attributed this elastic demand to competition from other fruits
and vegetables and competition from the same product grown outside the state.

Conclusions on the basis of Hypotheses I and II

In the short run price decreases will not be very effective for
increasing the quantity sold on the overseas market, but they will be
rather more effective on the New Zealand market. Conversely promotion
and advertising will be more effective on the overseas market than on
the local market for increasing the quantity sold.

$$\frac{\frac{dq}{da}}{\frac{dq}{dp}} \text{ overseas market} > \frac{\frac{dq}{da}}{\frac{dq}{dp}} \text{ New Zealand market}$$

Where

$\frac{dq}{da}$ = Proportionate change in quantity sold per unit
change in advertising and promotional input

$\frac{dq}{dp}$ = Proportionate change in quantity sold per unit
change in retail price

Hypothesis 3

Above a certain price level the overseas demand curve takes on a
positive slope.

Justification of Hypothesis 3

It could be argued that beyond a certain price level the fruit
achieves a certain status value. Of the three Hypotheses this one

Fig 3.1 Hypothetical* Demand Curves for Fresh Kiwi Fruit.

A-A: Overseas demand curve for export fruit.
B-B: N.Z. demand curve for export fruit.
C-C: N.Z. demand curve for second grade fruit.
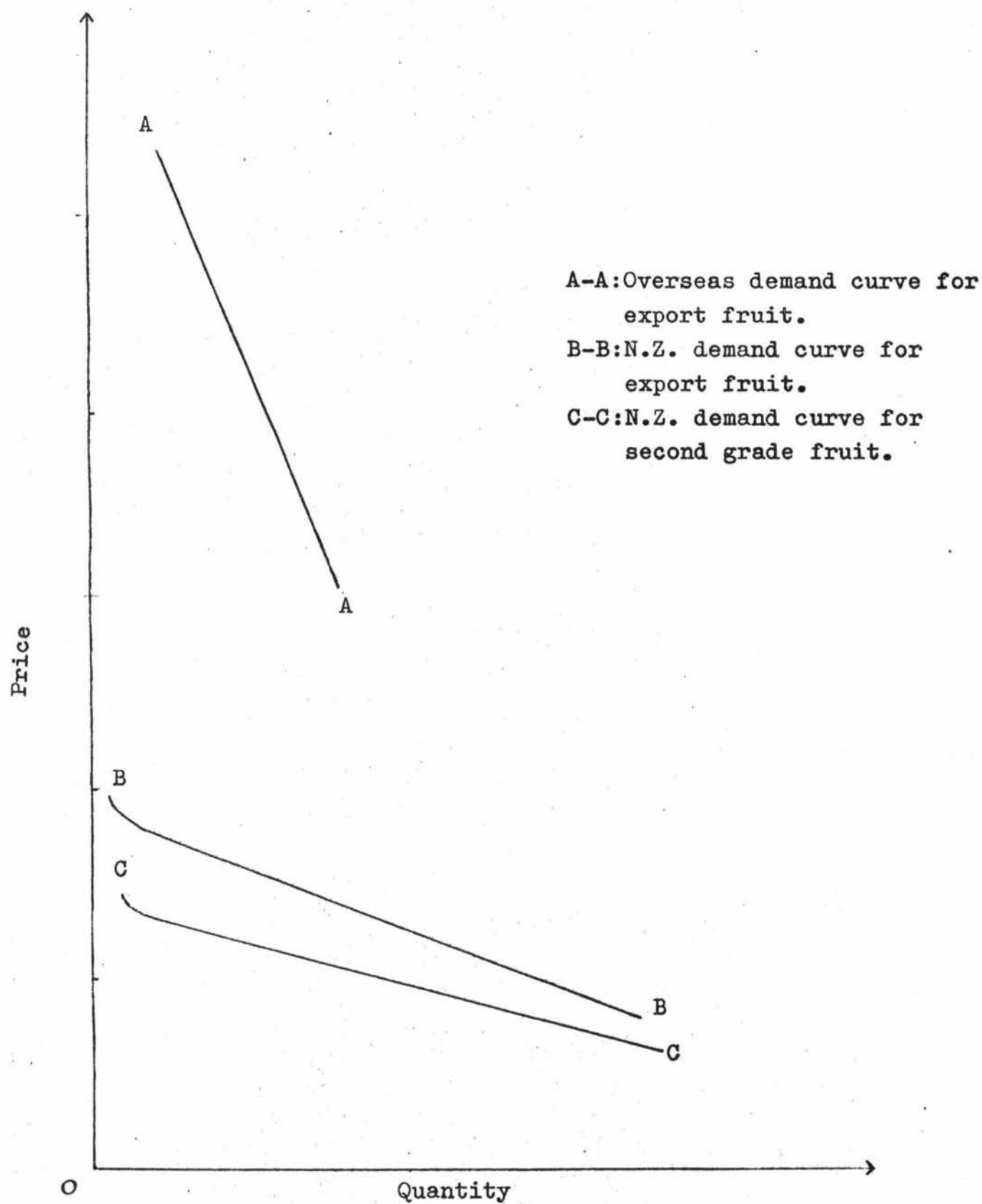
Because empirical determination of demand relationships is beset with pitfalls an intuitive approach is considered sufficient for the purposes of this discussion.

has the least justification therefore the implications of this situation are not considered.

3.3.2 Discussion on Disposal of Total N.Z. Production.

Apart from its probable small demand response, a promotion and advertising programme on the New Zealand market would require an organised body to obtain and allocate funds in a manner desired by the growers concerned with local market production.   The actual formation of this organisation body may present a problem, as may the extraction of a levy from the many small enterprise orchardists who sell the majority of their crop on the New Zealand market and especially by gate sales.

Processing does not appeal as a major avenue for disposal at present because the high prices paid by the canneries for the fresh fruit necessitates the canned fruit retail price to be approximately double that of competing canned fruits (peaches, pineapple, pears).   Canned Kiwi Fruit tend to be an inferior product compared with other competing canned fruits due to technical difficulties and poor fruit usually available for canning.   (Growers normally only sell second grade fruit to canneries).

The development of a new consumer product (e.g. Freeze dried) and consequently a new demand curve could aid in the disposal of the fresh fruit.   However, the introduction of such a new product for the New Zealand or export market in this decade, though highly possible, is unlikely to dispose of a significant quantity of the projected production increase.

At this stage, promotion and advertising tempered with small price reductions seem to be the best methods for ensuring that the increased production available for export is disposed of.   In the long run, larger price reductions will probably be required though they will not be as great (see Fig. 3.1) as for the local market fruit because of the larger market and increasing price elasticity of demand over time.

Another factor which may lower the New Zealand retail price for fresh Kiwi Fruit is the possibility of dumping of second grade fruit by growers primarily concerned with exporting, and who only desire to recover harvest costs.

Assuming that price reductions are reflected in farm prices, the above discussion suggests that the farm prices received for local market

fruit are likely to decrease substantially in the next decade and the price received for export fruit will also decrease in the same period, though by a relatively lesser amount. This effect can be clearly seen in the rapid decline in the price of cull laying stock with the advent of the specialised meat, chicken.

Many orchardists are using equipment compatible with the size of their operations. Others are operating with considerably less efficiency than is possible. At the present time efficiency within the industry is not vital, especially with regard to fruit production, because of the high prices being received for both local market and export fruit by the growers. With the probable fruit price decrease, effiency in all phases of the industry will become increasingly important. As the industry emerges as a specialized producer of an exotic fruit for the export trade the following questions are occupying the attention of the growers.

a. What is the minimum economically viable farm acreage for different farm sizes with:

        (i) Prevailing product prices?

        (ii) Substantially decreased prices?

b. Are large farms inevitably more efficient than small farms and is there an optimum for farm acreage and size?

c. Is there a need to assemble export fruit at central points for packing, grading and inspection?

d. Is there a need to have an authority to co-ordinate consignments by exporters or should a marketing board be set up for wider purposes?

To assist in answering questions a, b and c, an economics of size analysis is used. The remainder of this chapter briefly presents the theory of the economies of size, some recognised analytical procedures for determining economies of size and a review of a similar study conducted in California, U.S.A.

Question d is discussed, in connection with the findings of the economies of size analysis of packing and grading installations.

3.4   Economies of Size Theory and Analysis Methods

3.4.1   Theory of Economies of Size.[17]

Economies of size analysis is based upon the theory of the firm under perfect competition and two distinct time periods are recognised; the long run and the short run.

The short run average cost[18] curves (S.R.A.C.) assume one or more resources to be fixed with other resources variable. The long run average cost curve (L.R.A.C.) is derived under the assumption that all resources are variable. Empirically the long run average cost curve is formed as a tangent to the short run average cost curves. From Fig 3.2 theoretically the long run average cost curve is U shaped and shows minimum cost per unit output for each level of output and average costs decrease until Q, and thereafter increase . The theoretical U shape of the L.R.A.C. curve is due to the balance of economies to diseconomies as output is varied, economies $>$ diseconomies up till Q, and thereafter economies $<$ diseconomies. The long run average cost curve is smooth if all resources are continuously divisible and "scalloped" if all or some resources are not continuously divisible.

In the following analysis of Kiwi Fruit farms, machinery, buildings and specified land, permanent labour and management are assumed fixed in the short run. Ths S.R.A.C. curves in Fig 3.2 represent cost-output relationships for different sized fixed plants.

The production functions are of the forms.

Short Run

$$y = f\ (x_1 \qquad /x_2 \text{----------} x_n)$$

when y is the output of product

x_1 is the variable resource

x_2 ---------- x_n are the fixed resources (fixed plants)

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17.   Baumol (25) pp264-266, Madden (13), Heady (12) Chapter 12, French (24)

18.   Economic Theory defines costs to the firm as those payments which have to be made to induce factors of production to continue in their employment with the firm. - "Production and Cost Functions" A.A. Walters Econometrica Vol.31, 1963 .

Fig.3.2   Theoretical Average Cost Curves

SRAC I

LRAC

SRAC II

SRAC III

SRAC IV

Average
Cost
Per
Unit
Output

LRAC

Q
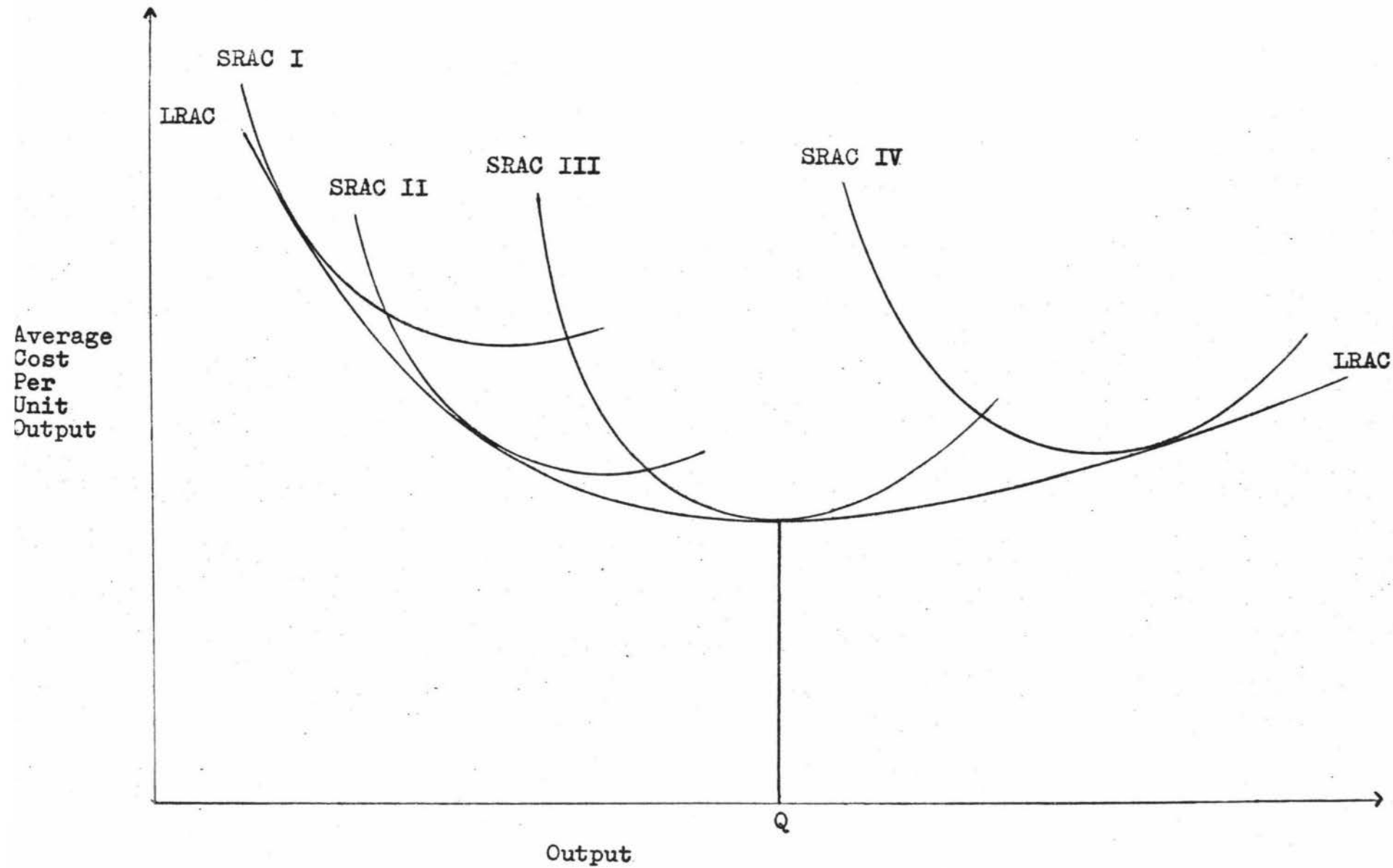
Output

<u>Long Run</u>

$$y = f (x_1 \text{------------} x_n)$$

y is the output of product

$x_1 \text{------------} x_n$ are the variable resources.

Short run average cost curves are used to indicate cost/unit output relationships as a specified fixed plant is extended to full capacity (when one or more of the fixed resources become limiting). Long run average cost curves are used to indicate the changes in cost/unit output as output increases with all resources variable.

3.4.2 Distinction Between Size and Scale Relationships.

This is adequately dealt with in numerous publications, some being: Jackson (10), Gow (11), Heady (12)

Briefly, scale relationships refer to situations where all resources involved in a particular production process are varied in constant proportions. Economists agree that this concept has very little relevance in real world situations.

3.4.3 A Definition of Economies of Size - Madden (13).

"Economies of size as used in this thesis means reductions in total cost per unit of production resulting from changes in the quantity of resources employed by the firm or in the firms output".

This concept of economies of size will be adhered to throughout the analysis of Kiwi Fruit farms.

3.4.4 Possibilities for Increasing and Decreasing Returns to
        Size in Agriculture.

Heady (12) (pp 361 - 362) separates cost economies and diseconomies into two classes; internal and external. Internal economies result from adjustments made within the individual firm. External economies are those which are concerned with changes within the industry to which the

firm belongs.

3.4.4.1 Internal Economies and Diseconomies (Jackson (10))

a. Cost economies and diseconomies which arise from greater aggregation of resources e.g. in the acquisition of inputs.
b. Cost economies due to superior techniques and to superior resources.
c. Economies and diseconomies due to proportionality relationships.
d. Pecuniary economies.
e. Technical economies.
f. Managerial economies and diseconomies.

3.4.4.2 External Economies (Heady (12))

a. Large numbers of farms in an area increase to such an extent that feed mills, marketing outlets and transportation systems are built togive a lower cost for products delivered to the market (serve as substitutes for processing and transportation which would otherwise be furnished at a higher cost by the individual).
b. Organisation of co-operative purchasing.
c. Technical economies - greater acreages under production help eliminate total number of pests in the area. Thus greater output from given farm resources.

3.4.4.3 External Diseconomies (Heady (12))

a. Use of additional resources by farmers in the aggregate is possible only as higher prices are paid for factors to induce them away from other industries.
b. Technical - Disease build up due to monoculture farming predominating in any one area.

3.4.5 Some of the Recognised Analytical Procedures for Studying Cost-Size Relationships (From Jackson (10))

Procedures that have been used for analysing cost-size relationships can be divided into four classes:

a.	Cobb-Douglas Production Function Analysis
b.	Survivorship Techniques
c.	Farm Record Analyses
d.	Economic Engineering or Synthetic Firm Techniques

3.4.5.1 Cobb-Douglas Production Function Analysis

a.	For this type of analysis it is necessary to vary resources in
	constant proportions which rarely occurs in real world situations.
Heady (12) comments on this: (page 360)

"While the size of the farm can be increased through scale
adjustments, most changes in farm size and most of the concern about
farm size revolves around semi-proportionality adjustments".
b.	It is necessary to assume all resources and products are infinitely
	divisible - again unrealistic.
c.	A fitted Cobb-Douglas production function represents only the
	average of the sampled farms. It provides no indication of the
	relative efficiencies of larger or smaller farms.

3.4.5.2 Survivorship Technique

This method is based on the assumption that competition among firms
will, over time, identify the most efficient firm size. The size of
firm is measured by the firm's capacity as a percentage of the industry's
capacity. Tabulations are prepared showing the number of firms in each
class and the percentage of the industry's capacity represented by each
class for two points in time. Size classes that exhibit a declining
proportion of the industry's capacity is taken as evidence of efficiency
and attainment of economies of size by that size class.
Deficiencies of this Technique

Negligible information is provided about the shape of the L.R.A.C.
curve.
"Disappearance of small farms may not be due to inefficiency".(Madden (13))
Size efficiency relationships may be masked by other factors. Reduced
importance of a given firm size could be due to location, access to
resources and markets, productivity of labour, quality of management and
degree of utilisation of plant capacity.

The most serious weakness of this technique lies in its measure of size. A firm's size is measured by its proportion of the industry's total production capacity - an extremely elusive measure.

3.4.5.3 Analysis of Farm Records

This method normally involved dividing farms into size groups and the average cost per unit of production is calculated for each size group. From these cost-size relationships are inferred. Many difficulties occur with this technique.

1. Farms selected vary widely in the combination of enterprises and in the nature of resources.
2. Different farms employ different technologies and practices.
3. Differences exist between size classes in the degree of utilization of a fixed plant.
4. Cost accounting procedures vary widely between farms, making comparison difficult.
5. The class averages are dependent upon the arbitrarily determined class intervals. Alteration of the class intervals will alter the cost-size relationships. Further, the "typical" farms produced within each class by averaging the total, have an aggregation bias* making them inaccurate replicas of the farms they represent.
6. The basis upon which the fixed costs should be allocated.

3.4.5.4 The Economic-Engineering or Synthetic Firm Approach

Madden (13) considers this the preferred technique when the objectives of the research are to:

1. Determine the total cost per unit of output or profit that farms of various sizes could achieve using modern or advanced technologies.
2. Determine differences in the average cost per unit of output which are attributable solely to differences in the size of farms and not due to other factors such as obsolete techniques, substandard management practices or differences in the degree of plant utilization.

This method involves developing budgets for hypothetical farms using the best available estimates of the relevant parameters. Specific plant sizes are identified and represented by different levels of fixed factors. S.R.A.C. curves are then produced by constructing budgets

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* i.e. The resource and product combinations of the "average" farm may be such that it is not a realistic working proposition.

representing varying degrees of plant utilisation and calculating from these budgets a series of cost per unit of production figures. The L.R.A.C. curve is produced from the S.R.A.C.

3.4.6. Analytical Procedure in This Study.

The aim of this part of the thesis is to aid in answering the questions on page 49. In the author's opinion this can best be achieved by the adoption of the economic engineering technique. The other methods being either partially or wholly unsuitable for the Chinese Gooseberry industry at the present time because of the inherent faults in the other techniques and the particular structure of this industry.

3.4.7 Summary of the Main Factors Necessitating the Adoption of the Economic Engineering Budgeting Technique.

1. As the acreage increases on Chinese Gooseberry farms proportionality resource adjustments occur, not constant proportion adjustments.

2. An indication of the relative efficiency of several fixed resource combinations and acreages was sought.

3. This is a new rapidly expanding industry and even if the survivorship technique was reliable it is too soon for this type of analysis to produce meaningful results.

4. Few established Chinese Gooseberry farmers grow solely Chinese Gooseberries, therefore costs incurred by the various crops on one farm cannot easily be separated. Even fewer farmers had suitable records to enable calculation of significant averages or formation of significant size groups.

3.5 A Review of a Fruit Industry Study in which the Economic Engineering Technique was used with features similar to the N.Z. Chinese Gooseberry industry.

The problem posed by the California Cling Peach Industry was that high grower prices in the mid 1950's apparently stimulated an unusually

large acreage of new plantings which were just then beginning to enter production[19]. California. Cling Peach growers were faced with the prospect of a reduction in tonnage harvested resulting from the green drop[20] programme and also with reduced prices.

In 1963 Dean and Carter (14) published an analysis of economies of size in Cling Peach production in the Yuba City - Marysville area of California U.S.A. The size range of peach farms examined ranged from 8 acres to 400 acres. Economic engineering budgeting methods were influenced by changes in wage rates and the introduction of mechanised methods of pruning, harvesting and thinning. The farm operators personal services (labour, management and risk taking) were included in the residual claimant.

Data was obtained by personal interviews with a sample of Cling Peach growers in the Yuba City - Marysville area, and supplemented with secondary engineering and cost data from several other recognised sources.

This analysis showed that under present production practices on Cling Peach farms, when resources are used to capacity, costs per ton decline as farm size increases up to approximately 60 acres (production of approximately 700 tons annually). Farms larger than 60 acres had slight reductions in harvesting costs and machinery investments per acre, but these were offset by increased cost of hired supervision. Consequently, the average total cost was basically constant beyond 60 acres.

Level of yields greatly affected costs per ton. Cling peach orchards with low yields show losses for the entire range of peach prices and orchard sizes considered. However, orchards of only 20 acres show profits with high yields.

With mechanisation (not considered a common cultural practice at the time) cost per ton decreased with increased orchard size up to about 90 - 110 acres and then plateaued. Mechanisation resulted in higher cost

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19. Similar to Chinese Gooseberry Industry at the present time.

20. Green drop refers to the industry program of eliminating surplus tonnage by knocking to the ground the green peaches from a determined percentage of trees in each orchard.

per ton for small farms and lower cost per ton for larger farms.
The break even point between current and mechanized practices occurred
at 55 acres. An increase in relative wage rates was shown to substant-
ially lower this break even point. For example a 25 per cent increase
in wage rates would reduce the break even point between present methods
and mechanization to 25 to 30 acres and a 50 per cent increase would
further reduce the break even point to 18 to 20 acres.

Damaged fruit was considered inevitable from mechanization and
the percentage of fruit losses a farmer could sustain depended mainly
on wage rates and farm size. (Mechanization is basically a non-biological
yield depressant).

Farm employment was examined and it was found that a farmer could
handle 20 acres of peaches while holding down a full time job, or
40 acres while working all year at a half time job. For small farm oper-
ators it was shown that it was more profitable to sell up and take full
time non-farm employment.

Selected Statistics[21] on the Californian Cling Peach Industry

Year	Bearing Acreage	Tons[22] Harvested	Yield in tons per Bearing Acre	Seasonal Average[23] Price Received by Grower
1961	93,898	692,023	12.8	US $66.50/ton

The cost-size analysis showed that even the largest most efficient
farms were achieving a relatively low profit per ton of fruit marketed.
For example from Table 8 page 17:

Machinery Component	Planted Acreage	Cost/Ton ($US)
I	8	68.68
	15	59.75
	24	55.84
V	250	59.33
	350	55.90
	430	54.30

21. Page 5 of the Bulletin.

22. Short tons.

23. Farmers with better quality fruit would presumably receive more
than the average price.

3.5.1   A Recent Report on the Californian Cling Peach Industry.[24]

Dean and Carter showed the highly vulnerable position that many of the smaller peach growers were in and advised them to sell up.   Subsequent events described in a recent report on the Californian Cling Peach industry have verified their conclusions.

Summary of the Report

Large tonnages produced in 1968 and 1969, a faltering U.S. economy and competition from Australia and South Africa for the export markets forced prices down and inventories of canned fruit up.   The result was thousands of acres of orchard were pulled out, dozens of growers forced to sell up, and many canneries amalgamated or changed ownership.   In 1971, growers averaged around $50/ton for their crop, including surplus tonnage, and production costs were about $60 to $70 per ton.   The California Cling Peach Association is seeking legislation to limit new plantings.   Growers are working through the state marketing order to expand research in processing, new products, consumer attitudes in addition to strong advertising to ensure the profitable disposal of their crop in the future.

3.6   Summary for Chapter Three

Production techniques, and the marketing system are in a state of flux at present.   It is thought that a large unexploited market exists for the Kiwi Fruit but slight price cuts with large promotional inputs are thought necessary for the export market in the future and larger price cuts with little promotion are predicted for the N.Z. market fruit.

Economies of size theory is briefly outlined and some possible analytical procedures are discussed.   Reasons for the selection of the economic engineering method are given and a review of a study which used this technique is presented.

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24.   American Fruitgrower February 1972.
      (see appendix for full article).

CHAPTER IV

KEY ASSUMPTIONS AND METHOD OF AVERAGE COST-
CURVE DERIVATION FOR KIWI FRUIT FARMS

4.1   Introduction

The aim of this thesis is to investigate those problems within
the Chinese Gooseberry Export Industry, associated with the potential
marketing effort required given the recent rapid upsurge in vine
plantings.   The dearth of written material relating to this industry
necessitated an exploratory survey, involving discussions with
Agricultural Department Officers, growers and exporters in the Bay of
Plenty, Auckland and Northland regions.   This preliminary study enabled
the author to obtain an insight into the structure and nature of this
industry as a whole.   From the exploratory survey several specific
problems were isolated and a more rigid form of questionnaire was developed
for the purpose of obtaining data concerning them.

The construction of synthetic firm models, required selection of
farmers[1] who were then intensively interviewed.

Each farm was visited several times in order that the initial hypo-
thesis could be tested, data collected previously checked and data
obtained elsewhere verified.   The interviews were always conducted in
such a manner as to permit a discussion[2] on all other aspects of the
industry as well.

4.2   Key Assumptions *

4.2.1   General Discussion.

This particular section of the study is directed towards the cost-
size and profit-size relationships that could be expected by Kiwi Fruit
farms of various sizes and acreages during the next few years.   The
technological coefficients used are considered to be the most advanced

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1.   These farmers were chosen because they were considered to be the
      industry leaders with regard to their efficient production techniques.

2.   Cartwright (15) describes these interviews as a free form type.

*   See appendix for specific details.

at this time (1971) and the assumption is that in time most farmers will be forced to adopt them or more efficient ones, by competitive pressure.

As stated previously the economic engineering technique is used to develop the cost curves. The key parameters vary between and within farms, between and within years and between and within districts and to allow for these variations, cost curves have been derived with several different sets of technological coefficients and yields.

Since more than 90% of planted vines are situated in the Bay of Plenty, the economic engineering models are assumed to operate subject to that district's environmental conditions. However, this does not exclude the applicability of this analysis for other areas of New Zealand, provided allowances are made for any significant differences in technical coefficients due to climate and soil type.

Technological relationships, prices and other necessary assumptions and data necessary for the formulation of the economic engineering models are included in the appendices. A brief summary of the relevant climatic parameters of the Bay of Plenty are included below in order to indicate the type of climate under which the models are assumed to operate.

TABLE 4.1

Climate parameters for the Bay of Plenty

	Tauranga[3] Aerodrome	Whakatane Board[3] Mills	Te Puke[4]
Temperature °F			
Mean	57.4	57.8	53.5
Mean Max.	66.0	66.9	N.A.
Mean Min.	48.8	48.9	N.A.
Relative Humidity	75	80.0	N.A.
Sunshine Hours	2315	2353.00	2300(approx)
Mean Annual Rainfall (ins)	51.2	49.9	66.83
Number of Rain Days	155	142	N.A.
Days of Screen Frost	7.0	7.3	N.A.

3. N.Z. Meteorological Service Data.

4. N.Z. Department of Ag. Economics Div.

N.A. - Not Available.

4.2.2   Topography.

Most commercial Chinese Gooseberry orchards in the Bay of Plenty lie in an altitude range of 100-500 feet above sea level.   Generally, the orchards are situated on low-lying, gently undulating hills, which provide excellent protection against untimely frosts because the cooler air tends to drain into the shallow valleys between ridges.

TABLE 4.2

Altitudes in feet above sea level

Tauranga Aerodrome	Whakatane Board Mills	Te Puke	Te Puke No 2 Road
20	30	200	400

4.2.3   Soils.

The predominant soils in which Chinese Gooseberries are grown around Te Puke are the yellow, brown pumice soils.   These are light friable soils derived from Kaharoa Ash and therefore sandy.   These soils have excellent drainage, but the more sandy types dry out badly during spells of dry weather, and therefore are not favoured by growers.

4.2.4   Type of Farming in the Area.

Cattle farming, sheep farming and horticulture farming are found throughout the whole of the Bay of Plenty.   Sheep farms tend to concentrate on the rougher, hillier parts, while dairy farming is generally found on the flatter land.   Subtropical fruit farming dominates the horticulture in the area and tends to be concentrated around Tauranga and Te Puke.   Other sub-tropicals besides Chinese Gooseberries, grown in the area are oranges, lemons, tangelos, manderins, grapefruit, tamarillos, passionfruit and are produced in significant quantities. Some pip fruit is grown in conjunction with the subtropicals.   Vegetable growers are found throughout the area and appear to mainly supply the population in the area.

The trend at the moment is for suitable dairy and sheep farms to be converted to horticulture production, especially   subtropicals.

4.2.5   Farm Practices Considered.

One of the outstanding features of the production of Kiwi Fruit at the time of this study was the large variety of cultural techniques and machinery combinations used by the different growers visited by the author.   The predominant vine culture techniques were the single wire method, the triple wire method, semi-pergola method and pergola method.

The single wire method was the most widely adopted by the new entrants and the successful established growers.   The N.Z.D.A. officers recommended the single wire method because of its relative simplicity, faster achievement of maximum production and lower capital outlay.

The pergola method is thought to give the highest yields per vine when in full production but takes longer to reach this point than the other methods.   It requires the highest capital outlay, highest input of pruning labour and the pruning labour probably has to be slightly more skilled than for the single wire method.

The triple wire and semi-pergola methods were considerably less popular than either of the other two methods mentioned, though there tended to be some experimentation with them by most of the growers visited.

Though a variety of machinery combinations and types were used on different farms, certain machinery such as tractors, mowers and sprayers was used on all the farms visited.

4.2.6   Farm Practices Adopted for the Analysis.

A typical combination of machinery, buildings and land constitutes part of the set of fixed resources for each farm size considered. Variations in the combinations of fixed resources (i.e. farm size) are achieved by increasing the number of permanent labour units and by altering the type of picking and grading installations used.   The single wire method of vine culture is assumed throughout the analysis and the only variety considered is the Hayward.   An idealized vine layout[5] is used, throughout the analysis.

4.2.7   Vine Acreage Considered.

The vine areas on the orchards visited in the Bay of Plenty
ranged from under an acre to approximately thirty acres.   Most
farmers grew other fruit in conjunction with their Kiwi Fruit enter-
prise.   Although no vine area was above thirty acres on any of the
orchards visited, the author considers that the farm practices would
not change radically for much larger acreages, therefore, short run
average cost curves have been derived for these larger acreages.

4.2.8   Working Capital Requirements.

The period of the year when overdraft facilities would be mainly
required is during and immediately prior to harvesting.   This is
because of the substantial cost of packing materials, harvesting labour
and packing shed labour which is incurred at this time.   The period
between the sale of, and payment for the fruit varys widely, depending
upon the particular terms of sale agreed to by the grower and buyer
(usually an exporter).   Consequently overdraft requirements also vary
widely.   For this reason working capital requirements have been assumed
non-limiting and available at zero interest rate.

Fig. 4.1   A typical plantation of Kiwi Fruit vines
trained on single wire fences.

4.3   Cost Classification

Twelve months has been used as the accounting period for this analysis.   Costs have been divided into four categories:

A.   Plant Fixed Costs

B.   Orchard Fixed Costs

C.   Pre Harvest Variable Costs

D.   Harvest Variable Costs

4.3.1   Plant Fixed Costs.

Are those costs that are incurred by the specified set of fixed resources, i.e. a specific farm _size_.[6]   They remain constant for each short run average cost curve.

Included as Fixed Costs:

Depreciation of the set of fixed resources

Interest on the capital invested in the set of fixed resources

Insurance on the set of fixed resources

Rates on house land block ($1\frac{1}{2}$ acres)

Telephone charges

Farm journals

Owner-operator remuneration[7]

Overdraft fee[8]

Accountants fee[8]

Repairs and maintenance of buildings

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5.   See Appendix, page 155

6.   Size refers to the quantity of fixed resources, not the acreage.

7.   Assumed that all farms are operated by owner-operators of similar managerial ability and therefore equal opportunity costs.

8.   These will generally be a function of the vine acreage but for the purposes of the analysis they are fixed, since in the author's opinion they do not significantly affect the cost-size relationships.

4.3.2   Orchard Fixed Costs.

These costs are incurred by each acre of vines independent of whether any preharvest operations or harvest operations are carried out.

Included are:

Repairs and maintenance of orchard

Rates on unimproved value of orchard land

Depreciation of the orchard (vines, posts, wire)

Interest on total capital invested in each acre of orchard

4.3.3   Pre Harvest Variable Costs.

All direct cash costs for the pre harvest operations are included in this section,

Freight of materials to farm

Repairs and maintenance of equipment

Tractor fuel

Weedicides

Pesticides

Fungicides

Fertilizer

Extra Seasonal labour requirements for pruning

4.3.4   Harvest Variable Costs.

These are costs that are incurred only if the fruit is harvested. They comprise of two distinct cost sections, picking costs and marketing costs.

Included as picking costs :-

Casual labour

Tractor fuel

Repairs and maintenance of tractor

Included as marketing costs[9] :-

Freight to packing and grading installation

Freight to a cool store

Packing and grading costs

Cool storage for one month

---

9.   Not included is a fruit levy since this is likely to be radically altered as the industry becomes stabilized and the annual requirement for advertising and promotion is more accurately determined.

4.4   Definition of Concepts Used

Total cost plus profit add up to the gross revenue or gross income. Gross revenue is total revenue.   In the subsequent analysis the components of total cost are:

    1.   Plant Fixed Costs

    2.   Orchard Fixed Costs

    3.   Pre Harvest Variable Costs

    4.   Harvest Variable Costs

When total cost equals gross revenue for a given farm size, then that farm is operating at its breakeven point, which could be expressed in terms of tonnage, acreage, or gross revenue.

For a farm operating below the breakeven point, as long as gross revenue covers depreciation and cash costs, an owner operator may stay in business indefinitely if he is prepared to accept below market returns for his resources.

The amount by which gross revenue exceeds total cost is considered to be profit.   The only resource assumed to absorb the profit (if any) is the entrepreneurship of the owner-operator, his other functions of management and labour being computed as an opportunity cost (the highest return a resource can earn in any alternative employment available) and included in the plant fixed costs.

In this analysis the opportunity cost for each permanent labour unit is assumed constant, i.e. when there are two permanent labour units per farm, each has the same opportunity cost as computed for a one labour unit farm.

4.5   The Average Cost Curves

4.5.1   General Discussion.

The short run average cost curves show the average cost per ton of fruit picked for specified sets of fixed resources when combined with varying numbers of Kiwi Fruit units[10] under specified yield per vine assumptions, specified proportions of the three fruit

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10.   1 unit = 2 acres of vines.

grades[11] obtained and specified numbers of export trays per ton of export fruit. For any specified vine yield, the acreage is a linear function of tons of fruit marketed, therefore acreage is synonomous with production in tons. For each set of fixed resources there is a limited fruit tonnage that it can handle per year, and also a limited number of vines that it can handle per year. Pre-harvest activities are independent of yield, consequently the output of a set of fixed resources may be determined either by pre-harvest operations or fruit tonnage, depending on the particular composition of a set of fixed resources and the specified yield per vine. The long run average cost curve is the envelope curve of the short run average cost curves.

4.5.2   Step by Step Derivation of a Short Run Average Cost Curve.

(1) a. Specify the set of fixed resources.
    b. State availability of variable inputs such as casual labour, packing and grading facilities.
(2) Determine the maximum number of acres of vines and tons of fruit that the selected set of fixed resources can handle. (i.e. determine their cut-off point).
(3) Determine the annual cost (i.e. plant fixed cost) of the set of fixed resources.

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11.   Grades
      Export Grade
      Second Grade - sold in New Zealand
      Rejects

      Export Fruit must be a) within a certain size range, b) free from blemishes, c) skin breaks, d) regular shape, e) free from disease.

      Reject Fruit is that which is non-saleable both in New Zealand and overseas.   This could be due to a) overripeness, b) excessive blemishes, c) disease, d) abnormal shape, e) size, f) skin breaks.

      Local market fruit (second grade) is the complement of the previous two grades.

(4) Specify the assumed: a/ Yield of fruit per vine ($\equiv$ to fruit picked per vine)

      b/ Proportion of each fruit grade obtained from the fruit picked[12]

      c/ Number of export trays per export ton

(5) Compute orchard fixed costs and pre-harvest variable costs of one unit of vines when combined with the set of fixed resources.

(6) Compute the harvest variable costs of one unit based on step (4) assumptions.

(7) Determine if any extra variable costs are incurred by subsequent units of vines when added to the set of resources other than those incurred by the first unit (e.g. extra pruning labour will be required when permanent labour is at maximum capacity).

(8) Compute the average cost per ton of fruit picked when one unit of vines is combined with the set of fixed resources.

Total Cost = Plant Fixed Cost + Orchard Fixed Cost + Pre-harvest Variable Cost + Harvest Variable Cost

$$\text{Average total cost per ton of fruit produced} = \frac{\text{Total Cost}}{\text{Tons of Fruit picked}}$$

(9) Repeat for successively greater number of units of vines being combined with the set of fixed resources up to the acreage or tonnage (depending on the fixed plant combination and yield per vine) where one or more of the fixed resources reaches maximum capacity, ensuring that any extra variable costs are added at the appropriate point.

(10) Manually extrapolate.

---

12. Farm yield $\equiv$ tons picked $\equiv$ tons produced $\neq$ tons marketed. Only 98% of the fruit picked is marketed because in all situations 2% is assumed non-saleable reject grade. Tons picked and tons produced are used interchangeably throughout the analysis.

4.5.3 An example of the derivation of a Short Run Average Cost
Curve.

(a) Set of Fixed Resources   One labour unit (owner-operator)
                              Standard equipment combination
                              'On Farm' packing shed

Assume adequate pruning and harvest labour available for employment at
required periods of the year.   The first Limiting Resource is the
'On Farm' Packing Shed.   Assumed yield 120 lbs of fruit per vine and
therefore maximum capacity of the specified set of fixed resources is
24 acres of vines.   Assume seventy percent of fruit is export grade
and that there are 260 export trays per ton of export fruit.

(b) Cost categories $NZ

     Plant fixed cost   6892.09

     Orchard fixed cost per
     unit* of vines   366.64

     Pre harvest cost per unit
     of vines   100.12

     Harvest variable cost per unit
     of vines   1371.48

(c) Cost of extra labour   required when permanent labour reaches
     maximum capacity:
                                 $NZ
Winter pruning   add   69.16   for the 5th unit
period
           then   117.858   for each subsequent unit.

Summer pruning   add   133.809   for the 4th unit
period   then   226.370   for each subsequent unit.

Harvesting period add   0.91   for the 6th unit

           then   114.17   for each subsequent unit.

Extra freight for fruit if total farm production exceeds 30 day packhouse
       capacity
                      add   226.95   for 10th unit

           then   264.07   for each subsequent unit.

*
[2 Acres = 1 unit of vines.]

TABLE 4.3

Variable, average and total costs at selected acreages.

No. of Units	Total Fixed Cost $	Total Variable Cost $	Total Cost $	Total Yield (Tons)	Average cost/ton $
0	6892.09	0	6892.	0	∞
1	"	1,722	8,614.	13.125	656.
2	"	3,444	10,336.	20.25	394.
3	"	5,167	12,059.	39.375	306.
4	"	7,137	14,029.	52.50	267.
5	"	9,269	16,161.	65.025	246.
6	"	11,449	18,341.	78.75	233.
7	"	13,629	20,521	91.875	223.
8	"	15,810	22,702	105.00	216.
9	"	17,991	24,883	118.125	211.
10	"	20,398	27,290	131.25	208.
11	"	22,843	29,735	144.375	206.
12	"	25,287	32,179.	157.50	204.

A graphical analysis of the Average cost per ton shows the derivation of an "L" shaped short run average cost curve.

Fig. 4.2 Short run average cost curve

Average Cost ($) Per ton of fruit produced
Acres of Vines
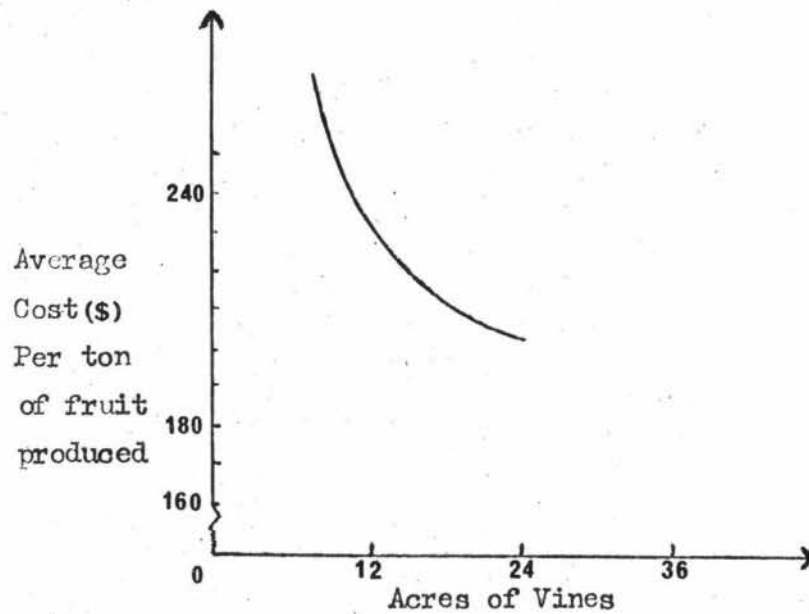
4.6   Summary for Chapter Four

The crucial assumptions for the economic-engineering model
are stated.   These include the assumed district, climate, soils,
topography, date of analysis and farm practices considered.
Costs are classified into plant fixed costs, orchard fixed costs,
pre-harvest variable costs and harvest variable costs.   The concepts
of total cost, gross revenue, breakeven acreage and profit are defined.
The short run average cost curves are discussed along with their
method of derivation and a worked example.

CHAPTER V

COST-SIZE AND PROFIT-SIZE RELATIONSHIPS
FOR SELECTED COMBINATIONS OF FIXED RESOURCES

5.1   Introduction

In this chapter the nature of cost-size, profit-size relationships
are discussed.   The effect of changes in the factors listed are exam-
ined to show their influence on costs and profits for selected combin-
ations of fixed resources.

        a.   yield of fruit per vine
        b.   composition of fixed resources
        c.   technical coefficients
        d.   farm fruit prices
        e.   cultural practices
      · f.   pruning labour availability
        g.   assumed economics and diseconomies

Section 5.2 is concerned with four typical fixed resource combin-
ations operating up to their maximum capacity.   Short run average
cost curves are derived for three distinct vine yield levels.   The
breakeven acreage is shown when vine fruit yields, farm fruit prices,
percentage of export fruit obtained from a given crop and degree of
utilization of the fixed resources are all varied for each of the
specified farm sizes.   Short run average cost curves are derived for a
hypothetical situation where extra diseconomies are included.   Possible
economies and diseconomies that are not included in the economic-
engineering models are listed and briefly discussed.

Section 5.3 is concerned with several special aspects.   The
comparative profitability of the selected combinations of fixed
resources is shown when 'off farm' packing and grading is assumed less
efficient than 'on farm' packing and grading.   Cost curves are derived
for a situation when casual labour for pruning is assumed unavailable.
Pest spraying carried out by helicopter is briefly discussed and a hypo-
thetical mechanical pruning situation is developed.

5.2   Cost-Size and Profit-Size relationships for Farm
       Sizes I, II, III and IV

   5.2.1   Key assumptions pertaining to the derivation of
            S.R.A.C. curves for Farm Sizes I, II, III and IV.

TABLE 5.1 Description of the combinations of fixed resources
          represented by Farm sizes I,II,III,and IV.

Farm Size	Number of Permanent Labour Units	Standard ✱ Equipment Combination	Packing and Grading Facilities	First Limiting Resource
I	1	1	'off farm'	Tractor during harvesting
II	1	1	'on farm'	Packhouse capacity
III	2	1	'off farm'	Tractor during harvesting
IV	2	1	'on farm'	Packhouse capacity

   5.2.1.1   Yield levels used (lb of fruit picked per vine)

        Low Yield = 90 lb
        Medium Yield = 120 lb
        High Yield = 150 lb

   It should be noted that pounds of fruit picked per vine is synonymous
with production per vine.

        5.2.1.2   Packing and Grading Facilities

   "Off farm" facilities are assumed to be in the form of Installation
P III (see page 173 for details) operating at 90% (573 tons) of its
seasonal capacity situated at a distance of 10 miles from the farm.
"On farm" facilities are assumed to be those of Installation P I
(see page 174 for description).   "Off farm" packing and grading costs
are assumed to be a linear function of fruit tonnage picked whereas
"on farm" packing and grading costs are not. (see Fig 5.1).

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✱ See page 157 for description.

Fig 5.1 Cost to the farmer for packing and grading.
Farm sizes I and III   'off farm'
Farm sizes II and IV   'on farm'
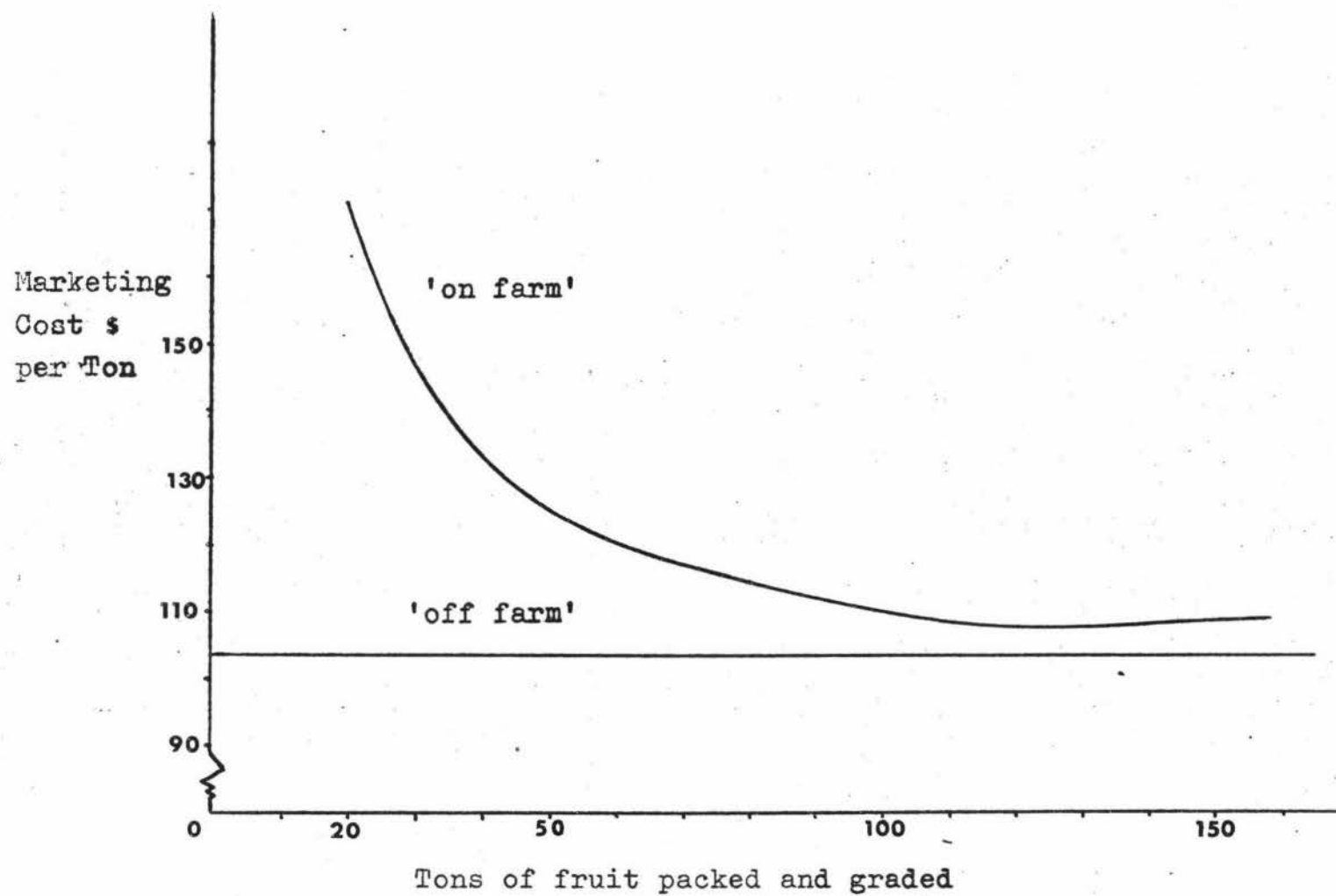
5.2.1.3 Limiting Resources

Harvesting operations are assumed to be confined to a limited time period in which one tractor must transport all the fruit picked from the orchard to a particular place on the farm, whether it be a pickup point for a truck, or a packing and grading installation. Depending on whether the farm has "on farm" or "off farm" packing and grading facilities, the full bins are either placed on a conveyor belt to await emptying "on farm" or removed by truck "off farm". Farm sizes I and III are assumed to have unlimited packing and grading facilities and the first limiting resource for them is the tractor haulage capacity during harvesting. Farms II and IV have limited packing and grading capacity and this capacity is the first limiting factor. For any specified yield, Farm sizes I and III have the same cut-off acreage* and Farm sizes II and IV have the same cut-off acreages.

5.2.1.4 Seasonal Labour Requirements

For the average cost curves shown in Figs 5.2, 5.3, 5.4, 5.5, 5.6, 5.7 and 5.8, unlimited seasonal labour is assumed to be available if required for summer pruning, winter pruning and harvesting operations. This is a reasonable assumption because a large number of housewives are employed for irregular hours by many orchardists during 2-3 months of the year. (This assumption is partially removed in Section 5.3 of this chapter).

5.2.1.5 Economies and Diseconomies operating in the Average Cost Curves shown in Figs 5.2 to 5.8 (inclusive).

a. Technical — the "off farm" packing and grading is assumed more efficient than the "on farm" with a consequent decrease in costs.

b. Economies due to proportionality relationships increasing the utilization of the sets of fixed resources by addition of variable resources (acres of vines) results in decreased average cost per ton of fruit.

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* The maximum acreage a specified set of fixed resources can handle.

Fig 5.2 Average cost curves for Farm sizes I,II,III and IV assuming a yield of 90lb per vine.

Fig 5.3 Average cost curves for Farm
sizes I,II,III and IV assuming
a yield of 120lb per vine.

Fig 5.4   Average cost curves for Farm
sizes I,II,III and IV assuming
a yield of 150lb per vine.

c. Diseconomies due to greater aggregation of resources.
    The "on farm" packing and grading installation has increas-
    ing average cost per ton beyond 120 tons.

5.1.2   Discussion on Figs 5.2, 5.3 and 5.4.

These average cost curves were derived with the assumption that
casual labour is available at the required periods of the year (summer
pruning, winter pruning and harvesting). Seventy percent of the fruit
which is produced is assumed to be export grade, twenty-eight percent
local or second grade and two percent rejected and dumped.

All the curves are 'L' shaped because proportionality economies
are the main influence with increasing utilization of each set of fixed
resources. The long run average cost curve for each yield condition
is given by Farm size I, (see Fig 5.8) this being predictable since it
incurs the lowest fixed cost, and the variable cost per acre of vines
per year is constant for all farm sizes for any given yield. Farms II
and IV incur a slight cost increase per ton of fruit beyond a 120 ton
farm output because of the extra cool storage and transport assumed
necessary, consequently they begin to plateau off very sharply just as
their cut-off point is approached. This is especially evident at the
lower yield condition of 90 lb/vine. The cut-off points for all
farm sizes depends on yield, therefore, the higher yield curves show
cut-off points at lower acreages than the lower yield curves. The
short run average cost curves for Farm sizes II and IV are just
beginning to plateau off at their cut-off points, but the cost curves
for Farm sizes I and III plateau at approximately 50 percent of fixed
resource capacity, therefore it appears that it is more important for
the farms with packing sheds to achieve maximum capacity than those
without.

The lower the yield per vine the higher the variable cost per ton
of fruit produced, causing a slower rate of decrease in average cost per
ton with increasing utilization of the fixed resources. This is
because plant fixed costs, orchard fixed costs, and pre-harvest variable
costs are independent of yield, i.e. constant for any given acreage and
farm size and only harvest variable costs are constant per ton of fruit.

TABLE 5.2

Average Cost (¢) per Ton of Fruit Produced for Farm Sizes
I, II, III and IV at Selected Acreages and Yields.

Yield	Farm Size	Acreage: 4	6	10	18	At cut off Acreage	(Acres)
	I	416.4	327.7	266.5	233.9	204.0	(66)
90lbs per vine	II	485.2	370.8	289.1	242.9	233.9	(30)
	III	575.7	433.9	320.4	252.8	208.4	(66)
	IV	652.6	485.1	351.1	269.0	239.5	(30)
	I	343.06	275.1	230.8	205.7	186.5	(50)
120lbs per vine	II	393.7	306.2	246.2	210.0	204.3	(24)
	III	465.0	356.4	269.6	220.0	191.00	(50)
	IV	515.6	387.5	285.0	225.0	215.0	(24)
	I	295.3	243.0	207.4	187.2	173.2	(40)
150lbs per vine	II	334.2	266.1	218.0	293.3	193.3	(18)
	III	392.8	306.0	237.0	198.6	178.5	(40)
	IV	431.6	329.3	247.8	204.7	204.7	(18)

5.2.2.1   Table 5.2 discussion

Table 5.2 compares efficiency from the country's point of view and
not profitability from the farmer's point of view.[1]   The average cost
per ton of fruit produced appears to be more sensitive to proportionate
changes in yield than acreage.   Differences in average total cost per
ton between different farm sizes are more pronounced at low yields and
low acreages, but at higher yields and higher acreages the differences
become considerably less significant.

_____

[1] This is adequately covered by Cartwright   (15)

Fig 5.5 Average cost curves for Farm
sizes I,II,III and IV
assuming a yield of 150lbs
per vine.

Average
Total
Cost ($)
Per Ton
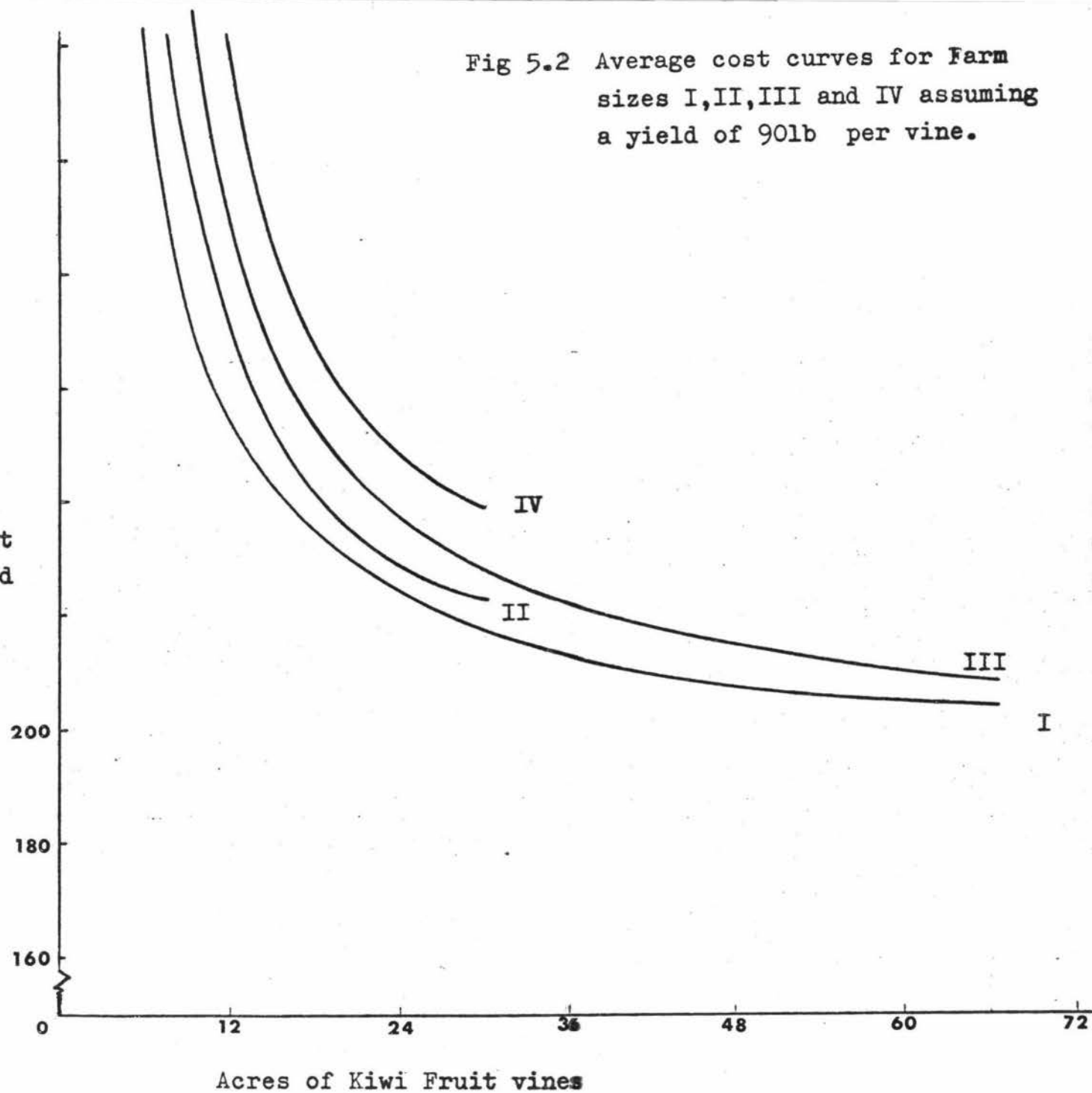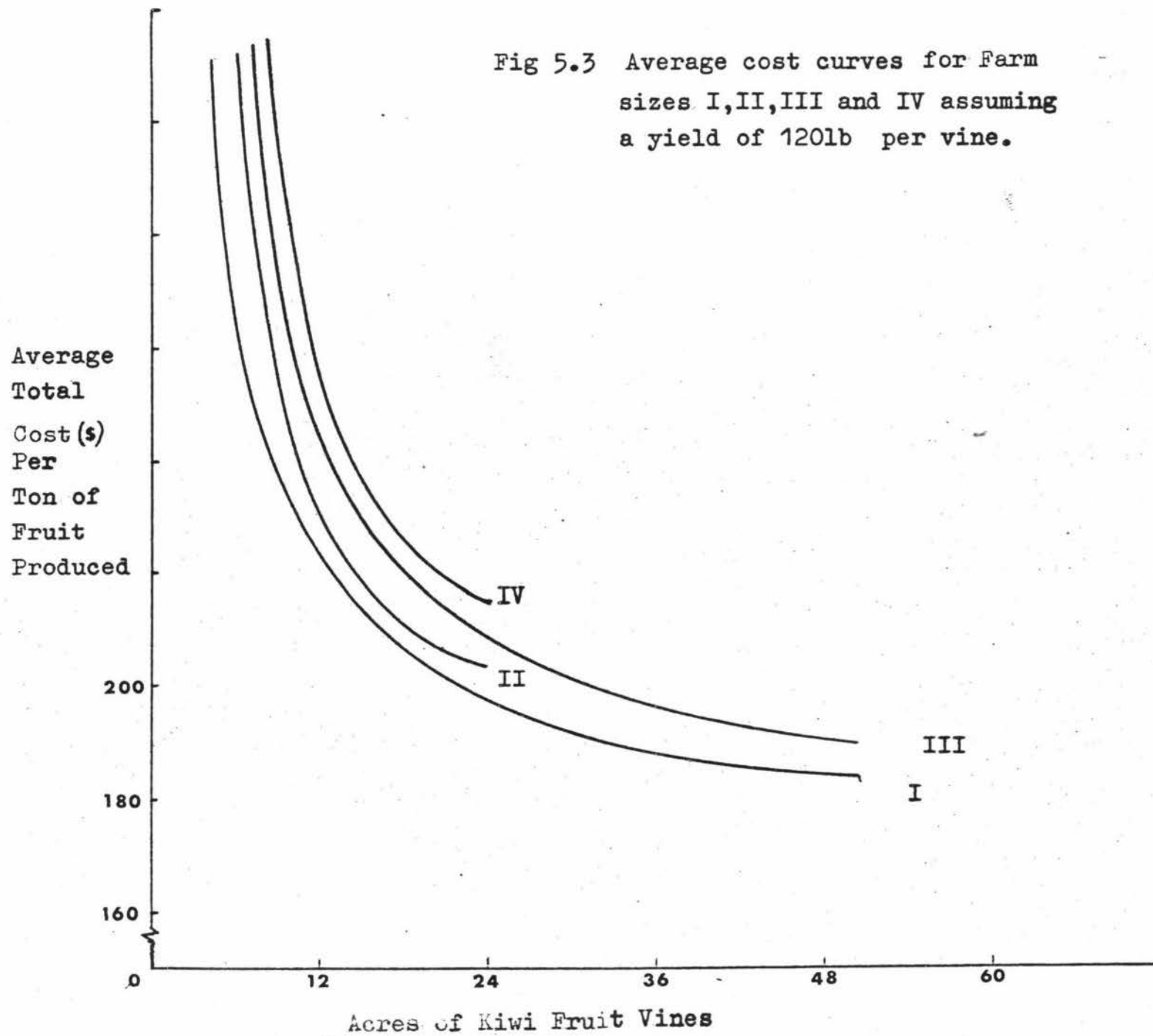of Fruit
Produced

Tons of fruit produced

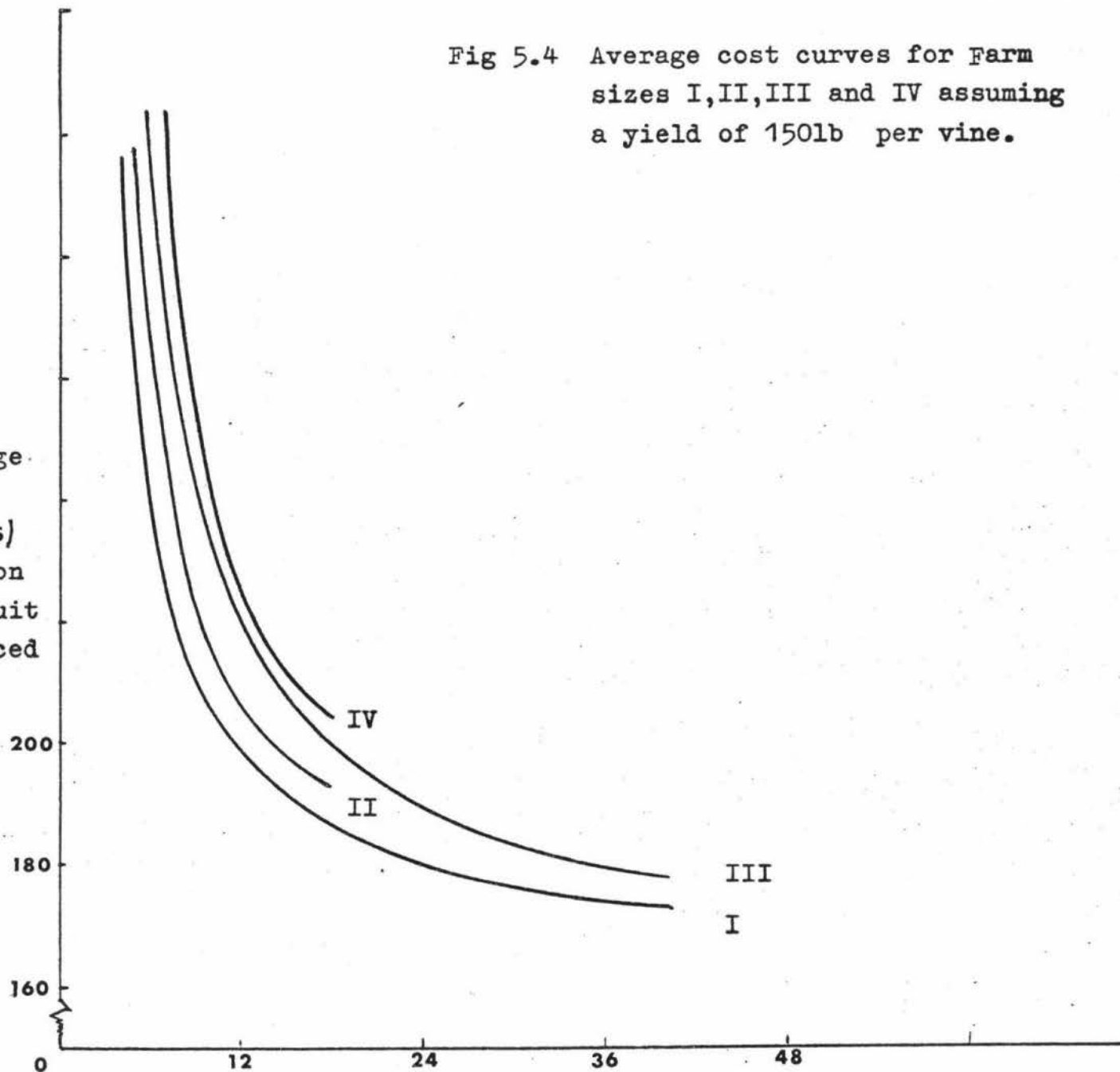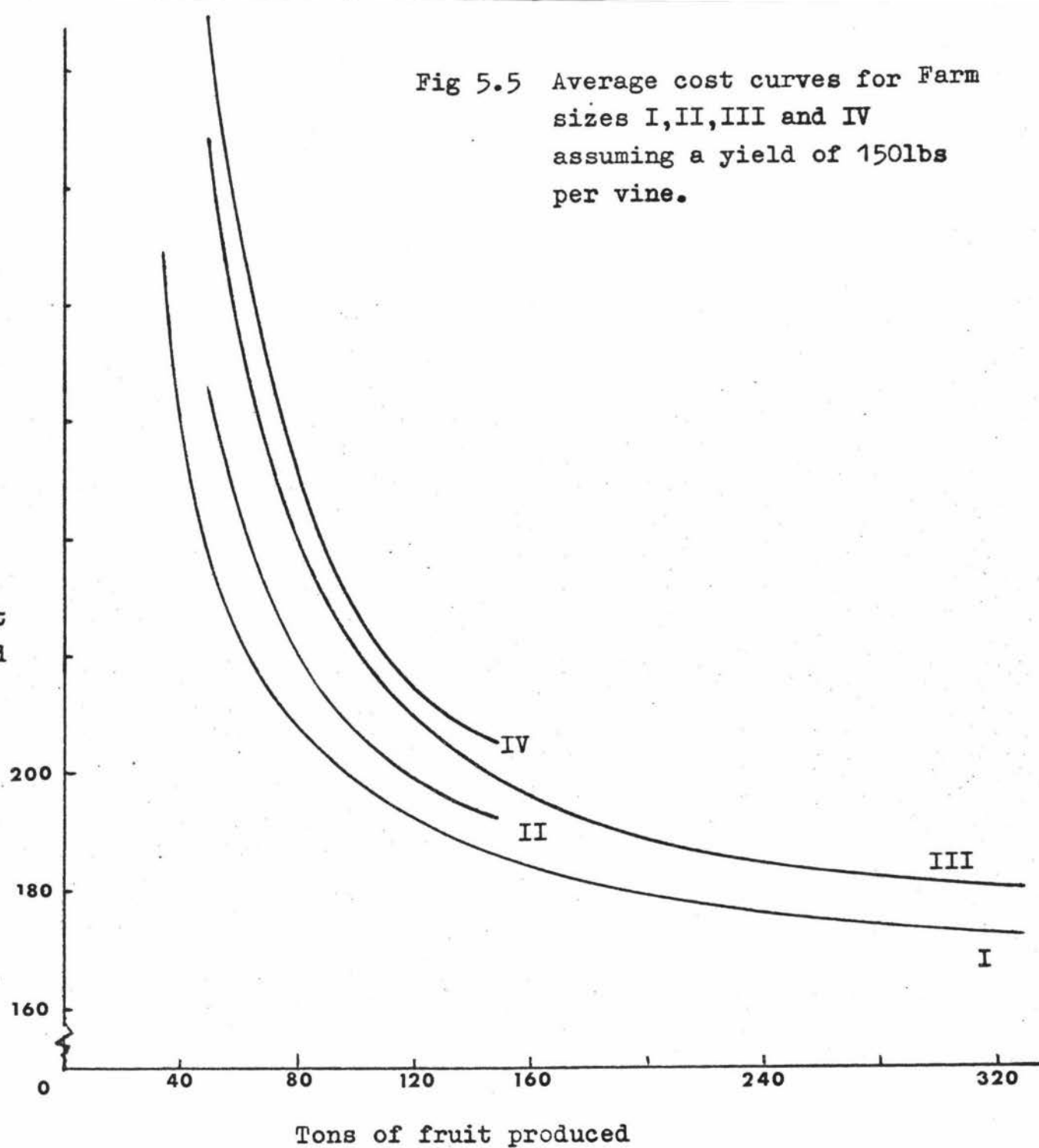Fig 5.6 Average cost curves for
Farm sizes I,II,III and
IV assuming a yield of 120lbs
per vine.
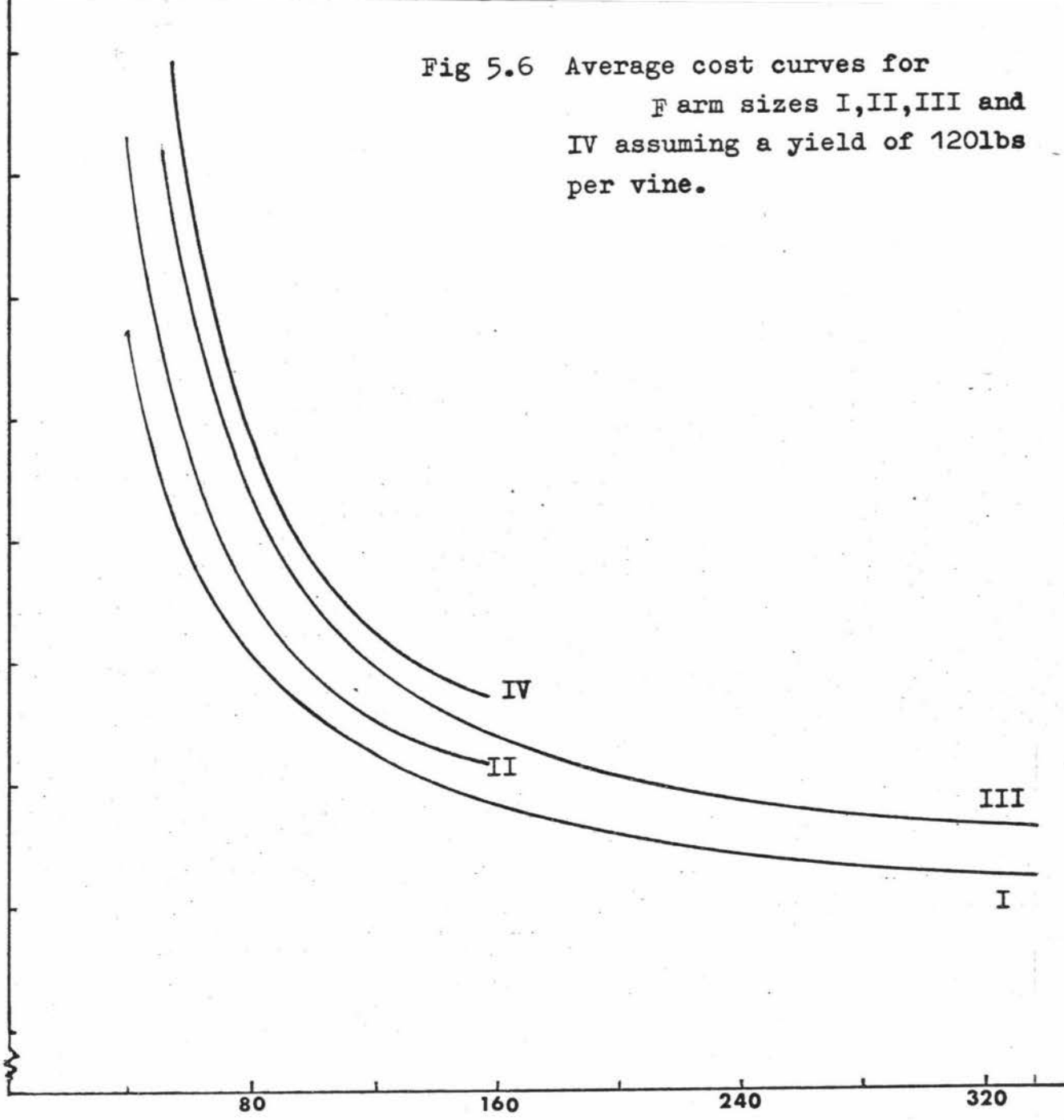
Fig 5.7 Average cost curves for Farm
sizes I,II,III and IV assuming
a yield of 90lbs per vine.

Average
Total
Cost ($)
Per Ton
of Fruit
Produced

Tons of fruit produced
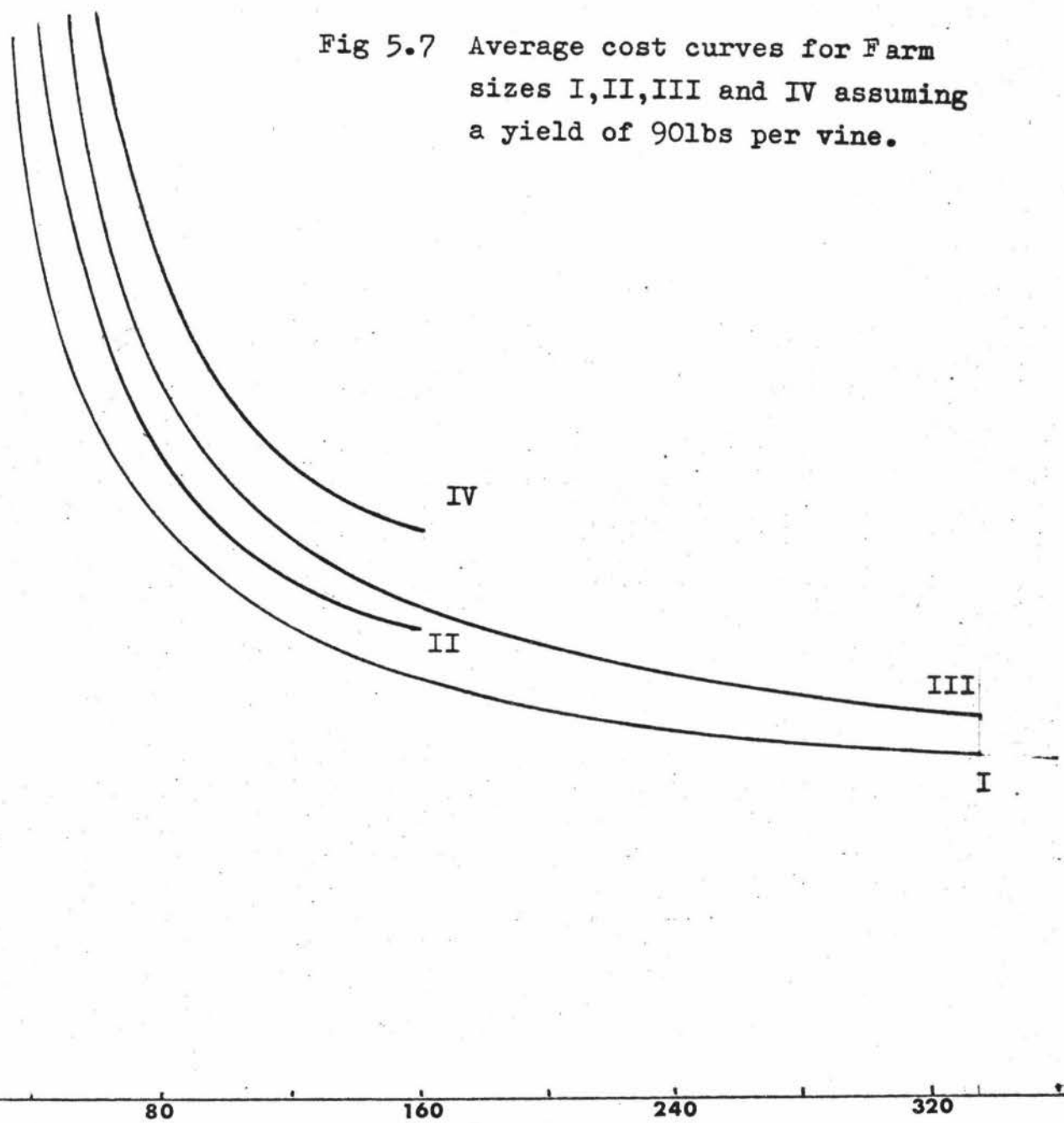
5.2.3   Discussion on Figs. 5.5, 5.6 and 5.7.

These cost curve groups show the relationship between the
average cost per ton of fruit picked and production (long tons).
Any selected tonnage on a cost curve is equivalent to a specific acreage.

Entrepreneurial income (i.e. profit) may be determined directly
from these curves for any given tonnage (or acreage) by subtracting
the cost per ton from the farm price per ton at the selected tonnage
and multiplying the result by the number of tons.   Cut-off points
for Farms II and IV at all yields are determined by the packing shed
capacity, whereas cut-off points for Farms I and III at all yields are
determined by tractor capacity at harvesting time.   Slight differences
in cut-off points for the same farm sizes under different yield condit-
ions are due to the indivisibility of the variable resources, i.e.
partial units of vines have not been added in order that maximum
tonnage be reached.

Once again, the cost curves are 'L' shaped since no significant
diseconomies with increasing utilization have been incorporated.
For each selected yield condition the short run average cost curve for
Farm size I is also the long run average cost curve.   Lower yields
result in higher short run average costs for all farm sizes, and this
is more marked at low utilization of fixed resources.   Farm sizes
II and IV operating at full capacity[2] approach closely the average cost
per ton of fruit picked   achieved by Farm sizes III and I at full
capacity, but the average cost per ton does not vary significantly
between 50 percent and 100 percent capacity for the latter farm sizes
but it does for the former two.

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2.   Full capacity $\equiv$ cut off point.

Fig 5.8   Average cost curves of Farm **size**
           I assuming yields of 90lb,120lb **and**
           150lb   These curves **are**
           the Long Run Average Cost **Curves**
           for Figs 5.2,5.3 and 5.4
           respectively.

Average
Total
Cost($)
Per Ton
of Fruit
Produced

90lb

120lb

150lb

200

180

160

0

12

24

36

48

60

72

Acres of Kiwi Fruit vines
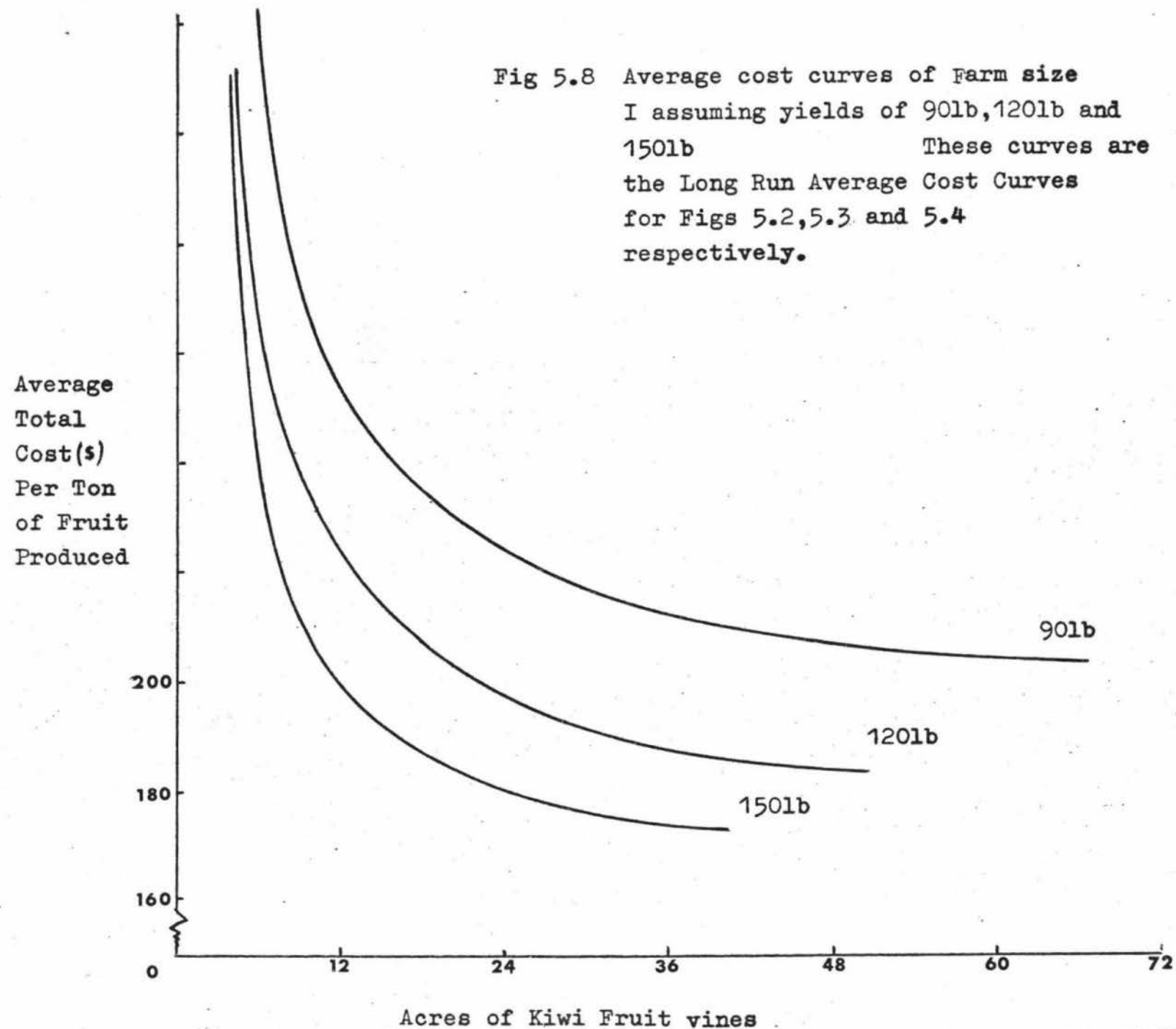
5.2.4 Selection of Farm Size and Acreage on the Basis of the Cost Curves shown in Figs 5.2 to 5.8.

Farm sizes I, II, III and IV were selected as representative of the fixed resource combinations within the industry. Under the prevailing assumptions the industry should select Farm size I. operating with twenty to thirty acres of vines. However, the advantage of this farm size over the other farm sizes is small in this acreage range and many other factors should be considered as well.

The choice of one or two permanent labour units is only important when the acreage of vines is below approximately 15 to 20 acres, and above this the average cost per ton for all selected yields does not differ significantly. Two permanent labour units would probably be better at the higher acreages because of such factors as increased overseeing of hired labour, more flexibility in carrying out such operations as pest spraying and generally sharing the managerial tasks which would more than compensate for the increased fixed cost. Farms where permanent labour is greatly underutilized, could charge the owner-operator cost on an hourly basis and take part-time work during slack periods in order to decrease the average total cost per ton.

Under the prevailing assumption regarding comparative cost of 'off farm' packing and grading and 'on farm' packing and grading, for any given yield, acreage and percentage of export grade fruit, it is cheaper for a grower to hire packing and grading facilities. This is especially so at low acreages, but at higher acreages this is less pronounced. (Table 5.2). However, the advantages and disadvantages of a grower owning a packing and grading installation depend upon many intangibles at this point in time (1972). The main factors being the availability of labour in the future, and the relative efficiency between 'on farm' [*] and 'off farm' installations. A grower would certainly not be advised to install his own packing and grading facilities for less than 12-15 acres of vines. Farm sizes II and IV would have more flexibility during the critical harvest period than Farms I and III since they could pick and pack at the most suitable time for their fruit, whereas with centralised packing and grading facilities growers may have to pick within a certain period or at a specified rate per day to fulfil their daily contracted quota. In the model used

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[*] 'On farm' Farm sizes II and IV
'Off farm' Farm sizes I and III

the short run average cost curves for all farms and all yields tend to plateau out at between 20 and 30 acres of vines, consequently from the nation's point of view this is the desired acreage range in which all farm sizes should operate.

5.2.5   Breakeven Acreage.*

Table 5.3 gives the breakeven acreage for Farm sizes I, II, III and IV.   The acreages are expressed as lying between specified multiples of 2 because the basic unit of vines used in the economic engineering model is 2 acres.   The following three parameters are used in order that a range of possible situations are covered:-

1.   Farm price for fruit
2.   Percentage of export fruit obtained
3.   Yield of fruit per vine

5.2.5.1   Farm Price Levels Used

Low (L) $1.5 per export tray ($0.175 per lb)
$0.05 per lb of second grade fruit

These are very pessimistic prices

Medium (M) $1.80 per export tray ($0.21 per lb)
$0.075 per lb of Second grade fruit

High (H) $2.2 per export tray ($0.26 per lb)
$0.10 per lb of Second grade fruit

These prices are approximately those currently operating.

5.2.5.2   Three Grade Percentage Combinations Used

	% Export Grade	% of Second Grade	%reject (unsaleable)
Combination 1	90	8	2
Combination 2	70	28	2
Combination 3	50	48	2

---

*   Acreage of vines when Total Cost = Gross Revenue

TABLE 5.3   BREAKEVEN ACREAGES.

	vine yield \ price level	90% of Crop Export Grade			70% of Crop Export Grade			50% of Crop Export Grade		
		H	M	L	H	M	L	H	M	L
Farm size I	150 lb	0-2	2-4	2-4	0-2	2-4	2-4	2-4	2-4	4-6
	120 lb	2-4	2-4	2-4	2-4	2-4	4-6	2-4	4-6	6-8
	90 lb	2-4	2-4	4-6	2-4	4-6	6-8	4-6	6-8	10-12
Farm size II	150 lb	2-4	2-4	2-4	2-4	2-4	4-6	2-4	4-6	6-8
	120 lb	2-4	2-4	4-6	2-4	4-6	6-8	2-4	4-6	8-10
	90 lb	2-4	4-6	6-8	4-6	4-6	8-10	4-6	6-8	14-16
Farm size III	150 lb	2-4	2-4	4-6	2-4	4-6	6-8	2-4	4-6	8-10
	120 lb	2-4	4-6	6-8	4-6	4-6	6-8	4-6	6-8	10-12
	90 lb	4-6	6-8	8-10	4-6	6-8	10-12	6-8	8-10	16-18
Farm size IV	150 lb	2-4	4-6	4-6	2-4	4-6	4-6	4-6	6-8	8-10
	120 lb	2-4	4-6	6-8	4-6	6-8	8-10	4-6	8-10	12-14
	90 lb	4-6	6-8	10-12	6-8	8-10	12-14	8-10	10-12	22-24

5.2.5.3 Yields per Vine Used

90 lb of fruit per vine
120 lb of fruit per vine
150 lb of fruit per vine

5.2.5.4 Discussion

The breakeven acreage ranges from 0-2 acres for Farm size I, price H, 90%. export grade fruit, and 150 lb yield, up to 22-24 acres for Farm size IV, price L, 50%. Export grade and 90 lb yield. This wide range shows that with the combination of low price, yield, and export grade percentage, farms with less than approximately 10 acres of vines are unlikely to be an economically viable proposition. However with the high price level operating even farms with very small acreages of low yielding vines can achieve a Total cost Total revenue and remain economically viable.

5.2.6   Some Possible Factors that Could Cause Diseconomies
with Increasing Acreage.

In the following section some possible diseconomies not included
in the cost curves depicted in Figs. 5.2 to 5.8 and which might occur
with a large acreage of vines being combined with a given set of fixed
resources are suggested and incorporated in the model and the resulting
cost curves shown.

5.6.2.1   Factors that are Assumed to cause Diseconomies
with Increasing Acreage

(a) When a grower depends upon seasonal labour to carry out pruning
and harvesting, then with increasing acreage an increasingly large
labour complement is required.   A situation may arise where inadequate
skilled labour is available, resulting in incorrect or inadequate pruning.
(b) The economic engineering model assumed a constant managerial input
per acre right up to the cut-off point, however, in real life managerial
ability varies considerably between farmers and the input per acre would
probably decrease as vine acreage increased.
(c) There are some seasons when the fruit may reach the optimum stage
for picking for only a short period and consequently the picking, packing
and storage operations cannot be performed before the fruit has passed
this optimum point, resulting in higher percentage of second grade fruit
and wastage.
(d) On larger acreages, the effects of pests may be more severe since
it would be harder to meet the timeliness requirements of spraying
(i.e. it could require a week to spray 30 acres because of delays due to
weather holdups).

5.2.6.2   Quantification of the Diseconomies

The hypothesis is that the cumulative effect of these factors acts
as a yield depressant, increasing with each additional acre of vines
combined with the fixed resources.   Though quantification of this yield
depression is highly speculative and hypothetical a 2.5 lb fruit
decrease per vine for each acre increase of vines has been used to
derive a short run average cost curve for each farm size.   On this
basis Fig 5.9 has been derived.

TABLE 5.4

Optimum acreage of vines for Farm Sizes I, II, III and IV
with quantified diseconomies of acreage.

Farm Size	Optimum Acreage of Vines
I	18
II	20
III	22
IV	23

With diseconomies of acreage incorporated into the model the
optimum and maximum acreage no longer coincide because the marginal
cost per ton exceeds the average cost per ton before the cutoff points
are reached.

Fig. 5.9
Average cost curves for
Kiwi Fruit Farm sizes I,
II, III, IV with incor-
poration of yield
depressant effects with
increasing acreage.

Average
Total
Cost ($)
per ton
of fruit
produced

Acres of Vines
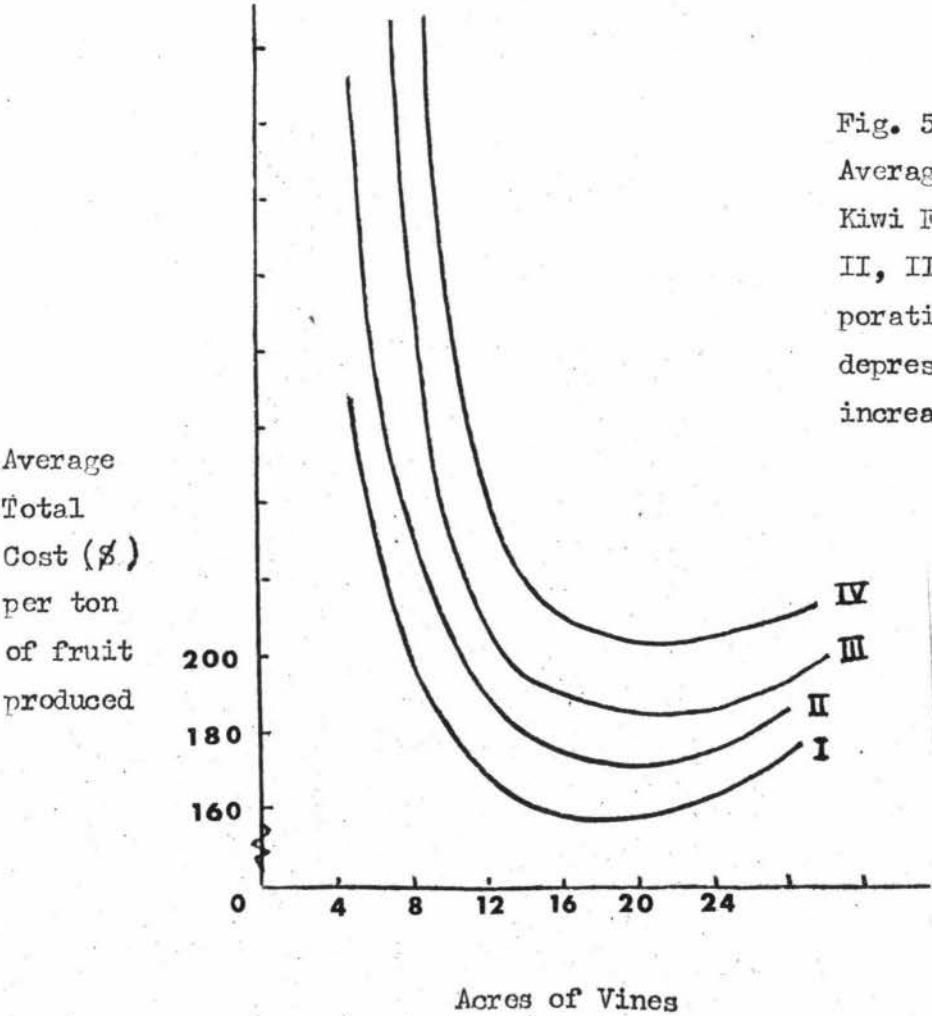
5.2.7 Other Economies and Diseconomies.

Specific examples of diseconomies and economies of size not included in any of the above cost curves but which may occur in the production section of the industry are listed below.

(a) Economies from buying larger quantities of inputs, e.g. larger trade discounts, by purchasing direct from a wholesaler or the factory.

(b) Economies from marketing advantages due to special contracts resulting in a higher farm price, e.g. An exporter may be able to fill a complete order involving hundreds of tons from one orchardist thus reducing his costs, which may be partly reflected in his paying a higher farm price.

(c) Advantage created by common ownership of farm and non-farm business, or conglomerate business, e.g. Turners and Growers ownership of a large orchard with resultant reduction in management supervision and business overhead for both businesses.

(d) Out of season use of permanent labour. Orchards with a large complement of machinery and a large acreage of vines but only one or two permanent labour units would have enough annual maintenance to fully utilize the labour during the slack periods of the year.

(e) Multi-product farming economies, e.g. Growing crops that utilize the fixed resources during the slack periods of the year.

(f) Pecuniary economies. Very large farms could employ capital and credit procurement specialists to obtain the use of large amounts of finance at a lower cost.

5.3 Special Aspects of Profit-Size and Cost-Size Relationships

5.3.1 Comparative Profitability When Off Farm Packing and Grading Facilities are less Efficient than On Farm Facilities.

Cost curve groups shown in Figs 5.2 to 5.9 inclusive were developed with the assumption that 70% of fruit is export grade. A possible situation that may arise in the next decade was postulated by Hancock[3]

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3. Packing shed equipment Engineer from Tauranga.

who suggested that centralised packing and grading facilities would recover a lower percentage of fruit for export compared with the smaller grower owned and operated facilities.   His reasons for this suggestion were:

(a) F.M.C.[4] graders are mechanically less accurate than orbit graders and therefore would have to recover a lower proportion of export fruit to ensure that the required standard is maintained.

(b) Lower labour efficiency in large packing installations.

(c) More fruit wastage due to extra handling.

A figure he suggested for export recovery was 50% since this was known to occur overseas for some centralised packing and grading installations.

A postulated and hypothetical profit profile analysis has been developed and presented in tables 5.6, 5.7, 5.8.

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4.   Food Marketing Corporation of America.

TABLE 5.6

Profit ($NZ) for Selected Vine Acreage and Fruit Price
Levels[5] for Farm Sizes I, II, III and IV.

Assumptions: 90 lb of fruit per vine

Farm sizes II and IV recover 70% of fruit
for export.

Farm sizes I and III recover 50% of fruit
for export.

Farm Size	Price Level	Acres of vines	4	10	18	30
I	H		-273	6846	15269	27904
	M		-1859	2878	8127	16001
	L		-3205	-496	2070	5906
II	H		-445	8731	19897	36031
	M		-2213	4311	1194	22772
	L		-3639	746	5524	12075
III	H		3473	4139	13560	26194
	M		5060	172	6418	14292
	L		-6406	-2707	361	4196
IV	H		-3809	5616	27534	33668
	M		-5576	1196	9579	20409
	L		-7003	-2370	3161	9712

5. H $2.2 / Export Tray, $0.1/lb for local grade
   M $1.8   "   " ,   0.075   "   "   "
   L $1.5   "   " ,   0.05   "   "   "

TABLE 5.7

Profit ($NZ) for Selected Vine Acreages and Fruit
Price Levels for Farm Sizes I, II, III and IV.

Assumptions: 120 lb of fruit per vine

Farm sizes II and IV recover 70% of fruit
for export.

Farm sizes I and III recover 50% of fruit for
export.

Farm Size	Price Level	Acres of vines	4	10	18	24
I	H		1570	11287	23287	32288
	M		−504	6102	13955	19845
	L		−2262	1706	6041	9268
II	H		1817	14224	29809	40743
	M		−493	8449	19414	26883
	L		−2356	3790	11028	15701
III	H		−1630	8745	21595	32767
	M		−3704	3560	12263	20324
	L		−5462	−836	4349	9747
IV	H		−1383	11682	28117	39052
	M		−3696	5907	17722	25192
	L		−5556	1248	9336	14010

TABLE 5.8

Profit (£NZ) for Selected Vine Acreages and Fruit
Price Levels for Farm Sizes I, II, III and IV.

Assumptions: 150 lb of fruit per vine

Farm sizes II and IV recover 70% of fruit
for export.

Farm sizes I and III recover 50% of fruit
for export.

Farm Size	Price Level	Acres of vines	4	8	10	18
I	H		3,533	12,040	16,042	31,853
	M		940	6,855	9,561	+20,188
	L		−1,258	2,828	4,065	10,295
II	H		4,229	14,977	10,099	39,828
	M		1,341	9,202	12,880	26,838
	L		− 988	4,543	7,056	16,354
III	H		333	9,212	13,604	30,170
	M		−2,260	4,027	7,123	18,505
	L		−4,458	369	1,627	8,612
IV	H		1,029	12,149	17,661	38,145
	M		−1,859	6,374	10,442	25,155
	L		−4,188	1,715	4,618	14,071

Fig 5.10 Profit curves for Farm sizes III and IV when
the 'off farm' installation achieves 50% export
fruit packout   and the 'on farm' installation
achieves 70% export fruit packout   (yield 90lb/vine)
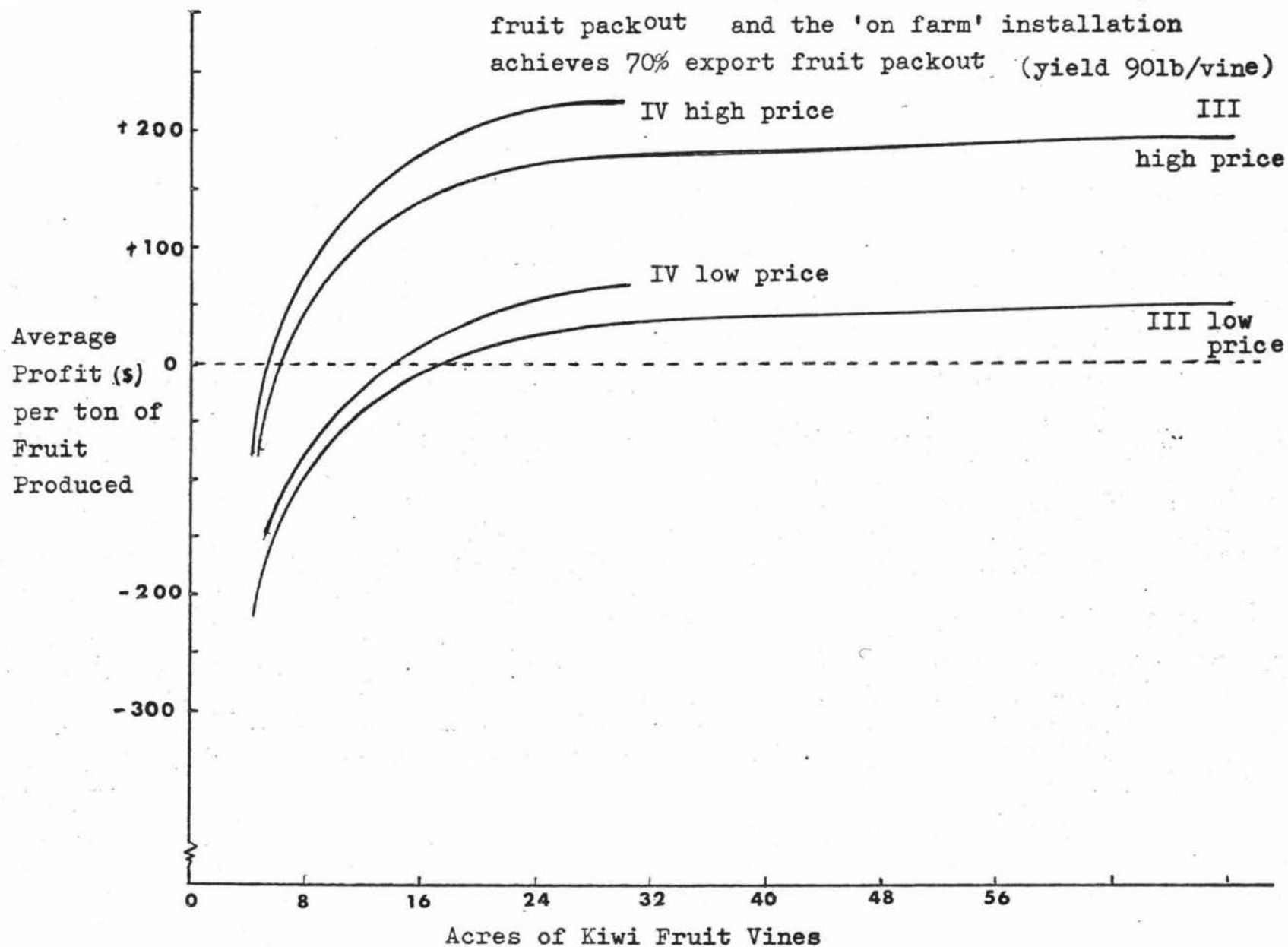
5.3.1.1   Discussion on Tables 5.5, 5.6 and 5.7

The 20% difference in recovery of export fruit between on farm
and off farm packing and grading installations has tended to reverse
the advantage Farm sizes I and III enjoyed over Farm sizes II and IV
in Section 5.1.   Even with ten acres of vines at each price level,
Farm sizes I and III achieve a lower total profit than Farm sizes II
and IV respectively.

5.3.1.2   Discussion on Fig 5.10

Fig 5.10 shows the profit per ton of fruit produced plateaus out
at approximately 30 acres of vines for both Farm sizes and price
levels selected.   It also shows that at this acreage the difference
in profit per ton between Farm sizes III and IV is approximately $45
at the high price level and $30 at the low price level.

5.3.1.3   Conclusion

Average costs per ton and consequently farm profits are very
sensitive to the percentage of export fruit a packing and grading
installation achieves.

5.3.2   Effect on the Average Cost Curves when Casual Labour for Pruning is Unavailable.

5.3.2.1   Key Assumptions

Four farm sizes are operating but differing from Section 5.1
with the assumption that casual labour is available only for harvesting
activities.   This is considered a less realistic situation than in
section 5.1 and consequently will not be treated in the same depth.

TABLE 5.9

Description of Farm sizes V, VI, VII and VIII

Farm Size	No. of Permanent Labour Units	Standard Equipment Combination	Packing and Grading Facilities	First Limiting Resource
V	1	1	'Off farm'	Labour (between mid-Nov and 28th Feb.
VI	1	1	'On farm'	Labour " " "
VII	2	1	'On farm'	Labour " " "
VIII	2	1	'On farm'	Labour " " "

The cut-off point for each short run average cost curve is where the permanent labour reaches maximum capacity. The period between mid-November and February 28th is the most active period with regard to mowing and pest spraying whilst summer pruning must also be carried out at this time as well. This limits one labour unit to approximately 7 acres of vines.

5.3.2.2 Discussion

Fig 5.11 shows the long run average cost curves for these Farm sizes for yields of 90 lb per vine, 120 lb per vine, and 150 lb per vine. The curves are scalloped in form because of the assumption that no casual labour is available for pruning operations, consequently when extra labour is required, a permanent labour unit must be added, which causes the average cost per ton of fruit picked to rise immediately, and which only slowly falls as the extra permanent labour unit is increasingly utilised.

Fig 5.11 cost curves show that it is important to fully utilise permanent labour units and that the average total cost per ton is highly sensitive to variation in yield. The one man farm operating at maximum capacity shows a $75.00 difference in Ac/Ton[*] picked between the high yield condition (150 lb /vine) and the low yield condition (90lb /vine).

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[*] Average cost per ton

Fig 5.11 Long Run Average Cost Curves when hired pruning labour is unavailable.

150lb per vine   120lb per vine   90lb per vine

Average
Total
Cost ($)
per Ton
of Fruit
Produced

Acres of Kiwi Fruit Vines
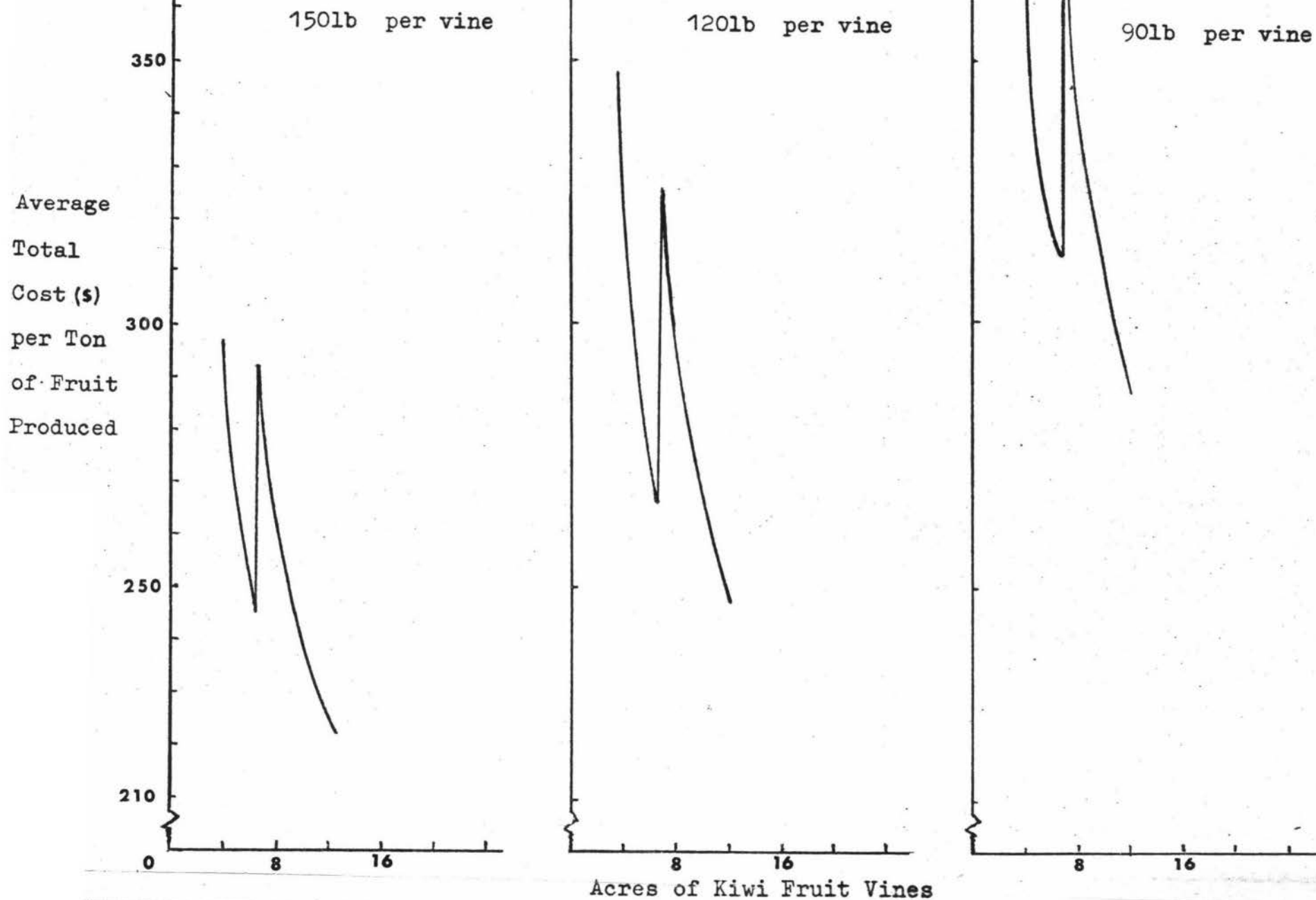
There is approximately the same variation for the two man farm operating
at maximum capacity, $65 difference between 90lbs/vine and 150lbs/vine.

TABLE 5.10

Average costs ($) per ton of fruit produced for selected acreages

Yield lb /vine	Acreage of Vines	2	4	6	8	10	12
90		682.6	416.4	327.7	362.9	320.4	292.1
120		546.7	343.1	275.1	302.1	269.62	248.15
150		453.35	295.3	242.9	262.58	237.11	221.09

5.3.2.3 Conclusion

When casual labour is unavailable the average cost
per ton of fruit produced will be relatively high unless a
farm uses its available permanent labour to maximum capacity. At
current prices, however, profitability is not seriously affected by
significant labour under utilization above 10 acres of vines except
in the low yield condition.

5.3.3 An Estimation of the Effect on Cost-Size Relationships with Inclusion of Mechanical Pruning.

5.3.3.1 Introduction

At the present time almost all pruning is done manually and
therefore requiring a large labour input per acre of vines during
specific periods of the year. Winter pruning must be completed within
approximately 2½ months (mid June - 24th August) whilst each vine requires
pruning approximately three times between mid-November and 28th February.
Discussions with growers showed that pruning is one of the most crucial
operations performed during the year and if incorrectly carried out,
depressed yields   resulted. The possibility of non-selective
mechanical pruning was not even considered by the vast majority of

growers, however one grower in Kerikeri interviewed by the author claimed to have considerable success with mechanical pruning. His vines were approximately 25 years old, very big and were hopelessly out of control when he acquired them. After initially cutting back the vines with a chainsaw he now has them non-selectively pruned with a hedgecutter once per year. These vines each produce approximately 600lb of fruit annually which is mainly due to the vine size, but it still appears that mechanical pruning was not a great yield depressant.

Mechanical pruning of vines would simplify the management of Kiwi Fruit farms, especially those with large acreages in the Bay of Plenty because it would no longer be necessary to employ and oversee a semi-skilled seasonal labour force which is likely to become a restricting resource as an increasing number of farmers compete for it.

Assuming that mechanical pruning is a gross revenue depressant per acre of vines, either by decreasing yield per vine or decreasing the percentage of export grade fruit per vine, or both, then it is only a feasible alternative if the decreased revenue is more than compensated by the decreased pruning cost. The feasibility of this alternative is investigated with the use of several average cost curves derived from a hypothetical situation.

5.3.2.2 Key Assumptions

Yields of 30lb, 60lb and 90lb of fruit per vine are used. Assume that 70% of the fruit produced (picked) is export grade, and that there are 260 export trays per ton of export grade fruit. Fixed resources are one permanent labour unit and the standard equipment combination, and the marketing costs is the same as that of Farm Sizes I and III (see page 75). In this situation the farmer employs no labour for pruning. Pruning cost per unit of vines is $344 per year when the farmer employs labour to carry out this operation. For mechanical pruning $196[6] per year is assumed cost per unit.

The limit of vine acreage is still governed by the tractor capacity during harvesting for the 90 lb/vine yield but with the lower yields of 30lb and 60lb, the tractor capacity during December and January required for mowing, pest and weed spraying becomes the first limiting fixed resource.

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6. See Appendix A2 for estimation method.

Fig. 5.12   Average Cost Curves for Farm size I when Mechanical
            Pruning is adopted.The average cost curve for this
            Farm size operating with manual pruning is shown
            for comparison.

Average
Total
Cost $
per Ton
of Fruit
Produced

30lb/vine mech. prun.

60lb/vine mech. prun.

90lb/vine man. prun.

90lb/vine mech. prun.

Acres of Kiwi Fruit Vines
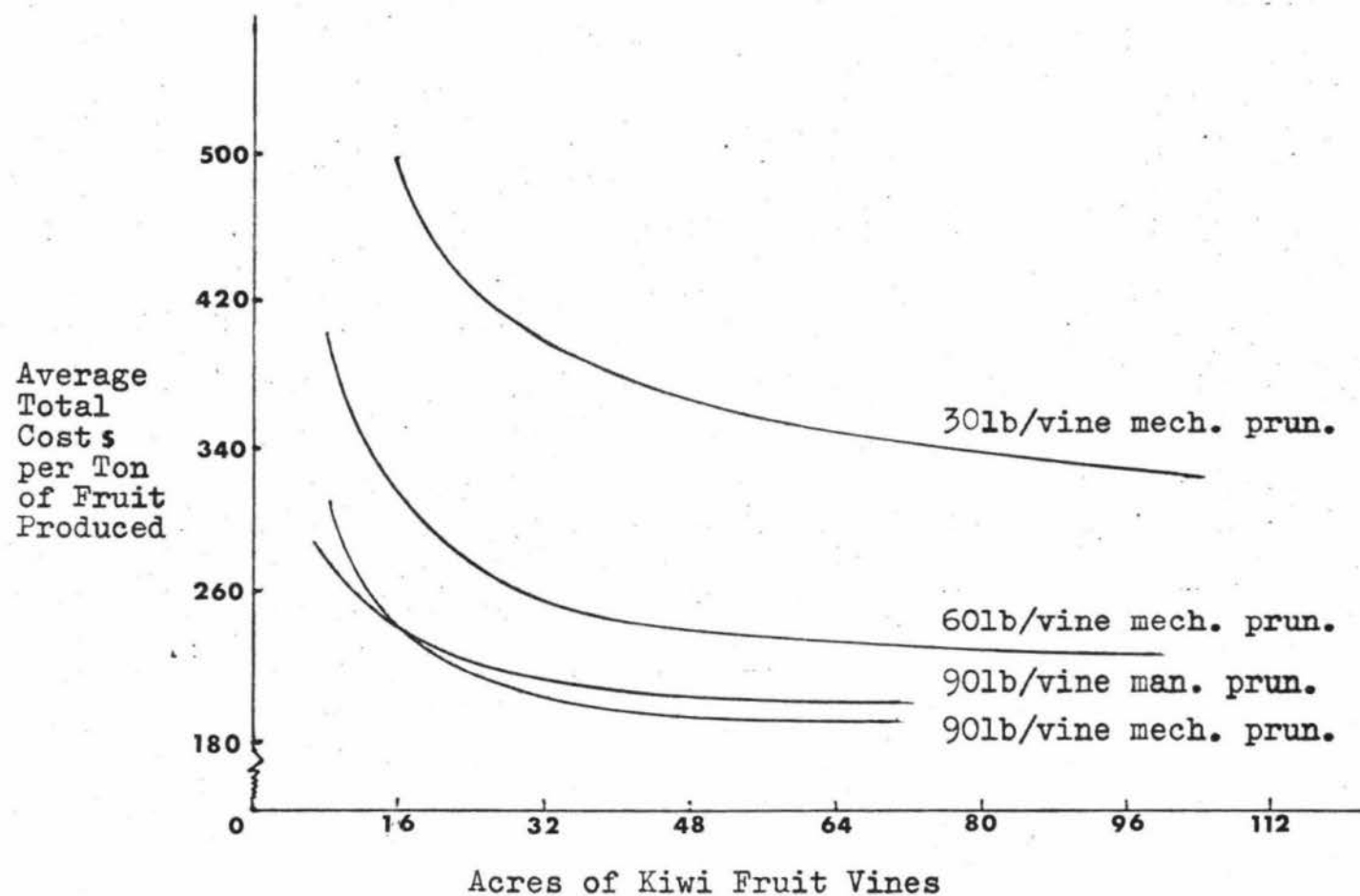
TABLE 5.11

Limiting resources at the three selected yields

Yield (lb/vine)	Maximum number of Acres	Limiting Fixed Resource	
90	66	Tractor at harvesting	
60	100	Tractor during	Jan
30	100	Tractor during	Jan

TABLE 5.12

Average costs ($) for selected vine acreages and
selected yields

Yield lb/vine	Acres of Vines	8	20	30
90		315	226	195
60		402	303	260
30		696	454	405

TABLE 5.13

Breakeven acreages

Yield lb/vine	Farm price $/ton	463	375	304
90		<4	4.3	8.5
60		6	9.2	16
30		18.8	44	Never

5.3.3.3   Discussion

From Tables 5.12 and 5.13 it is evident that yield is the critical
parameter.   If 90 lb/vine could be obtained with this method then
mechanical pruning could be a feasible concept.   However, current
opinion concerning mechanical pruning is that this yield would be hard
to achieve.   A yield of 60lb per vine would still enable a 30 acre
farm to operate economically, but the 30lb/vine yield would not achieve
of a profit for even the largest farm at the low price level.

5.3.4 A comparison of Contract Helicopter Spraying for Pest
Control and the Owner-Operator Carrying out the Pest
Control with his own Blast Sprayer Unit.

5.3.4.1 Introduction

The widespread uses of contract[7] spraying by a helicopter was
suggested as a more efficient method for the industry as a whole and
for most farmers individually, compared to the typical owner-operated
blast sprayer operation. This section investigates this suggestion.

5.3.4.2 Key Assumptions

Pesticide costs which are common to both methods have been
excluded.

Method 1. Blast sprayer, owner-operated application
Cost per unit of vines per application ($)

Labour	1.3
Tractor	3.605
Sprayer	.551
	5.456

Assume five applications per year

Variable cost per unit per year	$27.28

Fixed cost per year (Blast Sprayer only)

Interest	155.4
Depreciation	241.42
Insurance	6.6
Total Fixed Cost per year	403.48

Method 2. Helicopter pesticide application $ per year
Quoted[8] at between $12/unit of vines per
application   60.00
and $10/unit of vines per application   50.00

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7. The author was unaware of any contract blast spraying services
being available in the Bay of Plenty at the time.

8. These quotes were given on the basis that a helicopter had at
least 100 acres of vines to spray at one time. If a farmer
hired a helicopter to spray a small acreage, the rate would pre-
sumably be considerably higher.

Fig 5.13   Comparison of Helicopter Pest
Spraying and Owner-Operator
Blast Spraying

Helicopter
$6 /acre   application

Helicopter
$5 /acre
per application

Owner-Operator
Blast Sprayer

Cost* $
Per
Year
Per
Farm

Acres of Kiwi Fruit Vines
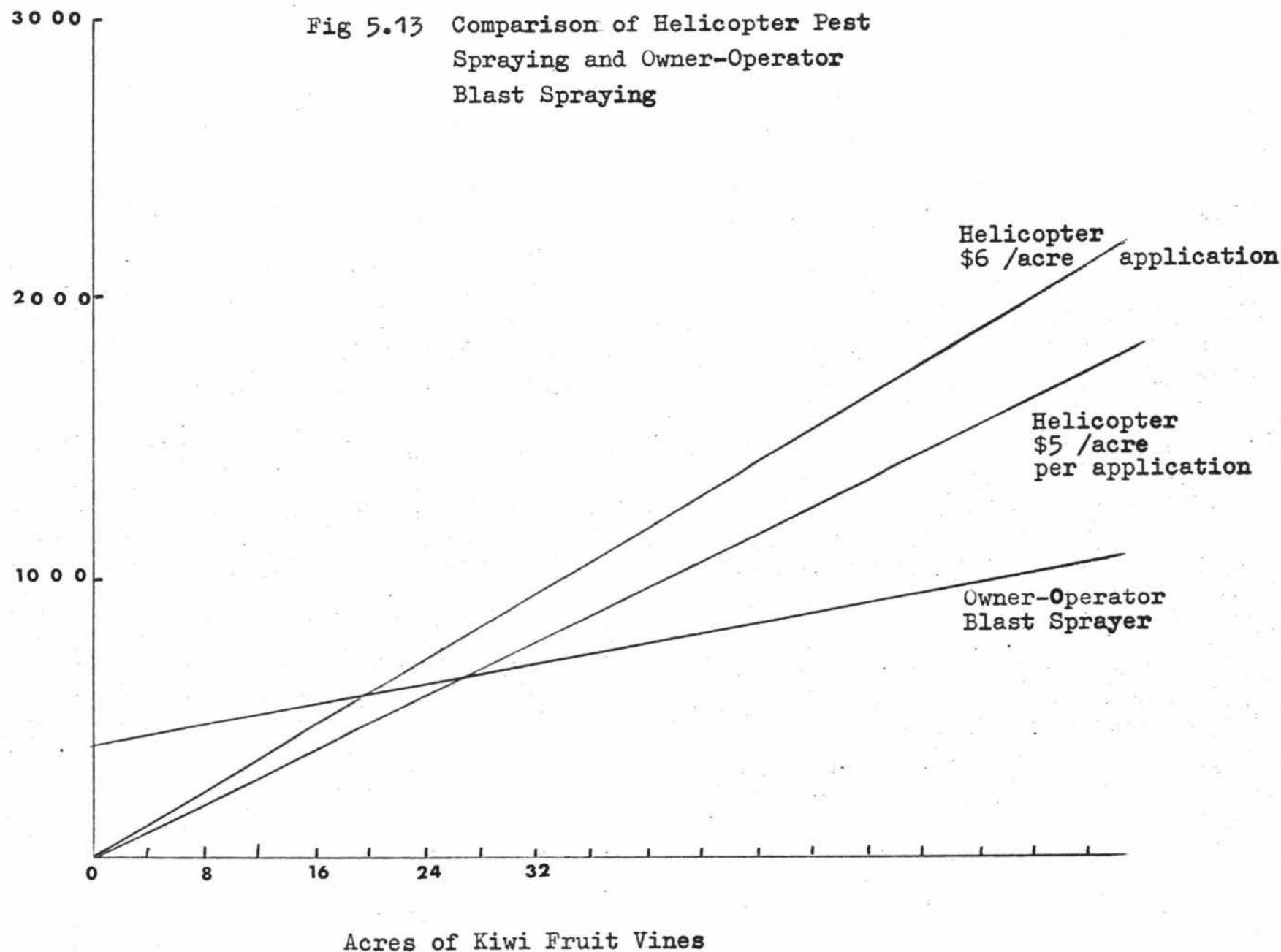
* Costs common to both methods are excluded.

5.3.4.3   Discussion and Conclusions

At $6 per acre per application the helicopter method is cheaper
up to approximately 20 acres of vines compared with the owner-operator
blast sprayer method.   At $5 per acre per application by helicopter
it is cheaper up to approximately 26 acres of vines compared with
grower owned blast sprayer method.   Therefore it appears that for the
vast majority of farmers it would be much cheaper to hire a helicopter
for pest spraying than to own and operate their own blast sprayer.
Spraying is considered a messy, unpleasant task by most growers so
that even if helicopter spraying does result in slightly higher costs
it would still appear highly attractive.   Even though helicopter
spraying is more expensive for farms with more than 26 acres the
increased cost is not large compared with the expected Farm profits
and would still be well worth considering, e.g. a 50 acre farm would
incur approximately $500 extra costs for the $6 per acre helicopter rate
and approximately $350 extra at the $5 per acre rate.

5.4   Summary and Conclusions of Chapter 5.

Investigation of cost-size and profit size relationships were
carried out using economic engineering models.
Cost curves were derived for several likely resource combinations.
Because of the current high prices for export fruit, efficiency on
the farm is not crucial from the farmers' point of view at the present
time and even very small orchards would be economically viable.   The
analysis showed, however, that there are significant cost reductions
possible up to about 20 acres of vines for all combinations of fixed
resources used.   Average cost per ton of fruit marketed was more sens-
itive to yield per vine than to the degree of utilisation of the set
of fixed resources and this was more pronounced at low utilisation.
Differences in average cost per ton of fruit picked, between farm sizes
for any given yield were more pronounced at low acreages.   Profits
seem to be quite sensitive to yield, acreage, percentage of export
grade fruit and fruit prices.   A farmer with a small acreage but high
yield and percentage export grade could do just as well as one with a
large acreage and low yield.   A low fixed cost is an obvious start for
ensuring a profitable enterprise and this would mean having as small a

fixed plant as possible, e.g. one permanent labour unit, plus the standard equipment combination. This could be reduced even further by employing a helicopter to pest spray therefore dispensing with the need for a blast sprayer. Ownership of a large set of fixed resources (e.g. Farm size IV) can be rationalised by a risk aversion policy and the position of high flexibility, i.e. a farmer can choose his own time for any specified operation to fit each season's particular requirements. Because of the seasonal nature of the labour requirements of the crop it does appear unnecessary for more than one permanent labour unit to be on a Chinese Gooseberry farm. Two permanent labour units could be justified once the farm size and acreage is large, and even though there is an excess labour capacity for the greater part of the year, the farm management may be possibly more efficient.

Concluding Remarks (J.F.E. p 753 1970 Vol. 52)

"Factors such as uncertainty, managerial ability and the tax structure may be more important in determining whether or not a farm operator should increase the size of his farming operation than economies of size. Increased farm sizes may be due to the attraction of increased net incomes and completely independant of changes in unit costs."

CHAPTER VI

MARKETING OF KIWI FRUIT

6.1. Introduction

In this chapter the marketing process of Kiwi Fruit is outlined and with the aid of an economies of size analysis some solutions are suggested to the following questions:-

1. Is there a need to assemble export fruit at central points for packing, grading and inspection?

2. Is there a need to have an authority to co-ordinate consignments by exporters or should a marketing board be set up for wider purposes?

6.2 The Kiwi Fruit Marketing Process

6.2.1 A Definition of Agricultural Marketing (Kohls (18))

"Marketing is considered to be the performance of all business activities involved in the flow of goods and services from the point of initial agricultural production until they are in the hands of the ultimate consumer."

The marketing process can be divided into two distinct parts, one part constituting exchange activities (buying, selling and title transferring activities) which co-ordinate the series of events in the marketing process. The other part constituting the physical handling of goods, (transportation, packing, grading and storage) in the series of exchange activities.

6.2.2 Marketing Structure of the Kiwi Fruit Industry.

The Kiwi Fruit industry is based almost entirely on the sale of fresh fruit in New Zealand and overseas. The fruit is of a perishable nature and subject to wide variations in size and shape, both between fruit varieties and within fruit varieties, consequently the fruit must be graded, packed in protective containers and then stored within a given

temperature   range.[1]   It travels by several different exchange pathways and physical handling pathways depending on the ultimate consumer location and the form in which the fruit is sold (loose pack, pre-packed, canned etc.).

6.2.2.1   Exchange Pathways

(a)   Local Market Fruit

Approximately one third of the total New Zealand production is exported at present, most of the remaining two thirds being sold on the New Zealand market, and the balance being processed.   Fruit sold on the New Zealand market is usually sent by the grower to a fruit auction where retailers effect purchase.   The grower sometimes sells direct to the consumer (gate sale) or he may have a forward contract with a retail outlet, consequently by-passing the auction system.

(b)   Export Fruit

Export fruit is involved in a greater number of transfer activities compared with local market fruit.   The current trend is for the exporter to purchase the fruit at the farm gate subsequent to the packing and grading operation, though some exporters act only as agents. The exporters either have a forward sale contract with an overseas wholesaler, or the overseas wholesaler acts as an agent.   The overseas wholesaler sells either by auction or forward sale contracts, to the retail outlets, usually large supermarkets.

(c)   Discussion and Some Problems

(i)   Until recently no more than a handful of orchardists produced Kiwi Fruit exclusively.   Kiwi Fruit were usually one of several crops being produced on any one orchard.   Due to the relatively small quantities produced by individual Kiwi Fruit orchardists, New Zealand exporters are forced to aggregate many small purchases from different orchards so that an overseas consignment for a specific variety and grade can be filled.   However, with the increasing number of specialised Kiwi Fruit farms this will occur less often in the future.

(ii)   Many of the smaller orchardists prefer to sell all their fruit on the New Zealand market because of the extra capital outlay and effort required for grading and packing export fruit.   It follows that if suitable facilities (centralized) were available to them a large

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1.   See (17)

Fig 6.1
Marketing exchange pathways of Kiwi Fruit.
Thickness of arrows indicates approximate proportion of total
New Zealand production moving by that pathway in 1971.
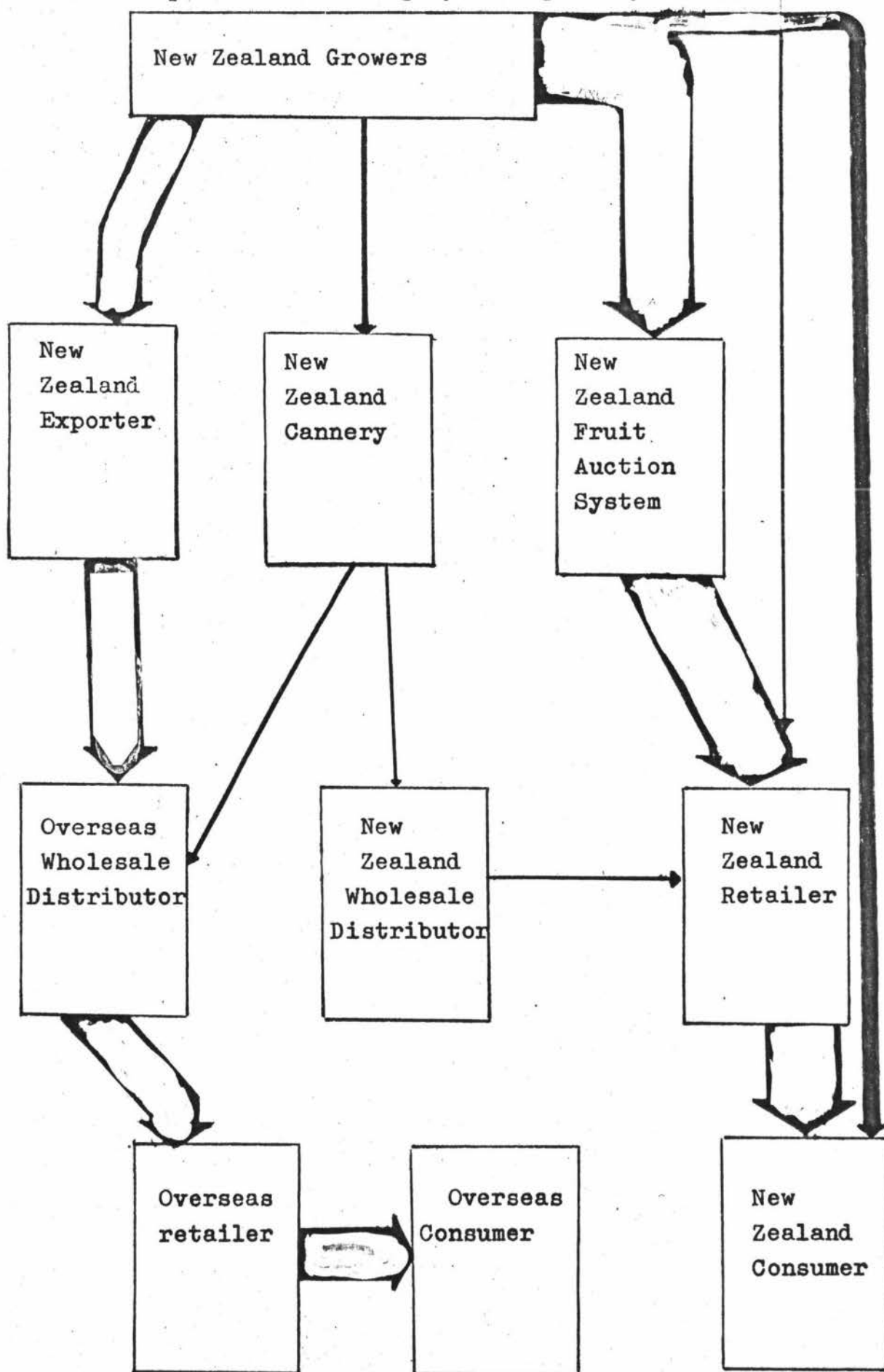
untapped source of export quality fruit may be secured.

(iii) One exporter who has shown considerable energy and skill in promoting and selling Kiwi Fruit considers that the fruit should be sold by forward contracts only[2], since he regards the auction system as a channel for non-luxury surplus fruit, an image which is being vigorously resisted by the Industry.

(iv) Although the exporting of this fruit is formally unregulated, care is in fact being taken by the current exporters not to oversupply any region with fruit in order to keep prices buoyant and to avoid clashes between overseas wholesalers.

(v) Working capital is a problem for the export sector of the industry at present, and producers have tended to sell to the exporter who offers the quickest payment arrangements. However, these exporters are not necessarily the best middleman from the industries point of view because they are well established conservatives who favour the auction system.

<div align="center">6.2.2.2   Physical Handling of the Fruit</div>

The fruit is normally picked into bags suspended around a picker's waist; these bags being emptied into conveniently placed bins or 40lb boxes. It is then transported to a packing and grading installation. Packing and grading facilities vary from one man manual arrangements usually found on small multi-fruit orchards to packing houses fully equipped with an orbit grader and auxillary equipment[3] operated by large orchards producing exclusively Kiwi Fruit.

Fruit destined for export (see Fig 6.2) is packed in single layer wooden trays weighing approximately 1.5lb which are lined with strawboards and polythene. These trays hold between 28 and 55 fruit[4] weighing approximately between $7\frac{1}{2}$ and $8\frac{1}{2}$ lbs in total, therefore constituting a total package weight of approximately 10lbs. The strawboards and polythene packing materials are used to ensure that the fruit is suitably protected and presented. After the tray lids are nailed on the trays are wired up into groups of three known as a tie, and transferred to a cool store as soon as possible. From this point

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2. See decentralization possibilities (Page 116)

3. See Installation PI Description for typical combination.

4. The fruit is normally graded according to weight (orbit grader technique) and this method tends to group the fruit according to volume and shape as well.
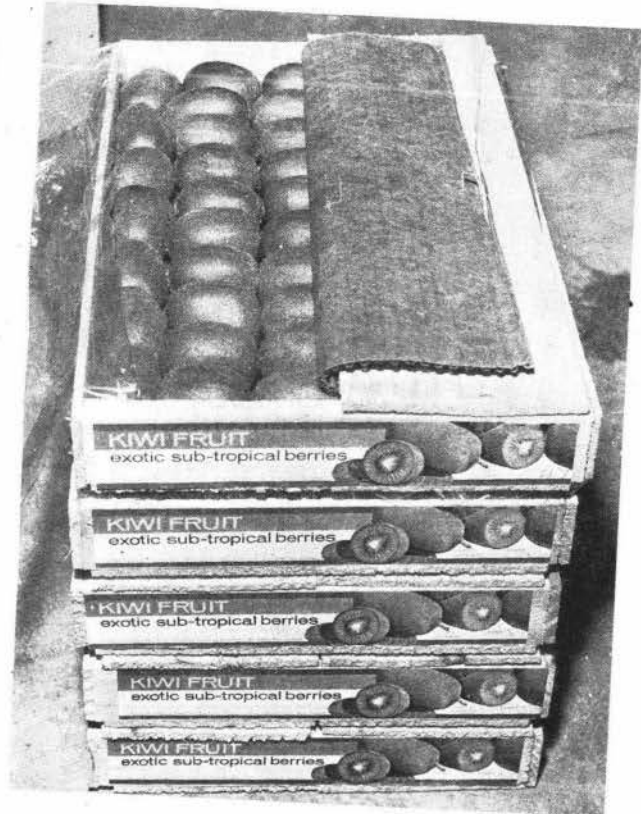
Fig 6.2

Trays packed for Export, showing packed trays before lidding
(left) and packed trays with corrugated strawboard with
partlid (right).

Fig 6.3

A view of a
typical On Farm
packing and grading
shed of a specialised
Kiwi Fruit farm.
Woman on left is
packing graded
fruit into an
export tray.
Women on right
are removing
irregular, blemished and
damaged fruit before it
goes into the orbit
grader.

in time until it is sold to a retail outlet the export fruit must remain in cool storage to prevent ripening and deterioration.

Fruit destined for the New Zealand market is packed into 10lb, 20lb or 40lb wooden boxes with less attention being paid to uniformity of size, shape and quality. Fruit not destined for immediate consumption must be cool stored in the same way as export fruit.

Export fruit must be cool stored during transportation unless immediate retail sale is planned. A small percentage of fruit is transported overseas by air at the beginning of the season, the rest travelling by refrigerated ship. Refrigerated road and rail transport is the usual method of land transport.

Fruit destined for immediate New Zealand consumption is transported by non-refrigerated road and rail when en route to auctions, retailers and consumers. Currently there is a tendency in New Zealand for fruit to be repacked for retail outlets, especially for super markets.

a. Typical Sequences of Physical Handling During the Marketing Process of Kiwi Fruit.

Any particular series of physical handling activities that a consignment of fruit goes through is determined by the pack it is intended to be sold in, the location of the ultimate consumer and the point in time when retail sale is planned.

(i) A Typical Sequence of Physical Activities for Fruit Destined for the Export Market.

1. Transported to packing and grading installation in a bin or box immediately after picking.

2. Graded and packed.

3. Transferred to a cool store by conveyor belt, truck or forklift depending on the location of the cool store in relation to the packing and grading installation.

4. Cool-stored.

5. Transferred to a refrigerated truck and transported to wharf.

6. Transferred to cool store in ship.

7. Transported by ship to overseas port.

8. Transferred from ships hold to refrigerated truck.

9. Transported from wharf to wholesalers cool store by refrigerated truck.

10. Transferred to auction floor.

11. Transported by non-refrigerated transport to retail store.

(ii)   A Typical Sequence of Physical Handling of Fruit
       Destined for the New Zealand Market.

1.   Transported to packing and grading installation after packaging.
2.   Graded and packed.
3.   Held in cool store.
4.   Transported to auction centre in New Zealand by non-refrigerated
     transport.
5.   Transported to retailers shop.

6.2.3   Possible Future Changes and Innovations in
           the Marketing of Kiwi Fruit.

6.2.3.2   Increasing Decentralisation

Moore (22) indicates that the major changes through time in the
organisation of marketing activities for fresh fruit and vegetables are:

          a.   Increased direct buying
          b.   Increased vertical integration
          c.   Fewer and larger plants and firms
          d.   Product improvement

Kohls (18) states, "The major structural change that has occurred
in food marketing since the 1920's has been in the direction of decent-
ralisation", i.e. direct buying has been increasing for nearly every
food product.   (Referring specifically to the U.S.A.).

Kohls lists factors which encourage and discourage decentralisation:

Basic Factors Favouring Development of Centralized Point	Changes in These Factors Over Time That Encourage Decentralization
1. Limited transport facilities with major dependence upon the railroad. This resulted in the limitation of advantageous points for product concentration.	1. Development of the truck and highway system. This has vastly increased the flexibility of assembling products.
2. Poor communication facilities. This meant that buyers and sellers had to physically assemble, establish price, and transfer title.	2. Continuous improvement in the speed and flexibility of communications. A seller in California and a buyer in New York can now talk quickly and cheaply without coming face to face.
3. High perishability and poor standardization of products. Physical inspections were necessary in order to ascertain just what was being purchased.	3. Improved techniques of refrigeration and storage along with much improved grading procedures. The feasibility of the transfer of products by sample or description has increased.
4. Production units small and unspecialized. The cost to buyers purchasing small lots from production points was high.	4. Rapid development of fewer but larger and more specialized production units. The output of individual farms now may be a feasible purchase unit.
5. Great variation in consumer preferences from area to area and the multitudinous, small retail units. This prohibited mass, uniform servicing by large-scale distributors.	5. Development of large-scale retailing with mass-standardized products. New potentialities of mass production and economies of scale are possible.

At present the bulk of the local market fruit moves through centralized channels, and the export fruit moves through partially decentralized channels.

Characteristics of Local Market Fruit	Characteristics of Export Fruit
1. Major dependence on rail transport	1. Main transport on land is by refrigerated truck
2. Poor standardization	2. Good standardization
3. Not rapidly perishable	3. Not rapidly perishable
4. Many of the producers small and unspecialized	4. Good techniques of refrigeration
5. Large proportion of retail outlets are small	5. Recent entry of many larger specialized producers
	6. Retail outlets tend to be supermarkets and retail chains.

The listed characteristics of local and export fruit shows that export fruit lends itself more to increasing decentralization than does the local market fruit.

Decentralization of marketing channels for export fruit may occur in the following ways:

a. Overseas wholesale distributors (especially in the U.S.A.) may be tempted, when the quantity they purchase becomes large enough to bypass the New Zealand exporter, and employ their own purchasing agents in New Zealand.

b. Overseas wholesale distributors may acquire the smaller New Zealand exporters, therefore retaining the same buying organization as before, but with increased profits and control.

c. The producers, by forming a marketing co-operative, may bypass the New Zealand exporter and deal directly with the overseas wholesaler, (or even overseas retail chains).

d. New Zealand exporters may bypass the overseas wholesale distributors and deal directly with retail organisations.

6.1.3.2 Containerization[5] of Export Fruit

(a) This could have an effect on the efficiency of the physical hand-
ling activities of Kiwi Fruit from the time the fruit is packed until
it is purchased by a consumer.

Fig 6.5

1. Physical Handling sequence when refrigerated container used.

Packed
and   (T) [RU] [UT> [RU] (U) [S> (U) [UT> (T) [RS] (T) [L> (T)   Bought by
Graded   Consumer

2. Typical physical handling sequence currently used.

Packed
and   (T) [RS] (T) [RT> (T) [RS] (T) [FS> (T) [RT> (T) [RS] (T) [L> (T)   Bought by
Graded   Consumer

KEY

☐ Storage Activity

▷ Transport Activity

◯ Handling Activity

T   Tie handled
U   Container handled
RU Container used as Cool Store
RS Cool store used
UT Container transport
S   Ship transport
FS Refrigerated ship Transport
L   Non-Refrigerated Truck Transport
RT Refrigerated Truck Transport

5. Assuming International Standards Organization container specification

(b)　Potential advantages from the use of refrigerated
　　　containers for export Kiwi Fruit

(i)　Less handling of the ties resulting in:
　　　1　Less physical damage to cases and fruit
　　　2　Less pilferage
　　　3　Possible lower handling costs.

(ii)　Fruit has longer uninterrupted stay in cool storage, with
consequent longer storage life.

(iii)　Fruit flow less limited by cool storage space, in New Zealand,
on ships and at ports of destination.　Would enhance timeliness of
arrival at overseas markets.

(iv)　Reduce the need of cool storage investment in New Zealand, which
may not be used at full capacity for more than a few months of the year.

(v)　Individual farmers with their own packing and grading installations
would not need to invest in a cool store.

(vi)　New Zealand industry could manufacture the containers, thereby
earning overseas exchange for both the container and its contents.

6.2.3.3　Packaging Innovations for Export Fruit

The wooden tray that the fruit is exported in is rather an unusual
method of packaging today.　Most other fruits sold in the same markets
are packed in material other than wood because:

a　Wood is expensive

b　Wood is relatively heavy and bulky compared with cardboard

However, many of those involved in the export market consider that
this wooden tray is one of the fruits unique selling features.　The
wooden trays also provide very good physical protection for the fruit,
and they withstand cool storage and permit rapid cooling of the fruit
when placed in cool storage.

Increasing transport charges however, are prompting research and
development into the production of a container that has adequate strength and
can withstand cool storage, but is less bulky and heavy.　So far it has
been found that a different package is not likely to be any cheaper than
the wooden tray.　Two types of material already tried are polystyrene
and water proofed cardboard.　The polystyrene was found to prevent

rapid cooling of the fruit, but the treated cardboard has given promising results in some storage tests.[6]

6.3   The Choice of Packing and Grading Facilities for
        Recent Industry Entrants who intend to Enter the Export Market

6.3.1   The Problem.

During the first three years of development on a Kiwi Fruit orchard, production is non-existent or negligible and in the 4th year total costs would still usually surpass gross revenue.   Significant production usually starts in the fifth year after planting the vines, and it is at this stage that packing, grading and storage facilities must be available.   The usual options available to the farmer in the past have been;

(a)   Hiring excess capacity of another grower's existing facilities

(b)   Installation of his own packing, grading and storage facilities.

The rapidly expanding acreage in the Bay of Plenty has ruled out option (a) for most new growers because only a small number will be able to hire the excess capacity of existing facilities.   Option (b) requires a capital investment[7] of approximately $14,000 per 160 tons of fruit produced per season and may extend many farmers beyond their borrowing ability.   A reluctance to invest by those farmers who were were able to was also apparent from field interviews.   With option (a) available to very few recent industry entrants and option (b) appearing expensive, the introduction of large centralized packing and grading installations has been suggested as a cheap escape route from this current marketing dilemma.

Centralized packing, grading and storage facilities implies a much larger total throughput of fruit per installation than the current typical 'on farm' packhouses.   The suitability of centralised packing, grading and storage is basically a question of whether net economies

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6.   Personal communication with Exporters and container manufacturers.
7.   See Section 6.5.1 for estimates.

of size exist in this operation. In this situation both internal and external economies and diseconomies must be taken into consideration.

6.3.2 Potential Advantages or Economies of size from Centralized or Co-operative Facilities are:

(a) Easier access to Government finance and associated pecuniary economies.
(b) Increased equipment utilization
(c) Better labour utilization
(d) Easier fruit inspection by Government Officers
(e) Improved uniformity of packing and grading standards
(f) Improved day to day data on fruit movements, grade percentages, estimated percentage of crops picked, percentage of crops packed facilitating better overall planning of industry resource requirements (labour, packing, materials, transport).
(g) Lower costs by bulk purchasing of packing materials
(h) Assembly and distribution economies

6.3.3 Possible Disadvantages from Centralized Packing and Grading Facilities.

(a) Lower utilization of a large, specialised investment.
(b) Management difficulties.
(c) Greater vulnerability to labour problems.
(d) Larger management input required.
(e) Obsolescence of some growers equipment used at present.
(f) Lower recovery of export grade fruit from any given crop of Kiwi Fruit.
(g) Assembly and distribution diseconomies.

Resources were not available for the author to investigate many of the factors and many other factors cannot be measured. Those factors that could be measured objectively have been incorporated in an economies of size[8] analysis and those that have not been included are discussed later with special reference to the derived short run and long run average cost curves.

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8. See Page 50 for Theory of Economies of size.

6.4   Economies of Size of Kiwi Fruit Packing and Grading
       Installations

   6.4.1   Introduction.

Four alternative Kiwi Fruit packing and grading installations[9]
are used as the basis for investigating economies of size.   The
economic engineering method is used to derive a short run average
cost curve for each installation and from these a long run average
cost curve is derived.   Packing and grading installation PI is a
typical owner-operator arrangement found on many of the larger Kiwi
Fruit orchards in the Bay of Plenty, but Installations PII, PIII, and
PIV are only hypothetical at this stage, therefore the subsequent
costs should be interpretted as comparative rather than absolute.

   6.4.2   Derivation of Average Cost Curves for Chinese
           Gooseberry Packing and Grading Installations.

       6.4.2.1   Fixed Resources

Four alternative packing shed arrangements are considered,[10]
(i.e. Four combinations of fixed resources are used).
a.   Installation Size PI:
     'On farm' packhouse plus one orbit grader and auxillary equipment
b.   Installation Size PII:
     'Off farm' packhouse plus four orbit graders and auxillary equipment
c.   Installation Size PIII:
     'Off farm' packhouse plus one four-lane F.M.C. grader plus auxillary
     equipment
d.   Installation Size PIV:
     'Off farm' packhouse plus one eight-lane F.M.C. grader plus auxillary
     equipment.

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9.   The four installations were selected after the author observed
     many of the current packing and grading facilities in the Bay of
     Plenty, and obtained data on proposed installations from Hancock
     (Engineer who manufactures orbit grading machines).

10. See Appendix for details of Key assumptions.

TABLE 6.1   Key data[#] for each Installation

Installation	Initial Cost $	Fixed Cost/Year $	Maximum Thruput (40 days) Tons (Long)	Investment Per Ton at Max.Thruput $	Rating[*] A.B.U./hour
PI	14,460	1544.52	159	82.628	50
PII	71,900	8257.21	637.5	112.872	200
PIII	81,400	9743.38	637.5	127.786	200
PIV	125,300	15185.28	1275.0	98.351	400

[*] = Average Bushel Unit is taken to be one bushel of average or medium apples.
The rating shown must be adjusted by a constant .595 to obtain rate of throughput
for Chinese Gooseberries.

Data source; personal interviews and Hancock.

Fig 6.6 Diagramatic representation of the grading and packing operation and relative positions of the grader and auxillary equipment. The arrows indicate the direction of fruit flow and material flow.

Each installation consists of a building, specific equipment, and land. Associated with each installation is a certain fixed cost per year, (Depreciation, interest etc.). The maximum capacity of each installation is defined as the maximum number of tons of Kiwi Fruit an installation can pack and grade in 40 days operation, assuming 7.5 hours operation per day. Since the _rate_ of throughput of each installation is fixed, the only avenue for increasing the maximum capacity is by varying the _time_ of operation per day and/or the number of days of operation.

6.4.2.2 Cost Classification for Derivation of Short Run Average Cost Curves

These average cost curves are actually marketing cost curves, since their components are defined in section 4.3.4 as constituting the marketing cost which in turn is a component of the harvest variable costs. In order to derive short run average cost curves for the four specified packing and grading installations, costs have been classified into fixed and variable.

a. Fixed Costs:

These are costs that are incurred by each installation regardless of the extent of utilization (i.e. throughput of fruit).

Included as Fixed Costs:

Interest on Capital Investment

Depreciation of Capital Investment

Repairs and Maintenance[11]

Insurance

Rates

Accounting Charges[11]

Telephone[11]

Overdraft fee[11]

b. Variable Costs:

These costs are a function of the packing and grading installation throughput[12] of fruit.

Included as variable costs are:

Labour

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11. In practice these will tend to be a partial function of throughput.

12. Throughput   Quantity of fruit delivered to the packing and grading installation.

Packing Materials

Freight to installation or cool store

Cool Storage for one month

Power and fuel

6.4.2.3   Discussion on Variable Costs

Differences in variable costs between installations in this analysis
are due to the different labour inputs per ton.   Installation PIV has
the lowest labour input per ton, Installations PI and PII have the
highest labour inputs and Installation PIII lies between the two extremes.

For any specified installation, the variable cost per ton throughput
will vary according to the percentages of fruit in each grade.   The
higher the percentage of export fruit per ton of fruit picked the higher
the packing material cost incurred per ton of fruit[13].   Installation PI
is assumed to incur an extra cost if it operates longer than 30 days
(i.e. more than 120 tons of fruit delivered to it) because it is assumed
to be without a cool store and spatially separated from a cool store.
Since the time allowed for the picking operation is 30 days, and if more
than 120 tons is harvested, the extra, up to 159 tons must be cool stored
until packed and graded.   This situation requires transportation of the
ungraded fruit to and from a cool store, therefore, extra costs are
incurred for transportation and cool storage for each ton of throughput
beyond 120 tons.

13.   Assuming that the total labour employed in any installation
       does not alter with variations in the percentage of export
       fruit obtained from a particular line of fruit but that the
       labour distribution is altered.   e.g. with a lower percentage
       of export fruit, workers would be transferred from packing to
       the sorting table.

TABLE 6.3

Marketing Cost ($)Per Ton of Fruit Delivered to the Packing and Grading Installation at Selected Throughputs (Tons per Season)

Installation	Installation Thruput (Tons)	90% Export Grade	80% Export Grade	70% Export Grade	60% Export Grade	50% Export Grade
	159	118.5	114	109	105	100.8
PI	120	116.7	112.3	107.8	103.4	98.99
	80	123	118.7	114.2	109.8	105
	637	116.7	112.4	107.9	103.5	99.1
PII	450	112.18	117.8	113.3	108.9	104.4
	300	131.3	128.9	122.5	118.1	113.6
PIII	637	110.3	105.8	101.4	95.7	92.5
	450	116.6	112.2	108.7	103.34	98.9
	300	127.4	123.0	118.5	114.16	109.7
	1274	105.4	100.9	97.5	92.1	87.98
PIV	900	110.3	105.9	101.6	97.1	92.95
	600	118.8	114.3	109.9	105.48	101.37
	300	144.1	139.7	135.2	130.8	126.68
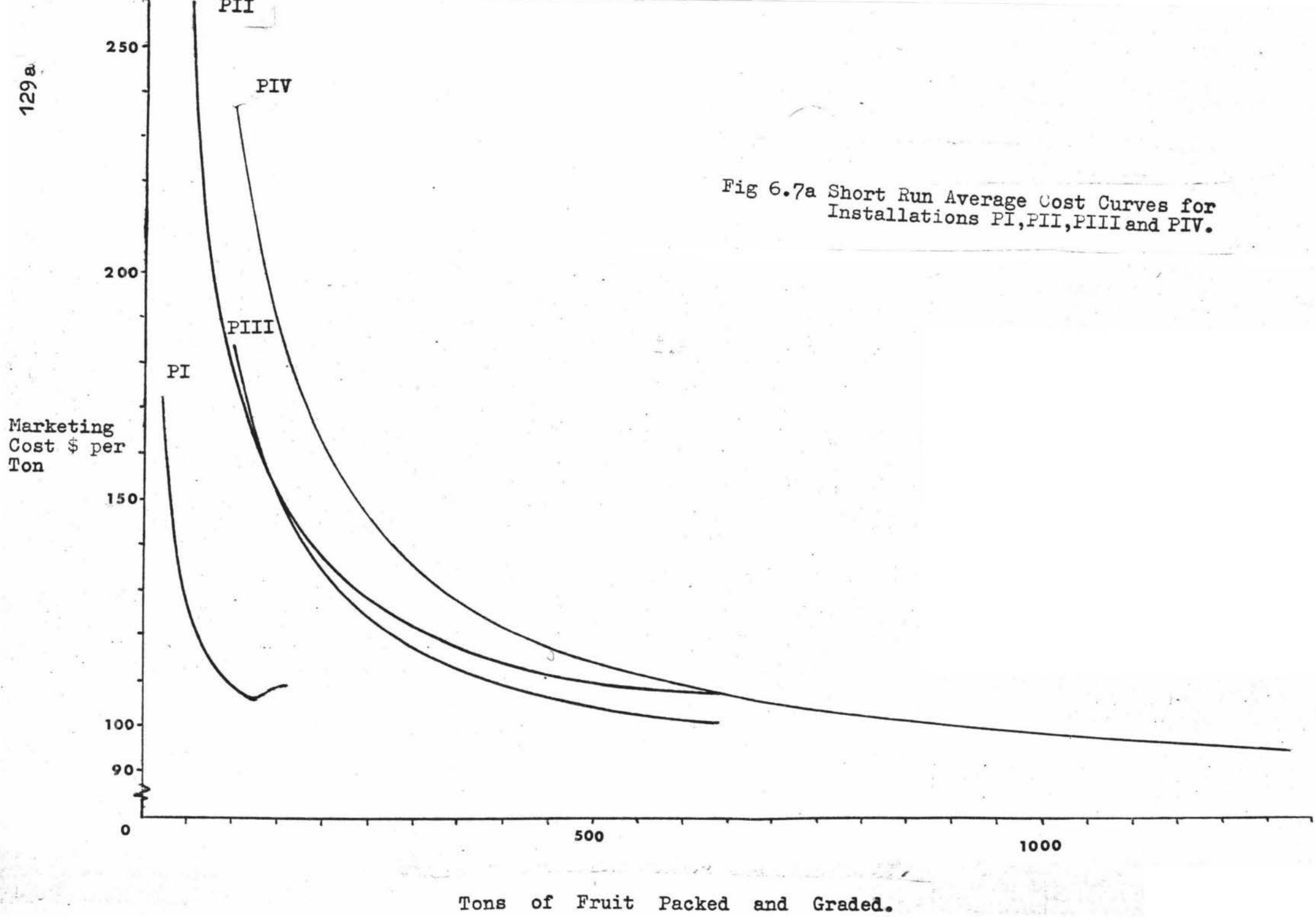
Fig 6.7a Short Run Average Cost Curves for Installations PI, PII, PIII and PIV.

Tons of Fruit Packed and Graded.

Fig 6.7b The Long Average Cost Curve derived from Fig 6.7a

Tons of Fruit Packed and Graded.
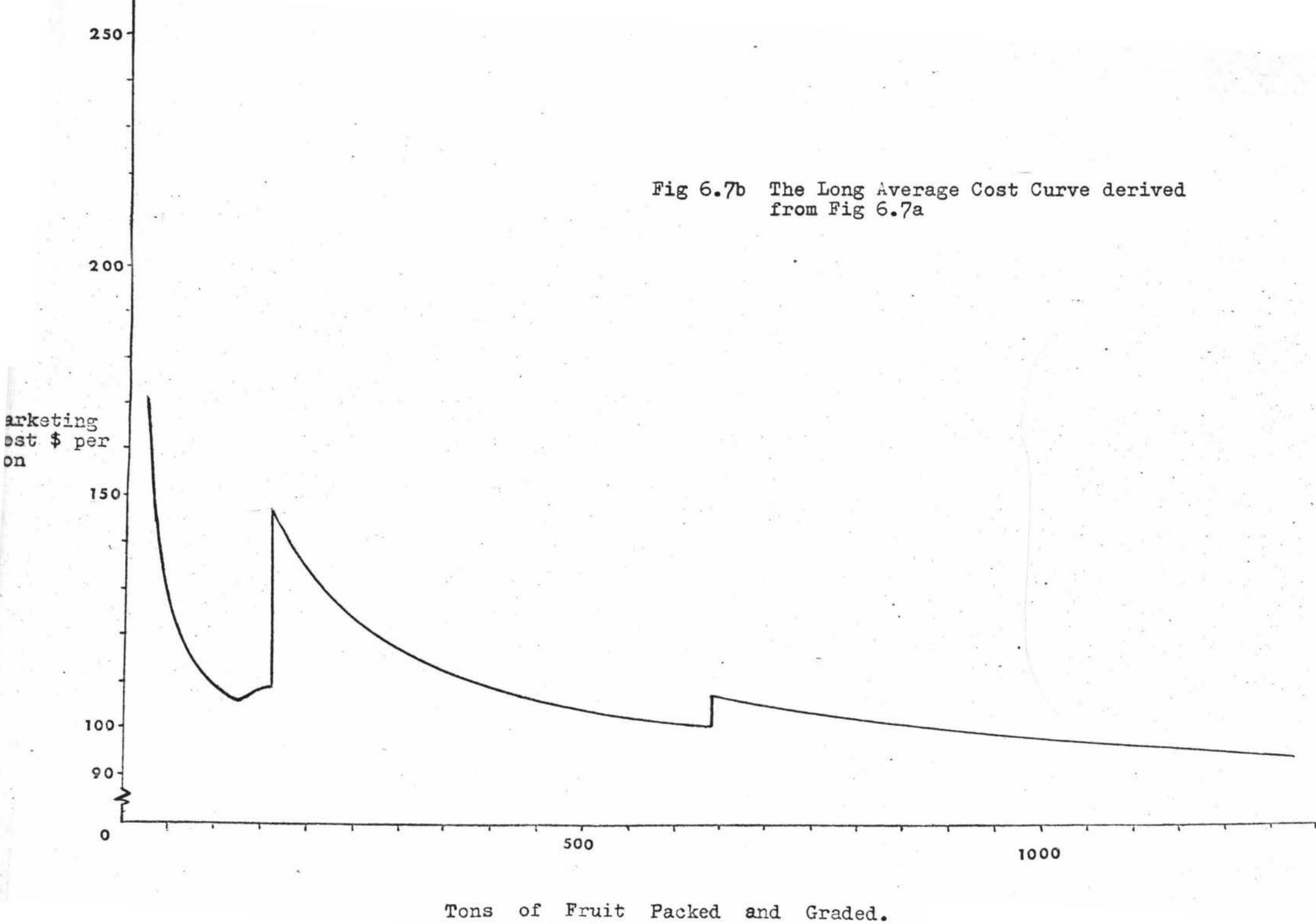
6.4.3   Discussion of Derived Average Cost Curves.

6.4.3.1   Discussion of Short Run and Long Run Average
Cost Curves

a.   Selection of Appropriate Installation

For any given crop between 0 and 1274 tons, the only four options
assumed available to the industry for packing and grading are the
Installations PI, PII, PIII or PIV.   Fig 6.7a shows the short run
average cost curves   A crucial assumption for the
derivation of the long run average cost curve in Fig 6.7b is that all
four installations obtained identical percentages of export grade
fruit from any given Kiwi Fruit crop.

Kiwi Fruit Crop Required to be Packed and Graded (tons)			Most Efficient Installation to Pack and Grade
0	→	159	Installation PI
160	→	637	Installation PIII
638	→	1274	Installation PIV

b.   Optimum and Maximum Installation Throughput

Under the prevailing assumptions in Fig 6.7a the maximum and optimum
installation throughput are equivalent except for Installation PI where
the optimum is reached at 120 tons throughput (39 tons below maximum).
For any given percentage of export grade fruit the difference in average
cost per ton throughput between installations at their optimum
throughput is small.   (See table 6.4).

TABLE 6.4

Average Cost Per Ton at
Optimum Throughput (70%
Export Grade)

	Installation
$107.8	PI
$107.9	PII
$101.4	PIII
$ 97.5	PIV

Although Installation PI requires the lowest investment per ton
at its maximum throughput, its minimum average cost is the second to
highest because of the higher variable cost per ton compared with
Installations PIII and PIV, and that fixed costs constitute a small
part of total costs at optimum throughput for all installations.

c. Importance of percentage utilization of the fixed resources

All installations only show a small reduction in average cost per
ton beyond approximately 50% utilization. If the optimum short run
average cost per ton is used as the base (i.e. = 100%) for calculating
the percentage decrease in cost between 50% throughput and optimum
throughput then the following results are obtained

TABLE 6.5

Percentage Decrease in Average Cost
as the Installations moves from 50%
Throughput (90% Export grade Fruit)
to Maximum throughput.

	Installation
4%	PI
12.4%	PII
15.2%	PIII
12.3%	PIV

The small decrease shown by Installation PI is because the 50% throughput
is close to the optimum.

6.4.3.2 Duplication of Installation PI

The cost curves in Fig. 6.7a were derived on the assumption that for any given fruit tonnage up to 1274, only one of the four specified installations could be used. This assumption will now be relaxed with regard to Installation PI. The choices for packing and grading any given fruit tonnage are now any number of installations PI, or either one of the other three specified installations.

The situation now exists where the appropriate numbers of Installation PI can be used to pack and grade a given fruit tonnage. To minimize the average total cost per ton of fruit graded and packed if duplication of PI is used, then every installation should operate at a throughput where their marginal costs are equal.

Cost curve PI dup in Fig 6.8 shows the minimum average total cost, possible per ton of fruit throughput achieved by the duplication of Installation PI only. The average cost curve for Installation PIII is included in Fig 6.8 for the purpose of comparison.

Cost curve PI dup exhibits dampening down fluctuations with increasing tonnage after about 180 tons. Every time the tonnage is a multiple of 120 then it reaches a local and global minimum of $107.8/ton (predictable because optimum throughput of PI is 120 tons). The average cost per ton for Installation PIII intersects cost curve PI dup at approximately 425 tons. Beyond 500 tons cost curve PI dup will tend to fluctuate less and less and consequently the cost advantage for Installation PIII will range between approximately $6.5 and $9 per ton. Duplication of Installation PI appears to be the best alternative for any given crop up to approximately 500 tons and beyond that still an acceptable alternative.

6.4.3.3 Relative Efficiencies When Installations Achieve Different Export Grade Percentages

a. Explanation

Two factors* suggest that large centralized Installations may achieve lower percentages of export grade fruit than Installation PI, for any given crop.

(i) F.M.C. graders are not as mechanically accurate as orbit graders therefore a greater margin for error would be required to ensure

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* Postulated by Hancock a packing shed equipment Engineer from Tauranga.

Fig 6.8 Average cost curve when Installation PI is duplicated and Installation PIII average cost curve for comparison.
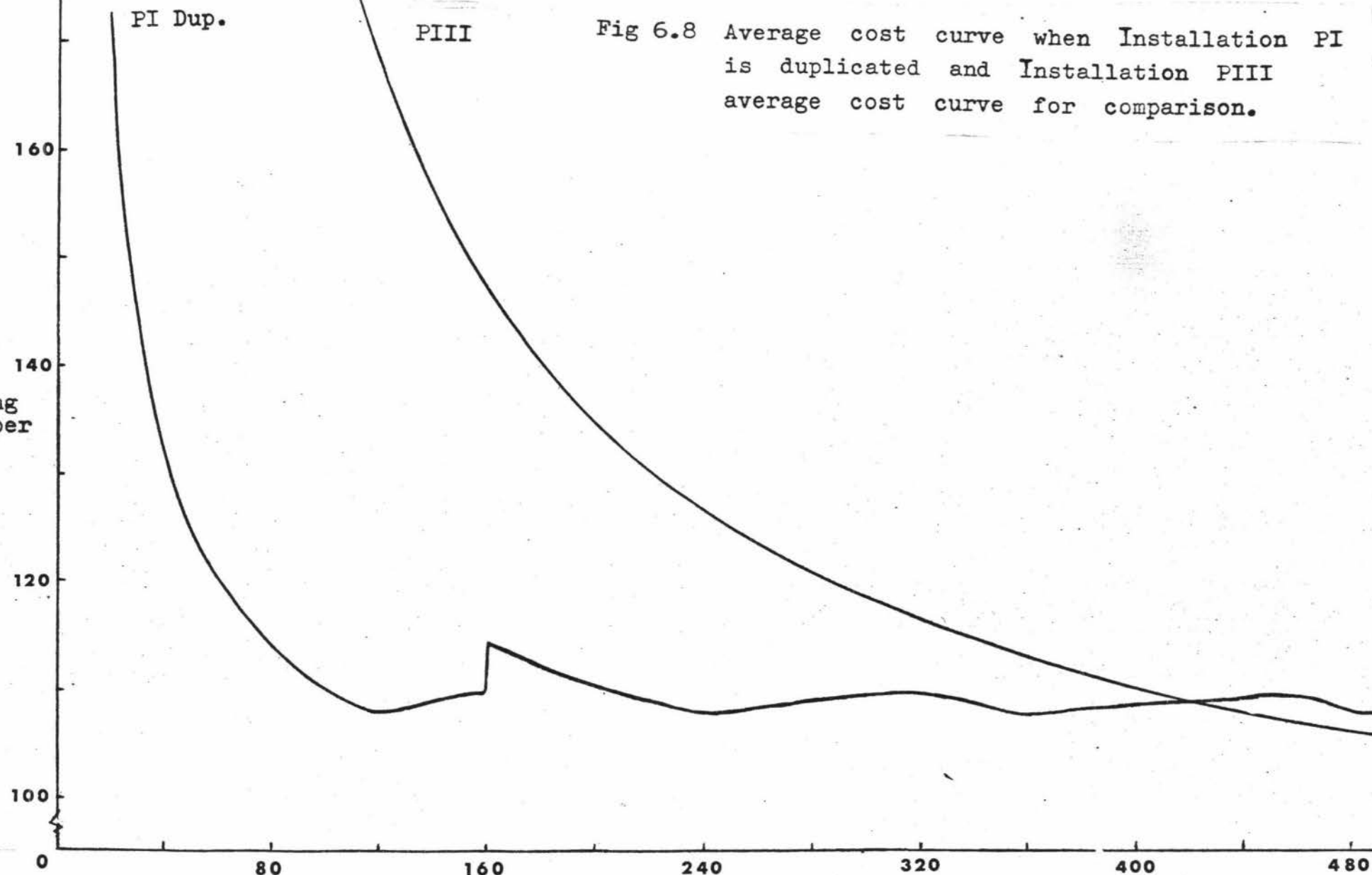
Tons of Fruit Packed and Graded.

that 2nd grade fruit is not packed as export grade.

(ii) There is a tendency in large packing and grading installations for the labour force to have an increased indifference to the job due to the less personal atmosphere, resulting in more fruit damage from bruising, cutting.

The combination of both of these factors would probably result in a lower percentage of export fruit for any given crop. Relating these factors to the four selected installations, the hypothesis is that Installation PI would achieve the highest percentage of export fruit for any given throughput of fruit. Installation PII would achieve a lower percentage than Installation PI, but a higher percentage than Installation PIII or PIV.

The relative efficiencies of the installations cannot be compared with the use of short run average cost curves when they are grading different proportions of export fruit. To compare the relative efficiencies the concept of Net Marketing Revenue is used.[14]

Net Marketing Revenue = Gross Revenue - Marketing Costs

(b) Assumptions

Three distinct sets of assumptions pertaining to the percentage Export Grade Fruit achieved by each Installation are used.

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14. Net Marketing Revenue equals Gross revenue minus costs incurred by the fruit after arriving at an 'on farm' packing and grading installation, or an 'off farm' installation pickup point, until it has been in a cool store for one month subsequent to packing and grading.

TABLE 6.6

Assumed Export Fruit Packout Percentages

Assumption Set

(a)	Assume all Installations achieve 70% for Export Grade.				
(b)	Installation PI	Achieves	70%	Export Grade	
	Installation PII	"	60%	"	"
	Installation PIII	"	60%	"	"
	Installation PIV	"	60%	"	"
(c)	Installation PI	"	70%	"	"
	Installation PII	"	60%	"	"
	Installation PIII	"	50%	"	"
	Installation PIV	"	50%	"	"

TABLE 6.7

Comparison of Net Marketing Revenues, for the four Installations when each of the Assumption Sets (a), (b) and (c) is adopted.

Installation	Percentage Utilization of Maximum Capacity %	(a) Net	(b) Marketing	(c) Revenue
			$ per ton (long)	
I	100	4	35	50
	75	5	36	51
II	100	5	9	24
	71	0	0	15
III	100	12	17	6
	71	5	10	0
IV	100	16	21	11
	71	11	16	6

Note: For each Assumption Set the lowest net marketing revenue per ton is taken as zero. Price levels for fruit are taken as $1.8 per export tray and $0.075 per lb of 2nd grade fruit. Two percent of all fruit picked is assumed reject.

(c)   Discussion

This section has shown that the net marketing revenue for a specific packing and grading installation is very sensitive to changes in the percentage of export fruit achieved. The slight advantage that PII, PIII and PIV have over PI when they all achieve the same percentage of export fruit, is reversed into a significant advantage for PI when they achieve lower percentages.

6.5   A discussion of Advantages and Disadvantages of Centralised Packing and Grading Facilities with Particular Reference to above Cost-Size Analysis

6.5.1   Capital Requirements of the Industry.

Considerable capital investment in the Industry will be required in the next few years of packing and grading facilities, regardless of what size or type of installations are generally adopted.

TABLE 6.8

Estimated Investment[15] Needed for Packing and Grading Facilities up to 1980 (inclusive).

Adoption of Installation	Approximate Capital Required	
	Maximum[16]	Minimum[16]
PI	$ 887,000	680,500
PII	1,106,000	846,500
PIII	1,252,000	958,000
PIV	964,000	738,000

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15.   Derived from Table 6.1 data and assuming that the installations all operate at maximum capacity. These estimations do not include cool storage or bulk handling facilities.

16.   Maximum and minimum projections allow for a range of production levels in 1980.

Fig 6.9 Crop sequence overlap in the Bay of Plenty
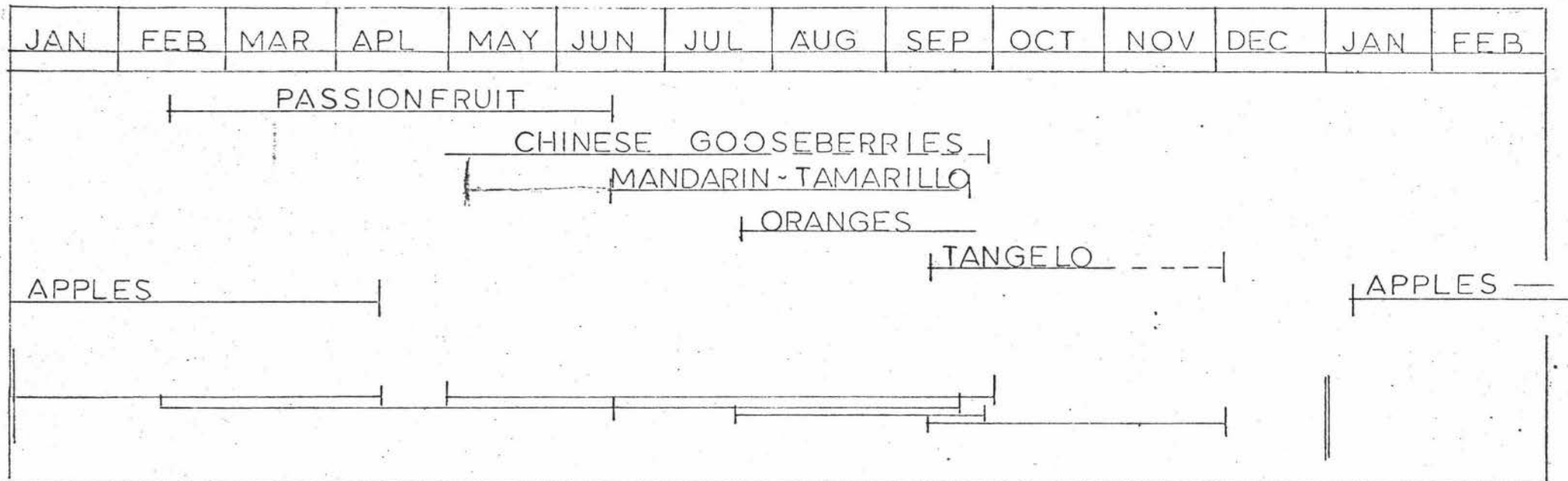
Adoption throughout the industry of any of the four specified packing and grading installations shows that 'on farm' Installations (PI) require the lowest total investment, though use of Installation type PIV does not require substantially more. Overall there is not a great difference between any of the alternatives. Formation of farmers co-operatives in order to invest in either of Installations PII, PIII or PIV may enhance the ability of the industry to obtain Government finance at concessional rates.

6.5.2 Equipment Utilisation.

Adoption of large sized central packing and grading facilities, several[17] of which would be required for the production in the Bay of Plenty by the end of 1980, would probably result in initial under-utilisation of the equipment and only slightly better utilisation of equipment compared with 'on farm' packing houses unless one or both of the following were introduced. (a) Night shifts, (b) Off season packing of other fruit and an extended season for packing. However, the economies of size analysis showed that under-utilisation of Installations PII, PIII and PIV did not seriously effect the average cost per ton throughput of fruit unless it dropped below approximately 50%.

(a) Night Shift Operation

The advantage would be small since labour is one of the major packing and grading costs. If overtime was worked by the day labour force, overtime rates would be incurred, and also decreased labour efficiency may result. Labour supply may be the limiting factor, since two shifts would require a very large seasonal labour force per packhouse. (Installation PIV requires approximately 60 people per shift).

(b) Off Season Operation

Packing and grading other fruit during the off season appears to be a feasible alternative, especially for the F.M.C. grading equipment

17. Approximately 4 to 5 Installations of size PIV.

which is more adaptable to a wide range of fruits. Figure 6.5
shows the crop sequence overlap in the Bay of Plenty, however, the
high cost of labour does not make this very attractive, but packing
alternative fruit would prolong the season and therefore attract
labour more easily.

6.5.3 Labour.

Labour input per ton of fruit throughput is assumed to be lower
in Installations PIII and PIV compared with PI and PII. In practice
labour efficiency may be lower in PII, PIII and PIV compared with PI,
resulting in a lower percentage of export grade fruit obtained and
consequent lower net marketing revenue than achieved in PI. (Table 6.7)
Another advantage that Installation PI has is the use of family labour
(growers wife and children) which has a low opportunity cost.

The labour force in a large installation would have to be employed
on a more formal basis than individual growers employ packers and
graders at present and a minimum weekly wage would need to be paid.
It is present practice for individual growers who pay by the day or
half day, and to employ according to the work available, i.e. labour
costs would become in effect a substantial fixed cost in a large sized
packing and grading installation making the uninterrupted flow of fruit
into the shed a very important aspect of low cost operation.

As the production in the Bay of Plenty rises the increased labour
requirement may be easier to meet if workers were attracted en mass,
following a season working with another crop (e.g. apples) elsewhere
in New Zealand.

6.5.4 Fruit Inspection

Fruit inspection by the Government officers would definitely be
more efficient with centralised packing and grading installation.
At present the inspectors must visit each grower producing for export
and it is becoming increasingly difficult to cover all the packing and
grading installations.

6.5.5 Packing and Grading Standards.

Better uniformity of packing and grading standards would certainly
be achieved by centralized installations. Quality differentials could

could be maintained for individual growers by using a random
sampling system, instead of clearing the whole packing line for
each new batch of fruit.

6.5.6   Industry Intelligence.

Improved day to day data on fruit movements, grade percentages
size of the seasons crop etc. would be more easily available if
centralisation was adopted.

6.5.7   Transportation.

In practice all suppliers of centralised Kiwi Fruit packing and
grading facilities would not incur equal transport costs due to their
varied geographical distribution.   Consequently the transport costs
used in the analysis are only arbitrary and hypothetical.   The trans-
port cost in the analysis is a linear function of the tonnage of fruit
transported.   This oversimplifies the real situation in which the cost
of transportation of Kiwi Fruit would be a non-linear function of load
size and distance travelled.   The complexities caused by the intro-
duction of this type of cost function are beyond the scope of this
economies of size analysis of Kiwi Fruit packing and grading Install-
ations.

Hancock[18] derived several cost curves (see Fig 6.10) for the
transportation of Kiwi Fruit from orchards to a centralised packing
and grading installation but the author considers that he has overstated
the costs on the following grounds:

Fig 6.10   Freight Cost Curve.

Cost per tray
in cents per
five miles

Bins per load from one orchard
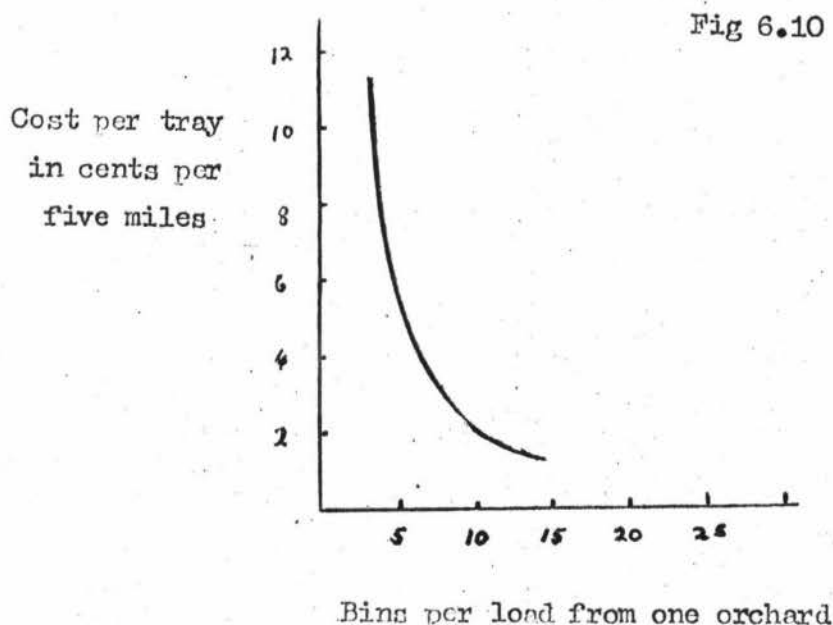
Fig. 6.10 shows cost per tray in cents per 5 miles versus the number of bins of fruit per load from one orchard. Assuming that a typical load from a farm would consist of 16 bins (say, one day's harvest from 20 acres of orchard) then from Hancock's cost curve the cost per tray is approximately 4 cents per 5 miles. Hancock assumes 230 export trays per ton of fruit picked, which is $9.20/ton per 5 miles.

In the above economies of size analysis, the general goods rate listed in the New Zealand Department of Agriculture (Economics Division) Bulletin of Farm Costs is used and the rate is $1.47 per 5 miles per ton. Hancock's cost curve seems to overstate the transport cost. Hancock also expresses the transport cost in terms of cents per tray, making an implicit assumption with regard to the number of trays per ton of fruit packed, disregarding the possibility of large variations in the percentage of export grade fruit.

The author readily concedes that economies and diseconomies of assembly may give either 'off-farm' or 'on-farm' installations a definite cost advantage, a point of view consisely stated below.

"Very often the limits to plant size are diseconomies of assembly and distribution rather than manufacturing economies."
Agricultural Market Analysis (6)

6.5.8   Neighbourhood Co-operatives

Several neighbouring farmers with small Kiwi Fruit orchards or multi-crop orchards could form a small neighbourhood packing and grading co-operative of their own and invest in an installation of type PI. Working night shifts could extend the capacity of this plant to approximately 200 tons. Essential requirements for this type of arrangement would be:

(a)   an amicable relationship between all members;

(b)   a clear and definite set of operating rules;

(c)   cost allocations clearly defined and agreed upon.

18.   Packing and Grading Equipment Engineer - Tauranga.

6.5.9   Probable Advantages and Disadvantages with the Adoption
        of Large-sized Packing and Grading Installations

Advantages:

(a) Lower labour input required for the industry
(b) Attract the required labour force more easily
(c) Fruit inspection more comprehensive and efficient
(d) Improved current industry data
(e) Better conformity of packing and grading standards
(f) Facilitation of processing for surplus or second-
     grade fruit.

Disadvantages:

(a) Lower net marketing revenue
(b) Vulnerability to labour disputes.

6.5.10 Critical Requirements for Achieving a Low Cost in a
        Large-sized Packing and Grading Operation

1. Experienced and efficient management who can function
    without interference from the growers.
2. A reliable and adequate labour force who only desire
    employment during the harvesting season (May-June).
3. A continuous supply of fruit in order that the labour
    is fully utilised for every hour that it is employed.
    This requires forward planning each season to ensure
    an adequate tonnage is available.

6.5.11 Probable Advantages and Disadvantages with the
        Adoption of Installation PI

Advantages:

(a) Higher net marketing revenue than PII, PIII and PIV
(b) Low opportunity cost of family labour
(c) Flexibility with labour organization.

Disadvantages:

(a) Higher labour input required by the industry compared to
     PII, PIII and PIV

(b) Fruit inspection by Government officers more difficult.

(c) Poor day-to-day industry intelligence.

(d) Difficulties in attracting labour.

6.5.12 Summary of Sections 6.3 and 6.4

It can be seen that the efficiency of the packing and grading operation
is highly sensitive to the percentage of export recovery any given installat-
ion achieves.

If the larger size installations can achieve the same proportion of
export fruit as that of 'on-farm' packhouses (Installation PI) then they
could pack and grade at a lower cost per ton.

Under utilisation of the 8-lane FMC grader (Installation PIV)does not
appear to raise costs significantly because operating at 50% capacity it
can still compete quite favourably with the smaller plants operating at full
capacity. The 8-lane FMC option requires the lowest labour input and the
second to lowest capital input per ton of fruit throughput.

In Fig. 6.7 Installation PI which is the typical 'on-farm' grading
facility for a specialised Kiwi Fruit farm. is shown to compete very favour-
ably with the larger installations. and if its percentage export packout is
higher. plus the low opportunity cost of much of its labour is taken into
account, then it is clearly the most efficient.

6.6 Statutory Intervention in the Industry

This section is based on the limited information obtained by the author
from several Kiwi Fruit growers and Kiwi Fruit exporters. The topic of stat-
utory intervention could support a complete study by itself but it was thought
worthwhile to briefly discuss it and suggest some guidelines. Because these
guidelines are based on limited information they should be mainly regarded as
the author's personal views and are therefore still very much open to comment.

A variety of views are held by the producers concerning the amount of
statutory intervention that should exist in the industry. They range from
those that consider that the unrestricted Laissez-faire system is best, to
those that advocate statutory control at all levels of the exchange pathway.

6.6.1 Statutory Control - The Case for a Centralised Agency

Some growers desire statutory control within the industry in order that
their interests are protected because of the small amount of flexibility they
have in responding to short-term market fluctuations relative to their export-
ing agents. At present a non-official committee exists for the purpose of
promotion only. and relies on funds derived from a voluntary levy paid nominally

by both growers and exporters.

As far back as March. 1967, one group of growers has felt that the
formation of a Kiwi Fruit Industry Statutory Board should be set up.
The proposed advantages claimed by such a body were:

    (a) Growers would obtain direct representation on a Board
          controlling their exports

    (b) It would ensure orderly marketing

    (c) It would enable fruit standards and grades to be enforced

    (d) It would provide the machinery to levy growers in order
          that the required promotion be carried out on a compulsory
          basis and the cost shared equitably by all.

    (e) It would improve the efficiency of funds spent on promotional
          work in order that markets are developed for the increase in
          production that has been forecast.

They proposed that this controlling Board be set up along similar
lines to the Australian Apple and Pear Board.[19]

6.6.2 Laissez-faire Advocates - Opponents of further
Government Intervention.

After discussions with many individual growers it became apparent
that there were many Kiwi Fruit growers who felt that statutory market-
ing was premature and that the industry was too small for any such con-
trols. It was pointed out that the Australian Apple and Pear industry
exported approximately 150,000 tons of fruit per year and consequently
the levied funds were large enough to support a staff of qualified per-
sonnel for achieving their stated objectives.

These growers emphasised that the Kiwi Fruit Export Industry is
young and rapidly growing, with expected exports reaching 8,000 tons
by 1980. One of the primary requirements for such an industry was
thought to be flexibility in both the production and the marketing
systems and techniques, enabling a free hand for participants with the
most drive, foresight and initiative to exercise their skills to the
fullest. One of the main factors accounting for the rapid expansion
of the industry is due to the impetus of a few growers and exporters,
may not have provided the same stimulus if there had been vigorous

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19. This Board has the power to control the export of apples and
    pears from Australia. Its powers are purely regulatory and
    unlike its N.Z. counterpart does not participate in trading.

statutory control in the past five years.

In monetary terms, Kiwi Fruit exports are small compared with receipts from many other exported products which are not controlled by a statutory body.

6.6.3 Current Government Policy for Small Agricultural Export Industries

The author was unaware of any policy relating specifically to the Chinese Gooseberry Industry at that time, however, an indication of their present policy for small agricultural export industries can be seen from the recommendations in a recent inquiry into the New Zealand Honey Industry[28] This inquiry was prompted because of a growing dissatisfaction among the honey-producing and honey marketing sectors of the industry. and the apprehension by producers about future honey production. The most contentious issues within the industry at the time of the inquiry were:

(i)   That the Honey Marketing Authority participates in exporting. and also has the statutory right to issue export permits to other exporters if it so desires. giving it a virtual monopoly in exporting.

(ii)   That the large administrative overheads incurred by the Honey Marketing Authority are an unnecessary burden on the industry.

(iii)   The honey levy is applied on an inequitable basis.

(iv)   A significant proportion of producers are circumventing both the H.M.A. and the packers by selling direct to the N.Z. retailers and the N.Z. consumers (gate sales, mail sales) thus creating a disservice to the industry.

(v)   The poor marketing efficiency of the H.M.A. gives its suppliers lower returns than thought otherwise possible.

The inquiry recommendations to these contentious issues were:

(i)   That the H.M.A. should continue to engage in export and local marketing of extracted honey to the best advantage of the industry.

(ii)   The H.M.A.'s authority to approve exports of honey be restricted to approval of its own exports.

(iii)   The Secretary of the Department of Industries and Commerce be appointed under the Sale of Honey Regulations 1971 with power to approve exports of honey; this power to be exercised to deal with applications by persons other than the H.M.A. for approval to export honey.

(iv)   That the H.M.A. undertake a review of its marketing operations with a view to improving the overall return to suppliers.

(v)   That the H.M.A. also undertake a review of its administrative functions to ensure that the cost of these is kept to a minimum compatible with efficiency.

(vi)   That the present seals levy should be replaced by a levy payable to the H.M.A. on all honey disposed of in the extracted form by producers either by sale to a manufacturer, wholesaler or retailer; by supplying the H.M.A., a packer or by export.

(vii)   That producers who pack and sell honey direct to consumers or to local retailers should be allowed to continue to develop their businesses without restriction.

The overall impression from these recommendations is that the present level of statutory control has created anomolies and inefficiencies, especially with regard to marketing and that the Government thinks that a reduction in statutory control is long overdue.   From this it can be summised that the Government favours freer interaction of market forces for other industries of similar size to the Honey Industry.

6.6.4   Discussion of these Views

Kiwi Fruit Industry participants should decide upon the present and expected requirements and then formulate the machinery which can best achieve these requirements.

For a statutory board to direct on such matters as prices. terms of sale, exports to particular markets and suitable quantities and varieties, it would need a staff of suitably qualified personnel independent of any vested interests within the industry.   If the Board wished to engage in promotional activities as well, then the overheads may be too high for this rather small industry.   Control of export licences to exporters by a statutory board could lead to impeded access to the industry for more efficient exporters.   If the controlling Board is marketing orientated, it is doubtful whether the grower members have the required expertise or knowledge to direct marketing since experience in the world has shown that the typical attributes of affluence, spare time, and maturity possessed by grower members of statutory boards are not necessarily the desirable ones for the functions performed.   More importantly members are unlikely to be unable or unwilling to pay a competitive salary to the general manager.

Perhaps most important of all is the diminished flexibility which
a statutory board has with regard to adaptation to changing conditions.
A statutory authority is given certain functions by law and thereafter
tends to adhere rigidly to these, and when its required function
changes, a new law must be passed before it can actually react to the
new situation.   It must also produce evidence of a substantial grower
support for any proposed changes.

The so-called orderly marketing requirement seems to have been
achieved with considerable success in 1971 without any statutory controll-
ing body and there is no reason to believe that this situation will drastic-
ally alter without warning. The Kiwi Fruit Promotion Board has used the
voluntary levy for promotional activities only, and it appears to be achiev-
ing its desired objectives.   At this stage it appears unwise to impose the
industry with a rigid set of operating rules which may tend to dampen the
present display of vigorous free enterprise.   The implicit assumption here
is that vigorous competition will force firms to excel more than if they
were motivated by the desire to maximise profits.

6.6.5   Recommendations

If a controlling body is set up, then perhaps it should restrict
its control to:

1. Maintenance of certain standards of fruit and packaging.
2. A minimum price F.O.B.
3. Making certain established stable markets restricted
    as   to quantity and variety. and permitting a free-for-all
    in other markets.
4. Levying the industry participants to obtain funds for
    promotional activities only.

6.6.5.1

Maintenance of certain standards of fruit and packaging would
ensure that poorly graded, poor quality fruit is not exported by anyone
who endeavours to make a short-term profit at the long-term expense of
the industry.   This would prevent second-grade fruit from being bought
on the New Zealand auction floor and repackaged and exported.

Maintenance of certain fruit standards would also give overseas
buyers continued confidence in the product when they know that the fruit
they have bought, but have not seen, has the Marketing Board's approval.

6.6.5.2

An annual minimum price f.o.b. would prevent sudden unwarranted reductions in farm prices. giving the farmer some measure of income stability each year.

6.6.5.3

An established stable market is defined as one in which the rate of increase in consumption of a given product is approximately equal to the rate of population growth in the area in which the market exists. Assuming a moderately inelastic demand curve in this market, it follows that price reductions or increases in quantity supplied will reduce the total sales revenue in that market. Severe price competition between New Zealand exporters, and uncontrolled quantities supplied to such a market would therefore result in reduction of total sales revenue. The overseas wholesalers would also be ill-disposed towards uncontrolled quantities arriving in this market, creating unpredictable fluctuations in their marketing margins.

The first Kiwi Fruit market that is most likely to become stable is the West Coast of North America. If, for example, it is found that the optimum quantity this market can absorb is 3,000 tons of fruit per year, then the Marketing Board could divide this into 30 permits of 100 tons each and advertise for New Zealand exporters to tender for them. These permits could depreciate at a given rate to ensure that any one exporter does not obtain a permanent right to the market regardless of his efficiency. The issuing of new permits would account for the depreciation and also allow for market expansion. Vigorous competition between New Zealand exporters would be the desirable method by which other markets are created and developed.

6.6.5.4

A levy from the growers could be used for promotional purposes in a method similar to the International Wool Secretariat's promotion of wool, though on a considerably smaller scale. An alternative method of obtaining funds for promotional purposes could be to use the proceeds from the export permits.

CHAPTER VII

THESIS SUMMARY AND CONCLUSIONS

Commercial production of Chinese Gooseberries has recently developed into a rapidly expanding export industry. New Zealand appears to have a comparative advantage and probably an absolute advantage in the production of this unique fruit. Analysis shows that it is almost twice as efficient at earning overseas exchange as is butter production.

The Chinese Gooseberry (Kiwi Fruit) is a deciduous fruiting vine first introduced into New Zealand by seeds from China around 1910. Several varieties have been developed since then and the 'Hayward' variety has emerged as the most favoured for export production, primarily because it produces the largest fruit. The Bay of Plenty has become the predominant region for commercial production due mainly to its favourable climate and a small group of innovative growers. Over ninety per cent of all vines are situated in the Bay of Plenty, however, there has been a recent upsurge in plantings in the other traditional growing areas of Auckland and Northland. An analysis in Chapter two indicated that there are several other smaller areas in New Zealand where commercial production appears feasible, of which the New Plymouth and Wanganui regions seem the most promising.

The compound rate of increase in vine acreage between 1965 and 1971 for all New Zealand was approximately 33 per cent per annum and the total production of fruit is expected to increase from the 1971 tonnage of 2,330 to well over 10,000 tons by 1980 and approximately 70 per cent of this increase is expected to be of export quality.

The major export markets at present are the more affluent countries of the western world; U.S.A. and Canada buying approximately half of the annual exports and Britain, Germany, Japan, France and Australia buying most of the complement. It is feared that the rate of increase in production of export fruit will be faster than these markets can absorb it, without incurring large price reductions. The author considers that although the projected increase in production is very large on a percentage basis the absolute amount of fruit

exported will still be small by world standards for other fruits.
In which case only moderate price reductions coupled with a sustained
promotional input will be necessary for export fruit. However, it is
postulated that large price reductions will be necessary to dispose of
the large increase in quantity of local market fruit.

The high financial returns being currently received by growers
for export and to a lesser extent local market fruit are initiating
attempts to grow it in many other countries of the world. Apparently
without the degree of success achieved in New Zealand. There is,
therefore, a strong possibility of significant competition from other
countries in the next decade. Therefore, it is in the interests of
the industry to ensure that all sectors attain a high degree of
efficiency if it is to remain a viable long term export industry.
This aspect, coupled with the expected price reductions for both local
and export fruit prompted an economies of size analysis of both prod-
uction operations and marketing operations. The economic-engineering
(synthetic firm) method was selected as the most appropriate for
investigating economies of size.

Economic-engineering farm models were constructed under given
assumptions of yields, cultural practice, prices, costs and combinations
of resources. These assumptions were varied to indicate their impact
on costs, profits and breakeven acreages. The analysis showed that
farms with the least fixed resources (one permanent labour unit and the
standard equipment combination) could produce fruit at a much lower
cost per ton than those with more fixed resources (packing shed, two
permanent labour units and the standard equipment combination) when
both were operating with less than 12 acres of vines. The cost
differences significantly diminish when farm sizes are operating with
18 or more acres of vines. For example from Table 5.2 the average
cost per ton ranged from $242 to $485 at 6 acres of vines (all yields)
but at 18 acres of vines the range was $269 to $187 (all yields).
The average cost curves for all farm sizes plateaued out at approximately
18 - 20 acres of vines because economies of acreage were not important
beyond this.

The average total cost per ton of fruit produced was very sensitive
to yield variations. This sensitivity was also more pronounced at low
acreages.

Assuming the most pessimistic fruit price level is $0.175/lb for export fruit and $0.05/lb for local grade fruit, and achieving 50 per cent of the crop as export quality, then the minimum economically viable vine acreages are approximately 10, 14, 16 and 22 for Farm sizes I, II, III and IV respectively. These vine acreages are economically viable in the sense that the owner-operator and capital are adequately remunerated. The percentage of export fruit achieved from a given crop is an unpredictable annual variable to which profits were sensitive. The overall recommendation is at least 20 acres of vines with any of the selected fixed resource combinations, which is twice as large as the orchard for which the N.Z.D.A. has published cost of establishment data. Although the N.Z.D.A. publication never recommended this as the optimum acreage, many of the new growers have assumed this and planted accordingly.

Average costs per ton of fruit significantly increase if casual labour is unavailable for pruning operations. Mechanical pruning does not appear to be an economically viable alternative unless the yield achieved is at least 60lb/vine and the vine acreage is greater than 20. Helicopter spraying does appear to be an attractive alternative compared to the present method of owner-operator blast spraying.

Export fruit and local market fruit move by different types of exchange pathways. The characteristics of export fruit enhance the likelihood of it moving by a totally decentralised pathway, and at the moment most of it moves by a partially decentralised pathway. The bulk of local market fruit moves by centralised pathways and is likely to continue to do so until its basic characteristics change (e.g. poor standardization, many small multifruit growers supply all their fruit to the local market).

There is considerable scope for innovations in packaging methods for local market and export fruit. Containerization appears to have considerable advantages over the conventional handling methods which involve the handling of individual ties at each point where the mode of transport changes. One of the major problems within the industry at present is the choice of packing and grading facilities that is most appropriate for the projected production increases. The alter-

natives investigated were a small 'on farm' packing and grading installation, and three types of 'off farm' packing and grading installations. Average cost curves were developed for each installation using the economic-engineering method under given assumptions of technical relationships, prices costs and combinations of resources.

It was shown that if all the installations achieve the same percentage of export fruit packout, and that they are all operating at more than 50% of maximum capacity then the marketing costs per ton of fruit do not vary widely. However, if the large sized installations achieve a lower percentage of export fruit from any given crop then the 'on farm' installation has a distinct advantage. Although there are clear cost advantages for a particular installation in several of the hypothetical situations, the choice of facilities may depend on such factors as the availability of capital, availability of labour and net transport economies. It is likely that each of these factors will affect individual growers differently and therefore no one installation will be best suited for all growers. Because the Kiwi Fruit is a high value commodity, and that over a reasonable range of assumptions the 'off farm' installations never had a distinct cost advantage, the 'on farm' installation seems to be the better alternative because of the greater degree of control by the owner-operator over the labour input; i.e. the 'on farm' installation is less vulnerable to labour problems.

Finally, the possibility of statutory intervention was discussed and the recommendation is that this should be kept to a minimum. This recommendation is based on the record of success of statutory intervention in other small industries, especially the honey industry. Also this industry is expanding rapidly and therefore its requirements and structure are likely to change rapidly, a characteristic that statutory authorities appear to have lacked in the past.

The Chinese Gooseberry Export Industry promises to be a very efficient earner of overseas exchange for New Zealand for many years to come, but every effort should be made to ensure that it remains efficient because of the strong possibility of future competition from other countries.

A P P E N D I X

A.1 Technical Co-efficients, Cultural Practices and Costs
used in the Economic Engineering Model.

A.1.1 Orchard and Vine Arrangement.

It is assumed that the variety of Chinese Gooseberry grown in
the Hayward and the single-vine system is used (Figs. A.1 and A.2).
This system consists of a single high-tensile wire supported at a
height of six feet above ground level by wooden posts. A leader
(see Fig. A.2) from the main trunk of the vine is trained along each
direction of the wire. Laterals are allowed to droop from each side
of the leaders at right angles to the wire. The last two posts at
each end of a row have a diagonal post between them in order that
the wire tension is maintained (Figs. A.3, A.4, A.5).

An idealized area of vines is used and is referred to throughout
the analysis as a unit of vines, or just a unit (Fig. A.6). This
unit of vines is almost exactly two acres in area including the
headlands, and is surrounded by shelter belts as indicated. There
are 280 vines in this unit, 245 female and 35 male. The distance
between rows is fourteen feet and the distance between vines in a
row is eighteen feet. The headlands at the row ends are sixteen
feet wide and approximately fifteen feet wide at the sides. The
extra width of the headlands at the row ends is to allow for the
turning of tractors and other machinery. Fig. A.7 shows the order
in which the units of vines are assumed to be added to any specified
set of fixed resources. Fruit haulage at harvest time is greatly
dependent upon the position of the units of vines in relation to
the house block. In the economies of size analysis a fixed time
period is required for hauling a bin of fruit from the picking
point to the packing and grading installation or transport pick-up
point. In practice this haulage time would be a function of the
number of vine units and their layout in relation to the house
block (shaded area of Fig. A.7). The assumed layout in Fig. A.7
is considered to minimise the haulage time for any given number
of units, and the 15 minutes allowed for each bin is probably an
overestimation of the time required for this operation. For
example, to haul one bin from unit 49 (Fig. A.7) to the house
block and to return with an empty bin involves approximately one
mile of travelling. If five minutes are allowed for loading and

Fig A·1 <u>End view of a row and a vine.</u>
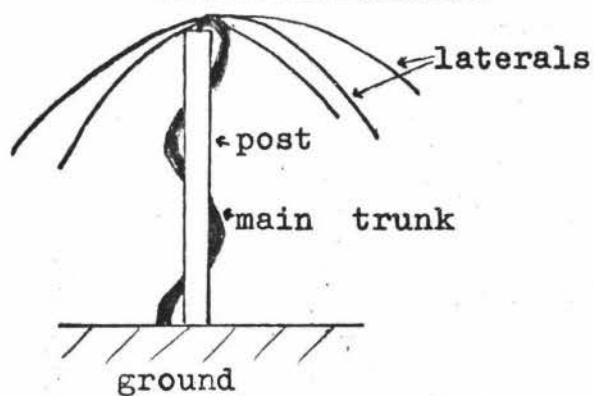
laterals

post

main trunk

ground

Fig A·2 <u>Side view of a vine.</u>

leaders

wire

6 ft

laterals

main trunk

post

ground

Fig A·3 <u>Side view of a row.</u>

posts

18 ft

shelterbelt

16 ft

16 ft

ground

Fig A·4 <u>End view of a unit.</u>

posts

14 ft

15·15 ft

15·15 ft

ground

Fig A·5 <u>Side view of a row.</u>

wire

shelterbelt

post

vine

vine

16 ft

6 ft

18 ft

8 ft

ground
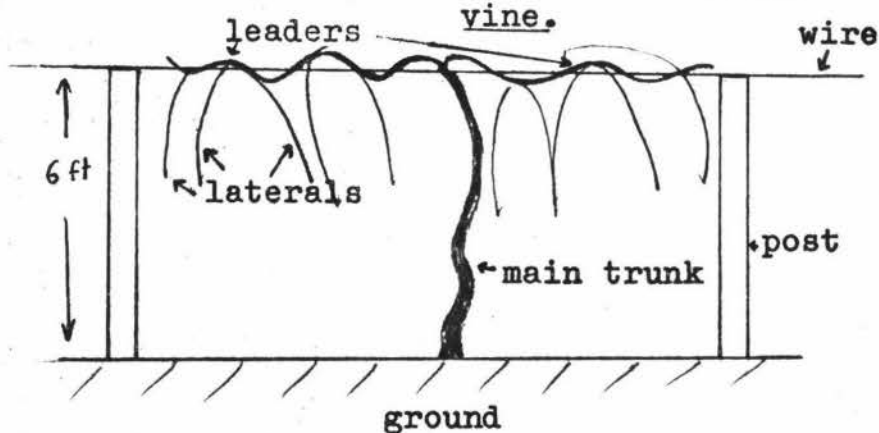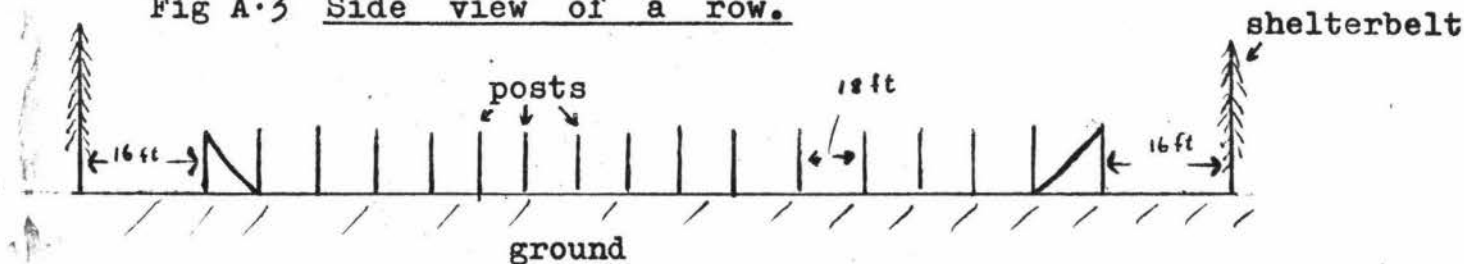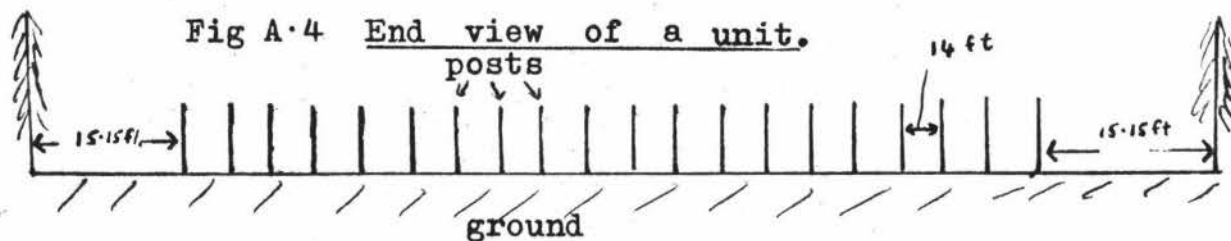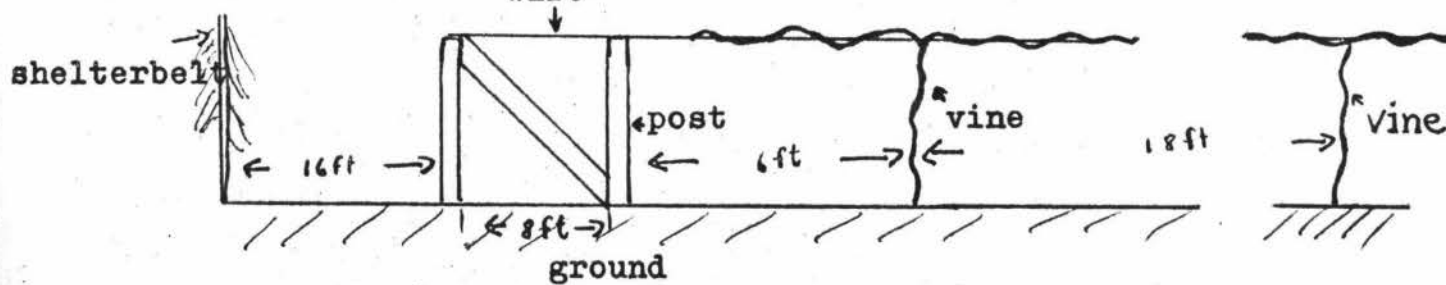
Fig. A.6   Vine layout of a unit of vines.

Key
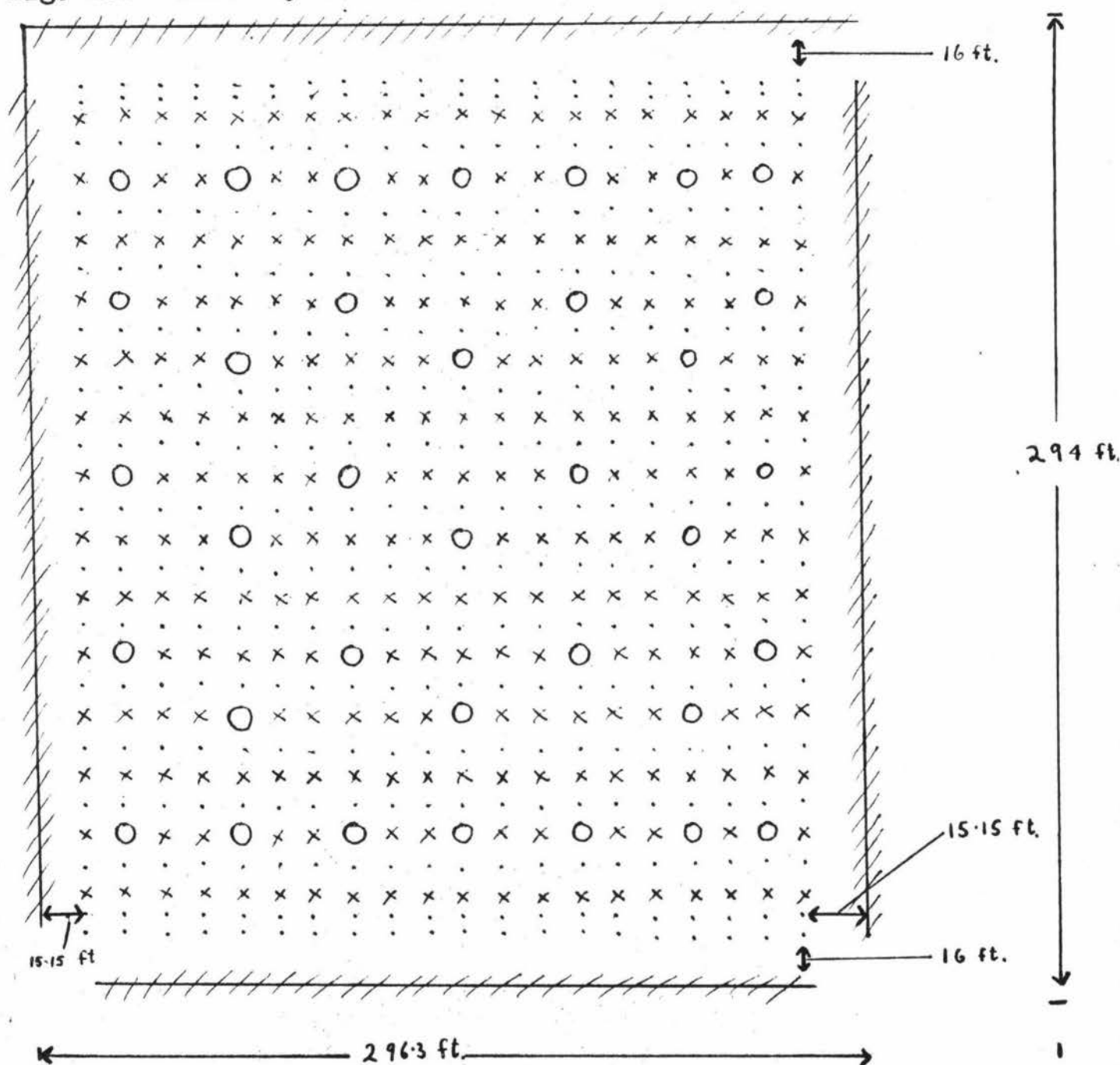
O - male vine

x - female vine

. - post

⫽ - shelterbelt

Fig A·7 Order of unit addition to fixed resources.

49	50	51	52	53	54	55
48	25	26	27	28	29	30
47	24	9	10	11	12	31
46	23	8	1	2	13	32
45	22	7	H.B.	3	14	33
44	21	6	5	4	15	34
43	20	19	18	17	16	35
42	41	40	39	38	37	36

H.B. = House Block (1.5 acres)

unloading then there are ten minutes available to travel this mile, necessitating an average tractor speed of six miles per hour.

A.1.2 The Standard Equipment Combination.

A.1.2.1 Introduction.

Table A.1 shows the standard equipment combination used in the cost-size and profit-size analysis. This Table also shows the associated annual fixed costs per year of the standard equipment combination. It should be noted that not all of the components of this combination are equipment but for convenience are referred to as such.

A.1.2.2 Discussion of Table A.1.

(a) Cost Prices

Obtained from Department of Agriculture Farm Commodity Price Schedules and "Cost of Establishment of Chinese Gooseberries"(27) (added 10% due to inflation since March 1971).

(b) House Block Land

One-and-a-half acres chosen as area necessary for placement of house, implement shed, driveway, garden, and turning area.

(c) Implement Shed

A 800 sq. ft. implement shed is larger than necessary for the housing of the specified fixed plant for all farm sizes. According to Jackson (10) shed space necessary for housing equipment:

	sq. ft.
Transport tray (small)	28
Trailer (small)	56
Hay mower	59
Fertilizer distributor	30
Author's estimates:	
3-point linkage forklift	40
Tractor	72
Boom spray	30
Knapsack	9
Tools	50
	374

There is also a need of storage space for bins as well and a place

TABLE A.1.   Standard Equipment Combination and its Associated Costs per Year.

	$ Cost Price	$ Average Value	$ Salvage Value	Depreciation Rate %	Insurance Rate $/$100 of Av. value	Interest. Av. value at 7%	$ Depreciation	$ Insurance	$ Repairs & Maintenance
Trailer	200	120.	20.	10	0.3	8.4	13.05	0.36	
P.T.O. Drive Pump	242	145.20	24.20	10	0.3	10.104	15.79	0.4356	
Rotary Mower	530	318.	53.	10	0.3	22.260	34.58	0.954	
Fertilizer Spreader	199	119.40	19.90	10	0.3	8.358	12.98	0.3582	Hourly basis use See Variable Costs table
Boom Sprayer	30	18	3.	10	0.3	1.26	1.95	0.054	
Water Reticulation	756	453.60	75.60	20	0.3	31.752	16.65	0.3608	
Knapsack Sprayer	50	30.	5.	10	0.3	2.1	3.26	0.04	
Blast Sprayer	3700	2220.	370.	10	0.3	1155.4	241.42	6.66	
Tractor	3156	1893.60	315.60	10		132.552	205.92	20.0	
House and Extras	11383	5691.05	0	2½	0.375	398.405	21.53	21.3431	227.66
Implement Shed	1600	800.	0	2½	0.275	56.0	8.0	2.2	36.00
Pump House	240	120.	0	2½	0.14	8.4	1.2	0.168	1.20
Land - 1½ acres	2025	2025.	2025.	0	None	141.75	N/A	0	0
Forklift	550	330.	55.	10	0.3	23.10	35.88	0.99	−

to carry out repairs and maintenance in wet weather.

(d) Description of Machinery

    (1) Tractor used in models - diesel Ferg. 135 ₵2,756, differential lock dual 11 x 28 modified to small types (extra ₵400)

    (2) Rotary mower with 6-ft. cut

    (3) Rotocaster fertilizer spreader MF Rotocaster Mark III

    (4) Miscellaneous tools - includes such items as ladders, nails, hammers, shovels, spades, rakes, rope, grease guns, pruning equipment.

    (5) Blast sprayer - Holder 210

    (6) Forklift - a 3-point linkage on back of the tractor.

(e) Water Reticulation

    (1) Pump - assume model c4 500 g.p.h. pressure on output   ₵ 306.

    (2) Tank - 3000 gal.   255.

    (3) Pipes - assume 3000 ft. of $\frac{3}{4}$" Alkathene @ ₵6.50/100 ft.   195.

    756.

(f) Description of Buildings

    (1) House - 1263 sq.ft. (Keith Hay Home Ready-built)

    (2) Pump House - 7'x 7'6" (permacrete)

(g) Interest Rate

After discussion with an accountant and members of the Massey Management Department, 7% was chosen as a current and realistic figure.

(h) Average Value

Determined by adding half the initial cost price to the salvage value.

(i) Salvage Value

Saleable value at end of specified number of years' use.

(j) Depreciation

Basically, used Taxation Department allowances as these are thought to be a fair indication of the rate of loss in value. Method: Assume to replace farm equipment at end of 10 years. Assume they have a 10% salvage value (used for spare parts or sold to a dealer).

For self-propelled vehicles (in this case, tractors) the Government allowance of 20% D.V. is used, then at the end of 10 years the D.V. is $\approx$ 10% of cost price (actually 10.875%).

For buildings the depreciation rate is $2\frac{1}{2}\%$ of cost price; salvage value is nil at the end of a period of 40 years. Special depreciation rates have been disregarded as they tend to change from year to year depending on current Government policy.

Using the Sinking Fund Formula [1]

$$A = Sn\ i/\ (1ti)^n - 1\ )$$

where Sn is money required to replace asset at end of specified period,

in this case Sn = (cost price - salvage value)

    A is the annual amount needed to be saved in order that

      Sn is accumulated at the end of n years

    i = interest rate

    n = number of years the asset is retained.

(k)   Insurance Charges

Charges allowed for each $100 of the average value of the asset. Jackson's (10) charges used, but he allowed the rate to be applied to each $100 of initial cost. Since the interest charges are based on average value, then for consistency this is the basis for insurance.

(1)   Repairs and Maintenance

Using Jackson's (10) figures:

Dwellings	2% initial cost	
Implement shed	2% "	"
Pump house	0.5% "	"

Also allowed 2% for miscellaneous tools and equipment.

(m)   Repairs and Maintenance of Machinery

Some publications give estimates for this as a fixed charge per year based on the capital cost of the machinery.

From: Bainer Kepner, Barger (16):- suggested values for

---

1.   As presented by Dillon (23)

estimating annual repairs and maintenance and lubrication charges:

	Annual charge as % of cost price
Mower	4.2
Manure Spreader	2.0

From: "Culpin's Farm Machinery":

- "generally speaking a charge in the region of 2% to 5% of capital cost is an approximate value of annual repairs and maintenance costs".

However, for the purpose of the analysis, assuming a flat rate for the cost will place a significant bias on the fixed costs.

Jackson expresses repairs and maintenance charges on an hourly-use basis; although still not ideal, it is considered by the author to be a more accurate method (the cost is still considered constant/hour for the whole life of machines) and therefore will be discussed in variable costs.

A.1.3 Other Fixed Costs

(a)	Rates	$
	2.5% of unimproved value of land	annually
	House block ($1\frac{1}{2}$ acres)	50.63
(b)	Telephone	
	Rental	50.00
	Tolls	32.00
(c)	Farm Journals	9.50
(d)	Accountant's Fee	70.00
(e)	Farm Liability	6.50
(f)	Workers' Compensation not included –	
	at $1.20/hr add $0.0156/hr, which is	
	insignificant and therefore disregarded	
(g)	Owner-operator Cost	
	Annual remuneration for all permanent labour units	
	is $3200, either as a direct cost or opportunity cost.	

A.1.4 Orchard Fixed Costs.

These are annual costs associated with each unit of vines.

(a) Rates

Two acres of land at a total value of $2,700. $

Rating on this value   67.50

(b) Interest

(1) Orchard

Includes interest on development investment
in posts, wire, vines and grassing.   Interest
is on the average value which is half the
·initial cost plus salvage value.

Development cost per unit $1225.20[2]

Average value   612.60

Salvage value   0

$612.60 @ 7%   42.88

(2) Land; one unit of vines

of value $2,700 @ 7% per annum   189.00

(c) Depreciation[3]

Orchard at 2; per year

Salvage value nil at end of 50 years   3.06

(d) Repairs and Maintenance

(1) Vines and Fences

Assume annual cost of 5% of the initial cost of
the material.   Per unit cost of material is
$973.90, therefore the repairs and maintenance
cost per year per unit is: 48.66
Assume this work is carried out during the
slack periods of the year, therefore there
is no extra labour cost

(e) Fruit Bin Requirements

The total crop must be picked between the 1st of May and
mid-June.   For an 8-hr, 5-day week this allows 256 hours.
Assume bin turnover is two days, therefore one bin can be
used 16 times during the harvest period.   One bin holds

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2. Based on "Cost of Establishing Chinese Gooseberries" (27)
but modified to include interest rates, insurances, etc,
and labour at $1.3/hr.

3. Sinking Fund Method.

approximately 780lb of fruit (level with the top of bin),
therefore one bin can cope with 12480lb of fruit per harvest.
Assume that the farmer has enough bins on hand to cope with
a high-yield situation with requires 2.944 bins per unit or,
to the nearest bin, 3 bins per unit

@ $15.00 per bin

	$		$
Interest	0.63		
Insurance	0.045		
Depreciation	0.978		
Repairs & Maintenance	0.750		
	2.403 x 3		7.21

(f) Miscellaneous Equipment

Assumed investment of $33 per unit in ladders,
pruning knives, etc. For each $33 of equipment
the following annual costs are incurred:

Interest	1.386
Insurance	0.594
Depreciation	5.691
Repairs and Main- tenance	0.660
	8.33

Anon. (27) assumed $330 investment for 10 acres
of vine, but the author considers this excessive
after personal observations during his field
survey.

A.1.5   Pre-harvest Variable Costs.

A.1.5.1   Material Costs.

(a) Fertilizer Requirements per Unit Per Year

		$ Prices ex $5 ton subsidy
(1)	Urea – 3 cwt @ $4.50/cwt	13.50
	$1\frac{1}{2}$ cwt applied in September	
	$1\frac{1}{2}$ cwt applied in December	
(2)	Sulphate of Potash – 2 cwt @ $78.10/ton	7.81
(3)	Serpentine Super Phosphate – 10 cwt @ $22.65/ton	11.32
		32.63
(4)	Lime – 20 cwt @ $5.20/ton	5.20
	(subsidies assumed not applicable to lime)	

(5)   Total Fertilizer Cost   ₰

      Total cost ex subsidy (except lime) 32.63

      Subsidy of ₰3.25/ton   2.43

                                           30.20

Assume 20 miles' cartage to and from
the farm = 1.75 tons to cart (in-
cluding lime)

Therefore: Other fertilizer   30.20
             Lime   5.20
             Freight   4.147   ₰

                                             39.547

(b)   Pest Control Programme[4]

      Time of application

        July   16 lb Bordeaux/unit
                      4 gal oil/unit
        Mid-November   4 lb Thiram/unit
        Early-December   2 lb Azinophos/unit
        January   2 lb Ethion/unit
                      4 gal oil/unit
        Late March   2 lb Azinophos/unit
                      4 gal oil/unit

      Cost:

      16lb Bordeaux   8.00
      12 gal oil (all season)   7.96
        4 lb Thiram   2.88
        4 lb Azinophos   5.00
        2 lb Ethion   1.72
                           25.56

(c)   Weed Control Programme

Spray under the vines (using a tractor boom spray) with
Paraquat twice each year because it is difficult to control
with a rotary mower mounted on the tractor.   Spray with
Weedazol once per year to control broadleaf weeds growing
directly under the vines.

Assuming 4657.78 sq.yd. sprayed per unit per application

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4.   N.Z.D.A. Recommendations

Paraquat	9315.56 sq. yd. at rate of	$
4 pints per acre	8 pints/unit/year	15.09
Weedazole	4657.78 sq. yd	
	8 pints/acre	5.14
	therefore 8 pints/unit/year	
	Total cost/unit/year	20.23

(d) Tractor Fuel Costs [5]

40 h.p. diesel tractor - 2 gal/hr

Diesel $0.185/gal

Oil 3% of fuel costs

cost fuel/hr

= 2 (0.185 plus 0.00555)

= approx. $0.38/hr.

(e) Running Costs of Tractor and Machinery

Repairs and Maintenance $/hour of use

Tractor	0.3410
Mower	0.2760
Spray	0.1102
Fertilizer Dist.	0.1340
Forklift	0.2000

[6]

(f) Freight Costs

Assumed small goods rate. The cost for weedicides, pesticides and fuel is imputed as $1.05 per unit of vines.

A.1.5.2 Casual Labour Requirements for Pre-Harvest Activities

Permanent labour is assumed to work for 7.5 hr per 8-hr day. The 0.5 hr per working day is allowed for 'smokos' and will be referred to as 'down time'. When labour is hired then it is assumed to work for 7.5 hr per 8-hr day but must be paid for 8 hr. The time (in hours) required per unit of vines for a permanent labour unit to carry out a pre-harvest activity must be multiplied by $\frac{8}{7.5}$ to determine the number of hours paid if those same activities are carried out by hired labour.

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5. Massey Farm Machinery Dept

6. From Jackson (10)

TABLE A.2.   Hours of work available from one permanent labour
unit for one year (1971).   An 8-hour day has been
allowed, but only 7.5 hours for actually carrying
out a task.

Month	Available hours for work – Monday – Friday
January	157.5
February	150.0
March	172.0
April	165.0
May	157.5
June	165.0
July	165.0
August	165.0
September	165.0
October	157.5
November	165.0
December	172.0

(a) Pruning

Pruning rates are dependent on many factors, the main ones being: method of vine culture, method of pruning and thoroughness of pruning.   The author used pruning rates achieved by some of the leading growers, who had reliable records.

(i) Winter Pruning

One permanent labour unit is assumed to prune 25 vines in an 8-hr day (7.5 hours actually working).   This activity must be carried out between mid-June and the 23rd of August. Eighty-four hours are required by a permanent labour unit to prune a unit of vines, or 89.6 paid hours for hired labour.

(ii) Summer Pruning

One permanent labour unit is assumed to prune 40 vines per 8-hour day (7.5 hours actually working).   Assume each vine must be pruned three times during the period between mid-November and the 28th of February at points equidistant in time.   One hundred and fifty-seven and a half working hours per unit are required for pruning for one permanent labour unit, i.e. 52.5 hours per pruning.

TABLE A.3.   Other Pre-Harvest Activities.

| | | Resources Needed | | |
Activity	Hrs/unit[7]	Tractor	Men	Equipment
Fertilizer application	0.5	1	1	Fertilizer spreader
Weed control	0.5	1	1	Boom sprayer
Pest control	1.0	1	1	Blast sprayer
Mowing	0.75	1	1	Rotary mower

TABLE A.4.   Annual Plan of Pre-harvest Operations (other than pruning)

Month	Mowing	Weed Control	Pest Control	Fertilizer application
July			1	
August	1			
September				1
October	1	1		
November	1			
December	2		1	1
January	2	1	1	
February	1	1		
March	1		1	
April	1			
May				
June				

A.1.5.3   Casual Labour Cost

Due to the timeliness requirements of the various pre-harvest activities there are certain months during the year when the permanent labour will be grossly under-utilized and the months when hired labour will be necessary if the vine acreage is beyond a certain area.   From Tables A.3 and A.4 it is evident that the pre-harvest activities of mowing, fertilizer application, pest spraying and weed control do not require a large labour input. The main activity influencing the need for casual labour is the winter and summer pruning requirements.   The maximum acreage of vines that one permanent labour unit can handle is approximately

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7.   No 'down time' included.

9 acres during the summer pruning period, and 7 acres
during the winter pruning period, therefore, according
to these restrictions the vine acreage cannot increase beyond
approximately   acres unless casual labour is employed.

TABLE A.5.   Winter Pruning Period Casual Labour Requirements.

Hours of casual labour that must be hired for ...

Permanent Labour Units	Vine Unit No.						
	3	4	5	6	7	8	9
1	0	53.2	90.66	90.66	90.66	et c.	
2	0	0	0	0	0	11.25	90.66 etc.

TABLE A.6.   Summer Pruning Period Casual Labour Requirements.

Hours of casual labour that must be hired for ...

Permanent Labour Units	Vine Unit No.					
	3	4	5	6	7	8
1	0	102.93	174.1	174.1	174.1	etc.
2	0	0	0	0	28.53	174.1 etc

Tables A.5 and A.6 show the acreage at which extra labour must
be employed and the labour required for each successive unit of
vines during the winter and summer pruning periods respectively.
Note that these figures also include requirements for activities
other than pruning during these periods.

TABLE A.7.   Casual Labour Cost ($) for Pre-harvest Operations.

	Vine Unit No.						
	3	4	5	6	7	8	9
One permanent labour unit	0	133.81	295.53	344.23	344.23	344.23	etc.
Two permanent labour units	0	0	0	0	37.09	240.91	344.23 etc.

The costs in Table A.7 are based on a rate of $1.30/hr for
casual labour. Though this rate may be slightly high for male
workers and excessively high for female workers, inflation and
imminent pay equality for women makes it a realistic figure for
the immediate future. The costs shown apply to the unit stated,
e.g. if a one-man farm had 7 units of vines, then the total cost for
pre-harvest casual labour would be: $133.81 + 295.57 + 344.23 + 344.23.

Summary of   1   Plant Fixed Costs

2   Orchard Fixed Costs

3   Pre-harvest Variable Costs

Plant Fixed Costs

Standard Equipment Combination

Interest	999.9	
Depreciation	612.21	
Insurance	53.97	
Repairs and Maintenance	264.86	1,930.94
Other Fixed Costs		216.62
Cost per Permanent Labour Unit		3,200.00

Orchard Fixed Costs

366.65

Pre-Harvest Variable Costs (ex casual labour costs)

Fertilizer	39.547	
Pesticides	25.560	
Weedicides	20.230	
Freight	1.05	
Tractor Costs	10.81	
Equipment Costs	2.92	100.121

A.1.6   Harvest Variable Costs and Harvest Input-Output
        Co-efficients.

A.1.6.1   Picking and Hauling.

(a) Picking

Fig. A.8

This operation involves plucking
the fruit from the vine by hand and placing
it in a bag slung around the picker's waist
(see Fig.A.8).   When the bag is full, the
fruit is emptied into a bin by opening a
flap at the bottom of the bag.   In
practice, for any given labour unit,
the picking rate (unit weight per unit
time) will vary according to the yield
per vine and the size of fruit.
Postulated relationships are shown in
Fig. A.9.

Fig. A.9   Graphical representation the probable effects
            yield per vine and fruit size have on the
            picking rate:

Picking
rate
lb/hr

Yield per vine   Fruit size
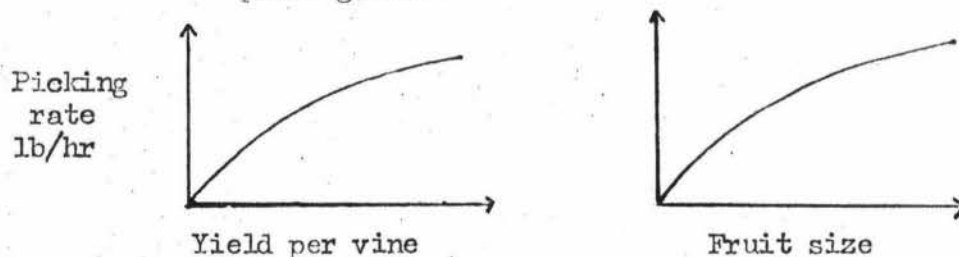
There is a plateauing off effect because the picker approaches
his maximum absolute rate and further size or yield increases tend
to have a diminishing effect.   However, incorporation of these
relationships is beyond the scope of this study and a high picking
rate has been used and it is assumed that the fruit size and yield
per vine have no significant effect on the picking rate.   The
assumed picking rate is 400 lb per picker per hour worked.   In an
8-hr day, 3000 lb per picker (7.5 hours working).

(b) Hauling

Allow 15 minutes for a full bin (780 lb) of fruit to be hauled from the vines to a packing and grading installation or a truck pick-up point. Hauling involves backing the tractor up to a full bin and lifting it up on the three-point linkage forklift, driving to the packing shed or transport pick-up point and depositing it, and taking an empty bin on the forklift and driving back to deposit it at an appropriate place for the pickers.

It is assumed that picking and hauling must be carried out between the 1st of May and mid-June, working weekdays only (essential if comparing with non-farm businesses). Each permanent labour unit can supply 240 hours of work during this period. When the labour reaches maximum capacity, then labour must be hired for any additional vines.

Table A.8 shows the picking and hauling labour cost per unit when all labour must be hired for that unit. Costs for yields other than listed can be calculated on a proportionate basis.

TABLE A.8   Cost of Harvesting Labour per Unit of Vines

Yield (lb/vine)	∮ Cost of Picking Labour	∮ Cost of Hauling Labour	∮ Total Cost
90	76.44	9.18	85.62
120	101.92	12.24	114.16
150	127.40	15.31	142.71

Table A.9 shows the first unit for which casual picking and hauling labour must be hired by one- and two-man farms, achieving three specific yields. The permanent labour unit(s) are able to carry out part of the picking and hauling operation on this first unit of vines, hence the full cost shown in the Table is not incurred for this unit.

TABLE A.9   Cost ($) of harvesting labour for the Unit
             of Vines at which the permanent labour reaches
             maximum capacity.

Yield lb/vine	Number of Permanent Labour Units	Vine Unit No.						
		1	2	3	4	5	6	7
90	1				9.43			
	2							24.96
120	1				0.92			
	2						19.42	
150	1			95.3				
	2					48.00		

TABLE A.10

Tractor running cost per unit of vines for hauling and
maximum number of units that one tractor can haul for

Yield (lb/vine)	Cost/Unit $	Maximum No. of Units
90	6.79	35.2
120	7.04	25.4
150	8.48	20.4

Maximum vine acreage that one tractor can haul fruit for in
the specified harvest period is dependent upon yield per vine.
There are assumed to be 240 haulage hours available.

A.1.6.2　Marketing Activities

(a) Packing and Grading

TABLE A.11　Cost prices of components[8] of the four installations.

Capital Item		P I	P II	P III	P IV
		$\cancel{\$}$	$\cancel{\$}$	$\cancel{\$}$	$\cancel{\$}$
Building		7,776.	37,700.	37,700.	50,500.
Land		675.	5,000.	5,000.	5,000.
Forklift	(Tractor 3-point linkage)		4,000.	4,000.	7,000.
Bin Marshalling		1,920.	2,000.	2,000.	2,000.
Sorting		(	(	(	(
Grading		(1,800.	(20,400.	(29,900.	(55,000.
Packing		1,860.	(	(	(
Lidding		960.	2,400.	2,400.	4,800.
Market Marshalling		144.	400.	400.	1,000.
Extras due to size		_____	_____	_____	2,000.
Total Capital Invested		15,135.	71,900.	81,400.	125,300.

8.　Capital requirements for cool storage has not been included for any of the packing and grading plants.　These costs are based on data supplied by Hancock.

TABLE A.12　　　Annual Fixed Costs of Installation P I.

Components of P I	Cost Price (New)	Average Value	Salvage Value	Depreciation Rate (%)	Depreciation Amount (A)[9]	Interest (%)	Insurance[10]
Building	7,776.	3,888.00	0	2.5	38.88	272.16	14.44
Bin Marshalling	1,920.	1,152.00	192.00	10	125.28	80.64	
Sorting & Grading	1,800.	1,080.00	180.00	10	117.45	75.60	
Packing	1,860.	1,116.00	186.00	10	121.37	78.12	15.20
Lidding	960.	576.00	96.00	10	62.64	40.32	
Market Marshalling	144.	86.40	14.40	10	9.40	6.05	

9.　A = Sn x 0.0725 (10 yr)

　　A = Sn x 0.005 (40 yr)

　　Sn = Cost price - salvage value

10.　Insurance Rates

　　　Building 37.037 cents per $100 (Av.value)

　　　Equipment 37.99 cents per $100 (Av.value)

(a)   Other Fixed Costs for P I.

Land

Assume packing shed is on 0.5 acres of land
of value ₰675.00

	₰
Interest	47.25
Rates	16.88

Repairs and Maintenance[11]

Machinery at 4%[12] per year of initial cost

267.36

Building at 2% per year of initial cost

155.52

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11.   Based on rates given in 'Culpin's Farm Machinery'.

12.   Possibly low.

TABLE A.13   Annual Fixed Costs of Installations P II, P III and P IV.

Installation	Cost Price $	Average Value $	Salvage Value $	Sn $	Interest 7% of Av. Value $	Depreciation [13] (A) $	Insurance $	Repairs & Maintenance $
P II								
Building	37,700	18,850	0	37,700	1,319.50	188.50	69.81	754
Machinery	29,200	17,520	2,920	26,280	1,226.40	1,839.60	66.40	1,168
Land	5,000				350.00			
P III								
Building	37,700	18,850	0	37,700	1,319.50	188.50	69.81	754
Machinery	38,700	23,220	3,870	34,830	1,625.40	2,525.17	88.00	1,548
Land	5,000				350.00			
P IV								
Building	50,500	25,250	0	50,500	1,767.50	252.50	93.51	1,010
Machinery	69,800	41,880	6,980	62,820	2,931.60	4,554.45	158.72	2,792
Land	5,000				350.00			

13. 10 yr   A = Sn x 0.0725
     40 yr   A = Sn x 0.005

(b) Discussion of Fixed Costs of Installations PII, PIII and PIV.

Interest Rate

7% of the average value.

Depreciation

Sinking Fund Method.

Insurance

Same rate as for Installation PI.

Repairs and Maintenance of Buildings

Two per cent of initial cost of the building per year is used. This is considered fairly realistic as repairs and maintenance on buildings is generally considered to be mainly a function of time.

Repairs and Maintenance of Machinery

In practice these costs would be a function of time, rate of work and amount of work, however, an incorporation of these factors is beyond the scope of this analysis because F.M.C. graders have never been used for grading and packing Chinese Gooseberries before, and data on orbit graders is not available. The important point to note about this analysis is that it is comparative, consequently repairs and maintenance costs have been included as fixed costs at a rate of 4% per year of the initial cost, though this may be an under-estimation.

Accounting Costs per Year

This would be a function of the total throughput per year and the installation size, however, at this stage it is considered sufficient for this analysis to regard it as a fixed cost of $1,000 per year.

Rates

5 acres at a value of $1,000/acre

2.5@ of unimproved value $125.00

Telephone $
                                                  150.00

The costs of auditing, rates, and telephone all become insig-
nificant compared with the overall costs of the packing and grading
operation, therefore, a considerable error in these costs will not
matter to this comparative analysis.

(c) Input, Output Co-efficients and Variable Costs of
     Installations PI, PII, PIII, and PIV

     (i)   Throughput Rates
           Assumed that the grading rate is the installation
           throughput rate.

     (ii) Labour Costs
           Foreman labour   @ $2.00/hr
           All other labour   @ $1.30/hr

     (iii) Packing Material Costs
           Assume : (a) 260 export trays for each ton of
                         export fruit
                    (b) 2nd grade fruit destined for New Zealand
                         market is packed in bushel cases (40 lb
                         fruit/bushel)
                    (c) cost of one export tray $0.244
                         cost of one 40 lb case $0.36
           therefore cost per ton for export fruit $63.44
                     cost per ton for 2nd grade fruit $19.60

     (iv) Cool Storage Costs
           Costs are for one month only, i.e. it is assumed
           that the fruit remains in cool storage for one month.
           Charges are 5 cents per 10 lb of fruit, or one export
           tray. Assumed that 98% of the fruit that is picked
           is cool stored.

     (v)   Freight Costs
           Freight cost to the cool store (if using PI) or to
           packing and grading installation is assumed to be $3.56
           per ton of fruit. If the packing and grading installation
           is on the farm then the fruit is assumed to be transported,

after packing and grading, by non-refrigerated trucks
to a cool store.   If the packing and grading install-
ation is not on the farm (PII, PIII or PIV) then the
fruit is transported in the bins into which it was
placed after picking, to either of PII, PIII or PIV where
the cool store is also situated.

(vi) Power and fuel, 1% of packing material cost.

TABLE A.14   Labour Requirements for Each Installation.

Installation	PI	PII	PIII	PIV
Administration	1	4	1	2
Bin Marshalling	1	4	1	1
Sorting	1	4	4	8
Packing	4	16	16	32
Containers in	1	4	4	6
Containers out	1	4	3	6
Market Marshalling	1	4	2	4
General	1	4	2	2
	11	44	33	61

TABLE A.15   Quantities of Each Grade of Fruit Obtained per Day
for Specified % Export Fruit and Wastage for a
50 ABU/hr installation.

For a Daily Throughput of Fruit 3.9843 tons

Grade Percentages obtained			Quantity of each grade (lb)			Material Cost ($) Per Day
Export	2nd	Waste	Export	2nd	Waste	
90	8	2	8032.5	714.0	178.5	233.73
80	18	2	7140.0	1606.5	178.5	216.26
70	28	2	6247.5	2499.0	178.5	198.80
60	38	2	5355.0	3391.0	178.5	181.37
50	48	2	4462.5	4284.0	178.2	163.86

TABLE A. 16

Installation	Tons Through-put Per Day	Labour Require-ment	Labour Cost Per Day	Cool Store Cost (∅) Per Day's Throughput	Freight Cost (∅) Per Day's Throughput
PI	3.9843	11	120	43.73	13.92
PII	15.9375	44	460	174.93	55.68
PIII	15.9375	33	338.8	174.93	55.68
PIV	31.875	61	613.6	349.86	111.364

TABLE A. 17

Total Variable Costs (∅) per Ton

	% Export Fruit				
Installation	90	80	70	60	50
PI					
0-120 tons	103.83	99.40	94.97	90.55	86.12
121-159	123.95	119.52	115.09	110.07	106.24
PII	103.83	99.40	94.97	90.55	86.12
PIII	94.97	90.54	86.12	81.69	77.26
PIV	93.46	89.04	84.61	80.18	76.07

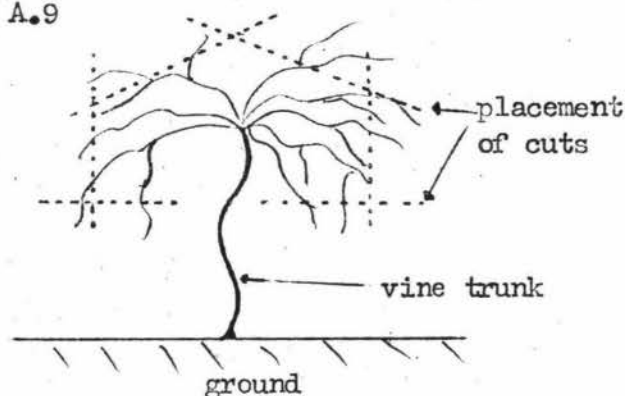Summary of Installation Fixed Costs (∅)

Installation

PI	1,544.52
PII	8,257.21
PIII	9,743.38
PIV	15,185.28

A.2   Mechanical Pruning Cost Estimation Method and Key Assumptions.

Assume three cuts each side of row, therefore six cuts per row.

Fig. A.9

Assume that vines are pruned once for winter pruning and three times for summer pruning. The vine layout is assumed to be the same as outlined in Figs. A.1 to A.7 Assume 294 feet per row per cut, therefore, total of 35,280 feet per unit. Assume the tractor moves at one mile per hour, therefore, requires 6.68 hours per unit of vines (of approximately seven rows). Assume contract hedge cutting charge of $7/hr resulting in $49 per unit per pruning or $196 per unit per year. (Assume unlimited amount of contract time available.)

With a one-man farm what limits on acreage now exist?

In December and January 50 units (100 acres) of vines are approximately the maximum that one man can handle if the required pest control, weed control and mowing are to be carried out at the correct time. The other restrictive period is during harvesting. Bin haulage hours available from one tractor are assumed to be 240 hours.

TABLE A.18   Key Data

Yield (lb/vine)	Tons Unit	Maximum No. of units one tractor can haul bins for	Maximum No. of units one man can handle during December and January
30	3.28	101	50
60	6.56	50	50
90	10.04	33.2	50

A.3   Overseas Exchange Potential Estimation Methods.

A.3.1   Kiwi Fruit

For the derivation of domestic cost per dollar of overseas exchange earned, Farm Size II[14] has been used and is assumed to be operating with 20 acres of vines, yielding 120 lb of fruit per vine, 70% of which is exported.   Since 70% of the fruit is exported, then 70% of costs common to both export and local fruit is attributed as the cost of export fruit.   Costs specific to export fruit have been added separately (e.g. export trays).

Total farm production	131.25 tons
Total export production	91.875 tons
Cost to farmer of export production	$20,800.
Therefore cost per tray	$0.87.

Domestic Costs	Per Export Tray $NZ	
Farm production cost	0.87	
Freight to wharf	0.07	
Export commission	0.225	
Cool storage cost at wharf	0.05	
Wharfage	0.023	
Domestic cost per tray		1.238

Invisible Costs	Per Export tray $US	
Freight to United States	0.616	
Publicity	0.066	
Insurance	0.0363	
Invisibles cost per tray		0.7183
Net Export Receipts ($US)		
Gross revenue per tray	3.465	
Invisibles cost	0.7183	
Net export receipts per tray		2.7467

Net cost per US dollar earned

$$= \frac{1.238}{2.7467} \quad = \quad \$NZ \ 0.45$$

_____

14.   See page 74

A.3.2   Butterfat

The farm cost of butterfat production is based on Jackson's
(10) analysis.   Plant size two, subclass b operating at maximum
capacity of 226 cows (constant milkfat per cow) is used.   The
cost curve for these assumptions is B_2B_2 and is shown in Fig 7.33,
page 103 Volume II of Jacksons thesis.   Production per cow is
assumed to be 300 lb of butterfat.   Allowance for factory costs
to f.o.b. is 4.11 cents per lb of butterfat, taken from the interim
costs published in the New Zealand Dairy Board Annual Report,
1971-72.   The net price received overseas per lb of butterfat by
the Dairy Board is assumed to be ⌀US 0.55

	⌀NZ
Farm cost per lb of butterfat	0.36
Factory cost to f.o.b. per lb of butterfat	0.0411
Total NZ cost per lb of butterfat	0.4011
Net export receipt per lb of butterfat	⌀US 0.55

Therefore the domestic cost per net
US Dollar earned $= \dfrac{0.4011}{0.55}$

$$= 0.73$$

A.3.3   Estimation Method to Determine the Net Overseas Exchange
Resulting from Export of Kiwi Fruit by 1980.

Assume (a) Net returns per tray ⌀US2.74
       (b) 260 trays per ton of export fruit.

Current Prices

| 6000 tons exported in 1980 | ⌀US4.274 million |
| 8000 tons exported in 1980 | ⌀US5.6992 million |

2/3 Current Prices

| 6000 tons exported in 1980 | ⌀US2.402 million |
| 8000 tons exported in 1980 | ⌀US3.20 million |

A.4   Recent Report on the Cling Peach Industry.

Merry-Go-Round Slows Down for Cling Peach Industry

California's cling peach industry seems to have turned the
corner in a bloody struggle to bring supply into balance with demand.
That is good news to a lot of people. Clings are No. 1 in canned
fruit markets. And, when clings are in trouble, other fruit markets
get hurt.

Current trade reports give hope that by midsummer - end of the
pack year - inventories will be down to what the industry figures is
a good working level. But no one is celebrating a victory; the cost
has been high. It will take several years to recover from the
wounds; thousands of acres of orchard pulled out, dozens of growers
forced to the wall, several canners squeezed to the point of merger
or ownership changes. And there's still plenty to worry about.

Loss of export markets was one of the major factors that put
clings into deep trouble. Hope for recovering part of that loss was
shattered by the long strike of Pacific Coast dockworkers; the
industry may have lost as much as 25% of potential export sales.
In spite of the sharp cut in acreage, there are still enough trees
in the ground to produce more than the market can easily handle.
And any upturn in grower returns may bring heavy new plantings,
starting the familiar, disastrous cycle.

This one began with two big packs back-to-back in 1968 and
1969. Then troubles multiplied. South Africa and Australia took
some export sales from the United States. A faltering national
economy was reflected in lower domestic sales. And the tight money
market sent interest costs skyrocketing on canners' huge inventories.

Growers responded, under the state marketing order, by eliminat-
ing big tonnages over the past three years by "green drop", cannery
diversion, tree removal, and surplus pooling. Profits turned to
red ink in the process. In 1971, growers probably averaged around
$50 per ton for their crop, including the surplus tonnage; production
costs may run $60 to $70 per ton.

The California Canning Peach Association is prepared to come
back again with the "Full Supply Contract" proposal it offered a
year ago. That proposal provided for long-term contracts to give
the association tight control over supply. Canners showed interest,

but not enough to put the program into effect. Then the association sought legislation to limit new plantings. The bill was passed by the legislature but vetoed by Gov. Reagan.

Growers also are moving through the state marketing order to expand research in processing, new products, and consumer attitudes, in addition to strong advertising.

In the export market, several major canners are working with dried fruit and nut handlers to develop a new joint export sales agency, under the Webb-Pomerene Act. That law allows domestic competitors to combine forces in export markets. And the new agency, Pacific Agricultural Corp. for Exports (PACE) could be in operation for this year's pack.

American Fruit Grower
February, 1972.

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