AGRICULTURAL ECONOMICS RESEARCH UNIT
LINCOLN COLLEGE

*in association with*

ECONOMICS SECTION, SCHOOL OF SOCIAL SCIENCES
UNIVERSITY OF WAIKATO

# TOWER SILO FARMING IN NEW ZEALAND

## PART II
## ECONOMIC POSSIBILITIES

*by*

D. McCLATCHY

Research Report No. 58
1969

## *THE AGRICULTURAL ECONOMICS RESEARCH UNIT*

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# PREFACE

This is the second report arising from Mr McClatchy's investigations into tower silo farming in New Zealand. As stressed in his first report, there is insufficient evidence from the past operation of these farming methods in New Zealand to assess their economic profitability. Instead, three budget situations are explored in detail: winter beef fattening, wintering store beef weaners, and town supply dairy; and the relative profitability of the system is assessed by this method.

Section A sets out the assumptions which have been taken into account in all three studies; Section B sets out the capital and current budget for each farm type, and Section C summarises the results. Some readers may prefer to skip over the detailed discussion of the assumptions and methodology of these analyses (Section A, subsections 3 and 4), and also the itemized details of each budget (Section B).

It is interesting to note that, of the three hypothetical tower silo development programs chosen, Mr McClatchy shows one to be apparently profitable (a town supply dairy unit with a large daily milk quota), one to be of marginal profitability (a winter beef fattening unit), and one apparently unprofitable (a store beef wintering unit), at present prices.

Once again I am happy to acknowledge the help received from the New Zealand Silo Society in this work.

B.P. Philpott

September 1969

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# TOWER SILO FARMING IN NEW ZEALAND
# PART II : ECONOMIC POSSIBILITIES

## 1. SECTION A : INTRODUCTION

A review of the present usage of tower silos and silage in New Zealand farming was presented in a previous publication in this series.* The approach was largely descriptive, and discussion concentrated on establishing the principal implications for practical management in each of the main areas of application of tower silo methods. There was no attempt at an economic profitability analysis of any particular tower-silo enterprise, or of tower silos in general.

In this bulletin, full programs of capital investment and annual returns and costs are budgeted for three hypothetical farm enterprises incorporating the use of tower silos: winter beef fattening, wintering store beef weaners, and town supply dairy. Each of these represents a unique farm situation and production enterprise, and it is emphasised that the profitability of the use of tower silos can be expected to be different for each situation. No general pronouncement can validly be made about the value of tower silo usage in all situations.

It appears that in most cases the initial investment in tower silos will bring about considerable changes in the whole management system. In fact, most farm annual cost items will be affected to some extent by the change. Thus to systematically and thoroughly take into account all the quantifiable benefits and costs of any given tower silo system will necessitate looking at most

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* See Agricultural Economics Research Unit Research Report No. 56, Tower Silo Farming in New Zealand, Part I : A Review.

items of the whole farm budget. For this reason, the approach used here has been to attempt to estimate the profitability of the whole farm investment including tower silos and associated buildings and plant. This farm net profit level 'with silos' can be compared with that level expected for the same farm 'without silos' (farmed by more conventional methods), and any difference in favour of the former can be imputed as a return on this incremental farm capital investment is then available for comparison with rates obtainable in other alternative on-farm or off-farm investments.

It is believed that such a method of analysis is to be preferred to one which attempts to analyse and compare the relative costs per unit of silage stored as between tower silos and alternative methods of storage.

Criterion of Profitability:

In the present analyses we are concerned with several points of view.

Primarily, interest centres on the man who already owns a farm which he is currently farming conventionally, but who has the opportunity of borrowing the capital required for a tower silo development program. He will be concerned whether a positive surplus remains (over and above his pre-silo farm income) to justify the tower silo change over, after interest charges on borrowed capital have been met. Where some capital repayment is expected annually, then there must be a surplus above living requirements from the overall farm enterprise to allow this charge to be met. Where no capital repayment is required until the end of a stated period, then it is important that provision be previously made for refinancing at this time.

Similarly the lender is interested to know whether the enterprise for which he is considering advancing money is likely to provide sufficient returns to allow the borrower to meet commitments of interest and capital repayment. Where most of the required capital is borrowed, then the lender concerned will require the expected rate of return to be at least as high as the rate of interest he intends to charge. If the lender is only supplying part of the capital requirements, but has first call on surpluses available for interest payments, then a lower rate of return on all development expenditure than the interest rate charged may satisfy him. Another important point of view is that of the farmer who is considering a further investment of his own money capital in his farm in the form of tower silos and ancilliary structures and equipment. This investor will want to know whether the post-tax rate of return to this new 'incremental' farm capital thus invested will compare favourably with the best return he could obtain by investing the same capital in another direction, e.g. in another farm, in a first mortgage loan, or in stocks and shares. He may decide that he can obtain a 5 per cent return per year (after tax) in the best alternative avenue; this is his personal 'opportunity cost' of capital. Then, for him, the tower silo investment will be a profitable or economically worthwhile one if it returns greater than 5 per cent on the capital involved. It should be borne in mind that this approach represents an over-simplification in that different levels of risk are normally associated with different types of investment, and that investment X with an expected return of 4 per cent per year may be just as attractive as investment Y at 6 per cent per year where the level of risk is considered to be higher with the latter.

Some readers may be interested in the profitability of the investment from the point of view of the country as a whole. Here 'pre-tax return on investment' figures have traditionally sufficed.[1] Many analyses conducted from the nation's point of view take 6 per cent per year to be an acceptable return on such a capital investment. This assumes that the same capital would earn 6 per cent if invested elsewhere.

In the pages which follow annual budgets have been prepared for each farm. Any pre-tax surplus remaining after deduction of farm expenses (including depreciation and wages of management, but not interest payments) from gross revenue for the year can be regarded as the total return to all farm capital. This total farm capital is divided into 'original farm capital' and 'new' or 'incremental' capital involved in the tower silo investment. The 'pre-silo' return on original farm capital under conventional farming methods is taken as equal to the average rate of return at present being earned in farming in the region concerned, as indicated by various surveys and aggregate studies as discussed in the next section. This 'pre-silo' net return can then be deducted from the 'post-development' net return in order to obtain the return to the incremental capital involved in the tower silo investment. This latter figure is further adjusted, e.g. converted to a post-tax figure, depending on the point of view being considered.

In adopting this method of analysis it is being assumed that the whole tower silo development and capital investment occurs in one year, and that the annual budget presented represents the average situation in every year thereafter.

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1 Though it is pointed out by J. T. Ward (pers comm.) that if taxation incentives are introduced in the country's interests then the post-tax analyses for the average individual for various projects should indicate their relative profitabilities to the country as a whole as well as to the individual.

Average Rates of Return on Capital with Conventional Farming Practices:

These can be expected to vary from region to region, as well as with the level of management provided.

From time to time analyses of total farm profitability on specific farms appear in the various farming journals, and in special publications such as this one. In addition, the New Zealand Department of Statistics, the New Zealand Dairy Board, and the New Zealand Meat and Wool Boards' Economic Service, publish annual survey data covering cross-sections of farms. In some instances the rate of return on capital is actually calculated, and in other cases it can be estimated from the data presented. Some confusion arises because the method of valuation of land used is sometimes historical and sometimes an estimate of the true current market value. Further evidence for average rates of return in farming in New Zealand comes from aggregate series of farm income and expenditure and land prices.

A fair conclusion from all this evidence would appear to be that on average over the last decade or so, rates of return in farming in the Auckland/South-Auckland areas have been of the order of 3-4 per cent of total farm capital (land valued at market rates) in both seasonal dairying and fat lamb type units.[1] It may

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1. See: a. N. Z. Dept. of Stats.: 'Ann. Survey of Sheep Farmers' Incomes.'
   'Ann. Survey of Dairy Farmers' Incomes.
   b. N. Z. Dairy Board: 'Survey of the Economic Structure of Factory-Supply Diary Farms in N. Z.'
   c. N. Z. Meat & Wool Boards' Economic Service: (Bull. 12 plus Ann. supplements) 'Financial Analysis of N. Z. Sheep Farms.'
   d. R. W. M. Johnson, (in prep.).

be argued that figures derived in this manner represent an average level of management, while in the programs presented here a fairly high level of management efficiency is assumed. On the other hand it will be noted that the units taken are smaller than average conventional farms, and this will tend to make their pre-silo rate of return rather lower than average. It is assumed that these considerations cancel each other out, and that there is justification for adopting such an average rate of return figure as indicative of the profit level obtainable under conventional farming practices on the units concerned.

Taxation Considerations:

Considerable emphasis is placed in this bulletin on the estimation of the after-tax profitability of the tower silo development. This emphasis reflects the belief that the individual farmer is first and foremost interested in the prospective change in his own cash income, and that this cannot be validly represented in an analysis which ignores taxation.

For any given level of net farm income, the individual's income tax commitments will vary considerably, depending on several factors. It is important that the reader should modify the results obtained here according to his own particular circumstances. Nevertheless, it is useful for illustrative purposes to calculate the post-tax situation for a given individual, even though the particular set of assumptions involved may have only a narrow range of applicability in practice.

For the purposes of this discussion it will be assumed that the individual considering a tower silo development program, already owns the basic farm unit, in which he holds 100 per cent equity, and will be borrowing all the necessary capital for development at 6 per cent. Various levels of off-farm income are explored. Starting from a high equity situation, but using largely borrowed capital for development appears to be the most typical situation found in practice. It is emphasised, however, that the post-tax profitability will be just as important in other situations, which are not discussed here. The same principles should be used in modifying the pre-tax results appropriately for each particular individual situation in order to obtain the change in post-tax net income due to tower silo development.

Normally it could be expected that any change (increase or decrease) in net income before tax, as a result of some farm development, would be diluted by taxation to some extent, so that the change in post-tax net income would be less. Under a progressive tax system, such as exists in New Zealand, the extent of such dilution (i.e. the difference between the post-tax and pre-tax income changes) will increase as the level of assessable income increases. However, if advantage is taken of the various taxation incentives for farm development which exist at present, it is quite possible in certain situations that the change in assessable income is considerably different from the change in 'real' farm income before tax.[1] As a result it is possible that the increase in post-tax real income is actually higher than the increase in pre-tax real income, or alternatively, possible that a positive change in

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1. 'Real' income is taken here as the true business income, net of expected actual levels of depreciation and other expense, and as distinct from that level of income indicated by the taxation accounts.

post-tax real income be consistent with a negative change in pre-tax real income. Such situations are more likely to occur where the pre-development level of assessable income is already high (e.g. marginal tax rate is at or approaching the maximum level of 67.5 cents in the dollar), and hence the tax saving effect of the various incentives is higher. Of course such extreme situations are not necessary for investment or development program 'X' to be more profitable than program 'Y' in the post-tax analysis, even though it appeared less profitable in the pre-tax analysis.

Estimates of tax payments 'before' and 'after-silos' have been made for each farm example for the case of a married man with two children of school age, and paying $250 worth of deductable life insurance premiums. The object of this exercise is to test the extent to which certain taxation incentives for farm investment make this enterprise a relatively more attractive one 'after-tax' than 'before-tax'. Such incentives include special depreciation rates, the opportunity to deduct some items of capital expenditure (of minor significance in this case), and higher-than-actual levels of ordinary depreciation for some items.

The 'special depreciation' allowance, which provides for accelerated writing off of assets, is of considerable significance here. Most farm buildings and plant machinery items qualify for this allowance and the tax savings will be equal to the tax payable on that portion of the total depreciation allowance which exceeds the true level of annual depreciation. For assets depreciated on a cost price (C.P.) basis (e.g. buildings) this may be 20 per cent (the full value of special depreciation which is allowable in addition to ordinary depreciation) of asset value spread over the first few years, in which case, for a farmer paying tax at the maximum rate, the total tax savings would be equal to 13.5 per cent of asset value.

For those assets which are depreciated on a diminishing value (D. V.) basis, the tax-saving incentive of the special depreciation allowance is much less, and in many cases negligible. Here the higher depreciation deductions in early years result in a lower book value and hence lower level of depreciation allowable in later years. Where income is steady, or varies in an unpredictable fashion from year to year, then taxation payments are merely 'put off' till later years in this case by claiming special depreciation, rather than being significantly reduced over the life of the asset.

Since 1967, depreciation on simple loafing barns and wintering barns of all types has been allowable for taxation purposes at 10 per cent C. P.[1] Only $2\frac{1}{2}$ per cent C. P. for depreciation has been allowed here in the budget for Farm A for a wintering barn of fairly solid construction. If $2\frac{1}{2}$ per cent is a realistic rate, then a taxation incentive exists to the extent of $7\frac{1}{2}$ per cent of the capital cost of the wintering barn as a tax deduction each year, - a considerable amount in this instance.

The 'investment allowance' represents another type of taxation incentive which has been offered for a period in the past, but which at present is only available on the West Coast of the South Island. This allowance is disregarded here.

Further Points about the Present Analysis:

(1) Capital costs of buildings and silos : farm labour content.

It has been assumed in each case that a certain amount of farm labour is available (in slack work-load periods) for use

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1. These inflated ordinary depreciated rates are extended to all new farm buildings, and the allowance termed 'supplementary depreciation', in the 1969 budget proposals.

as the main unskilled labour force in the laying of concrete, erection of silos, and erection of feed bunks, stalls, and barns. The value of such labour has not been included in the total capital costs of these investments on the grounds that such labour has already been paid for and that the opportunity cost of its use in this way is zero. It appears that such a situation is a realistic one on many farms, and that farm labour has been used in this way on most farms which have already become established with a tower-silo-based organisation. Total cash costs of building erection in several recently recorded cases have been considerably lower per square foot than those used in these budgets, which are themselves intended to be lower than government valuation levels.

(2) Assumed Repairs/Maintenance and Depreciation Rates for Buildings, Plant and Machinery

Estimates of these items must of necessity be fairly arbitrary. Standard rates of allowance are an attempt to approximate as close as possible to what has been observed as the averages of such costs incurred for the various categories of capital items. There appears to be no evidence to suggest that the rates of repairs/maintenance and depreciation with plant and machinery associated with tower silos will differ from those for similar classes of plant and machinery at present in general use on farms.

For the typical item, depreciation will be relatively high and repairs/maintenance relatively low, in the first few years immediately following purchase. This position gradually reverses as the asset gets older. It appears that the combined figure of depreciation plus repairs/maintenance will be much more constant in each year than either of its constituents. In the present instance such a constant combined figure is assumed for each category, and the figures adopted are expressed below in terms of a percentage of new price:

| Item Category | Annual Depreciation plus repairs/ maintenance of % of new cost | Made up of the following average figures for: Depreciation | Rep/Maint. |
|---|---|---|---|
| Houses (farm share) & farm buildings | 5 (C.P.) | $2\frac{1}{2}$ (C.P.) | $2\frac{1}{2}$ (C.P.) |
| Tower Silos | $6\frac{1}{2}$ (C.P.) | 5 (C.P.) | $1\frac{1}{2}$ (C.P.) |
| Motorised plant & Machinery | 20 (C.P.) | 20 (D.V.) | 10 (C.P.) |
| Not-motorised p. & m. Class A | 15 (C.P.) | 15 (D.V.) | $7\frac{1}{2}$ (C.P.) |
| Not-motorised p. & m. Class B* | 10 (C.P.) | 10 (D.V.) | 5 (C.P.) |

* Class A includes items of plant and machinery with a more frequent usage and/or a higher proportion of moving parts and/or higher speed moving parts than Class B.

(3) Wages of Management; Farm Share of Manager's House, Car.

In these enterprises, with high capital/output ratios, wages of management charged have purposely not been related to total farm capital. Rather an owner-manager situation is implied, and the manager's salary is purposely maintained at the level considered to be appropriate for the farm prior to the tower silo investment. This ensures that no gains from the development are 'hidden' in a higher management reward. Wages of management have been purposely set slightly higher in town supply dairying because of the work load involved.

It is desirable, for purposes of comparison with other off-farm investment alternatives, that the farm business be not required to provide the owner with a free house and car. Consequently, interest, depreciation and repairs/maintenance on part only of the manager's house (office, facilities) has been charged against the farm. The farm business has been charged with hire of the owner-manager's car, on a per mile basis, to the extent of its estimated usage for business purposes.

(4) Total Dry Matter Losses with Herbage Stored in Tower Silos

The figures adopted here are considered to be 'best estimates' based on a considerable amount of published overseas evidence which was summarised in the previous bulletin.[1] These wastage rates, expressed as a percentage of the herbage dry matter stored, are as follows:

| Silage Type | Field Losses | Storage Losses | Feeding Losses | Total Losses |
|---|---|---|---|---|
| A. For Tower Silos completely air-sealed | | | | |
| Corn | 4 | 4 | 1 | 9 |
| Haylage, Wilted Lucerne | 10 | 4 | 1 | 15 |
| B. For Tower Silos incompletely air-sealed | | | | |
| Corn | 4 | 8 | 1 | 13 |
| Haylage, Wilted Lucerne | 10 | 10 | 1 | 21 |

1. See Tower Silo Farming in N.Z. Part I, A Review, Agricultural Economics Research Unit Research Report No. 56.

(5) Estimates of Cattle ad lib Intakes and Rates of Liveweight Gain on Various Tower-Silage Based Diets

These input/output ratios are highly critical with respect to the result of the analysis in each case. The figures adopted here vary with the type of animal and the type of silage, and are specified later for each program. These assumptions are regarded as fair 'best estimates' for each particular situation, in the light of rather scant New Zealand evidence to date and a good deal of published American data.

Intake and growth rate data under New Zealand conditions come from recent work of Bryant at Ruakura, and of Brown at the R. & W. Hellaby Limited Research Farm at Paerata, near Auckland. Further data, on growth rates only, have been obtained from the liveweight records of two silo farmers over the past season. All these data have been recorded under conditions of full housing for the livestock concerned. They encompass both corn silage and pasture haylage, and a wide range of animal size, as well as sex and breed differences. None of these data have, as yet, been published. In general the New Zealand results have been similar to what might be expected on the basis of American trial results. There appears to be nothing to suggest that the qualities of grass/clover haylage and corn silage conserved in towers in this country are significantly different from those observed for silage from the same crops in the U.S.A.

The above conclusions appear to be further borne out by the results of basic chemical analyses of a limited number of tower silage samples carried out over the past season by Lancaster at Ruakura (pers. comm.).

Consideration of all the above evidence from this country together with a good deal of published overseas evidence (summarised in Part I of this Report), has led to the following energy ratings[1] being assumed here for the main silage types: (Mcal = Megacalorie)

| | |
|---|---|
| Mature corn silage | = 1.2 Mcal M.E./lb. D.M. |
| Wilted Lucerne Silage; Haylage | = 1.1 Mcal M.E./lb. D.M. |

These estimates have been used as the basis for arriving at fodder intake rates and growth rates used in the budgets. Animal requirements for minerals, vitamins, and protein have also been taken into consideration, and it is believed that the rations specified meet these requirements in each case.

## SECTION B : HYPOTHETICAL CASE FARM PROJECTIONS

### (1) FARM (A) WINTER BEEF FATTENING.

This enterprise consists essentially of the winter fattening, under housed conditions, of beef breed animals for the spring local butchers' market. Mature store animals are bought in the late autumn at 900 lb. L.W. and sold prime in September-October at 1,200 lb. L.W. A spring price premium on the fat stock market in these months of $1.5 per 100 lb. carcase weight over autumn

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1. Using Blaxter's "metabolisable energy" concept. (see Blaxter, K.L., 1962, "Progress in Assessing Energy Value of Feeding-Stuffs for Ruminants", Jl. R. Agric. Soc. Eng., 123:7-21.)

values is assumed. This follows the pattern of recent years as evidenced by published Westfield and Addington Fat Stock Market Reports.[1]

Capital, and annual income and expenditure budgets follow. Tower silo development results in an increase in total farm capital from $75,000 to nearly $187,000, and the pre-tax interest surplus for the whole farm after development is $5,219. Program details are given in Appendix A (p.47) entitled "Budget Notes for Farm (A)".

1. See monthly livestock market reports in the "N.Z. Meat Producer".

## CAPITAL & ANNUAL BUDGETS FOR FARM (A)

(Winter Beef Fattening)

| | Capital Cost $ | Annual Fixed Charge % | Annual Fixed Charge $ |
|---|---|---|---|
| **1. Capital Involvement** | | | |
| Original Land & Buildings: | | | |
| 110 acres (1 house) @ $500/ac. | 55,000 | | |
| Of this, buildings etc. = $20,000 | | 5 | 1,000 |
| New Buildings & Structures: | | | |
| New house - farm share 1/6 | 2,000 | 5 | 100 |
| Three 25' x 60' tower silos erected (incl. base) @ $10,700 each | 32,100 | 6.5 | 2,087 |
| Two 120'x100' cattle barns @ $1.5/sq.ft. | 36,000 | 5 | 1,800 |
| One 120' transfer auger @ $10/ft. | 1,200 | 15 | 180 |
| Electric power supply & wiring | 750 | 5 | 38 |
| Two 120' feed bunks with chain conveyors @ $15/ft. | 3,600 | 10 | 360 |
| Machinery: | | | |
| Electric motors: Two 3h.p. (chain conveyors) @ $60 | 120 | | |
| One 5h.p. (t/f auger) @ $85 | 85 | 15 | 64 |
| Two 7½h.p. (unloaders) @ $110 | 220 | | |
| Tractors: One 72h.p. | 4,000 | | |
| One 65h.p. | 3,400 | 20 | 1,680 |
| One 35h.p. (2nd hand) | 1,000 | | |
| Two self-unloading forage waggons @ $2,000 | 4,000 | 15 | 600 |
| 5' Forage harvester ($2,000) plus 1-row corn pick-up ($850), windrow pick-up ($650), & sickle-bar ($1,000) attachments | 4,600 | 20 | 920 |
| Two 25' silo unloaders @ $1,500 | 3,000 | 20 | 600 |
| One silo loading blower plus distributor | 1,100 | 20 | 220 |
| One sickle bar mower plus hay conditioner | 1,000 | 15 | 150 |

| | Capital Cost $ | Annual Fixed Charge % | Annual Fixed Charge $ |
|---|---|---|---|
| One vacuum slurry waggon with pump, plus one agitation auger | 1,000 | 15 | 150 |
| Other machinery: Discs, plough, harrows, roller, cultivator, rake, boom spray | 2,000 | 10 | 200 |
| **Livestock:** | | | |
| (Take $^1/_3$ of capital value for interest purposes as finance is required for 4 months only) $^1/_3$ x 620 head x $80/hd. | 16,560 | | |
| **Working Capital:** | | | |
| Average requirement for interest purposes (for other than livestock purchase) | 10,000 | | |
| Annual Fixed Charge (Depreciation plus Repairs/Maintenance) - c.f. to Annual Budget | | | 10,533 |
| Total Farm Capital (for annual interest purposes) After Development | 186,575 | | |
| Estimated Original Total Farm Capital (110 acre dairy farm) | $75,000 | | |
| Therefore Incremental Capital Investment in Tower Silo Enterprise Development | $111,575 | | |

## 2. Annual Budget

### Expenditure

| | $ | $ |
|---|---|---|
| Depreciation & Repairs/Maintenance b.f. | | 10,533 |
| **Other Overheads:** | | |
| Accountant, Administrative, Phone | 250 | |
| Insurance (Buildings 150, Plant 100, Personal 30, Employers Liab. 20) | 300 | |
| Rates (Land tax nil, - U.V. < 60,000) | 200 | |
| | | 750 |
| **Electricity:** | | |
| (Silo etc. 70) | | 250 |
| **Labour:** | | |
| Wages of Management | 2,800 | |
| Married Man | 2,000 | |
| Casual | 200 | |
| | | 5,000 |
| **Animal Health:** | | |
| Vet club membership, visits & drugs | 30 | |
| Lice spray 620 hd. @ $.05/hd. | 31 | |
| | | 61 |
| **Fertiliser:** | | |
| 40 ac. Pasture: 4 cwt. super (30% K) = 8 ton @ $30/ton | 240 | |
| 60 ac. Corn to Winter ryegrass: 5 cwt. super (30% K) = 15 ton @ $30/ton | 450 | |
| 1 cwt. ammophos = 3 ton @ $60/ton | 180 | |
| 1 cwt. urea = 3 ton @ $60/ton | 180 | |
| Lime : 20ac. @ 1 ton = 20 ton @ $3/ton | 60 | |
| Spreading: Fertilizer 200 ac. $.40/ac. Lime 20 ac. @ $1/ac/ | 100 | |
| | | 1,210 |

| | $ | $ |
|---|---|---|
| Freight: | | |
| Fert. & Lime: 49 ton (for 25 miles av.) @ $3/ton | 147 | |
| Livestock: In 620 (100 miles av.) @ $4/head. | 2,480 | |
| Out 614 (50 miles av.) @ $3/head | 1,842 | |
| | | 4,469 |
| Weeds & Pests: | | |
| Weeds in Corn: 1 lb. a.i./ac. of 24D amine (or MCPA/Dicamba mix) 60 ac. @ $4/ac. | 240 | |
| Wireworm & cutworm: $1\frac{1}{2}$pt. Diazinon/ac. 60 ac. @ $5/ac. | 300 | |
| Armyworm: 90ac. (av. $1\frac{1}{2}$ applications) methoryl @ 8oz. a.i/ac. + aerial application $6/ac/ tot. | 540 | |
| Grass grub/porina: 13ac. DDT prills @ $2.5/ac. | 33 | |
| | | 1,113 |
| Seed: | | |
| Corn: 60ac. @ $\frac{1}{4}$ bush./ac. = 15 bush. @ $14 (hybrid) | 210 | |
| Grass: 70ac. @ $^2/_3$ bush./ac. = 50 bush. @ $2 (av.) | 100 | |
| Clover: 70ac. @ 5lbs. = 350lb. @ $.3 | 105 | |
| | | 415 |
| Vehicle Expenses: | | |
| Tractors (fuel & lub.) 2000 hrs. @ 35c./hr. (av.) | 700 | |
| Car (all expenses) 5000 miles @ 10c/mile | 500 | |
| | | 1,200 |
| TOTAL ANNUAL EXPENSES | | $25,001 |

| Income | $ | $ |
|---|---|---|
| Cattle Account: | | |
| Sales: 614 @ $130 = $79,820<br>Less Purchases: 620 @ $80 = $49,600 | | 30,220 |
| Pre-Tax Interest Surplus (Income-Expend.) | | 5,219 |

This represents an overall pre-tax return on total farm capital ($186,575) of 2.8%.

If interest at 3.5% on the original capital of $75,000 (=$2,625) is deducted, then:-

(i) The incremental pre-tax interest return on development capital is 2.3% $\left( \frac{5219 - 2625}{111,575} = 2.3 \right)$

(ii) If an interest charge of 6% of total development capital of $111,575 (= $6,695) is also deducted, the development shows a net pre-tax loss of $(2,625 + 6,695 - 5,219) = $4,101.

(2) FARM (B) WINTERING STORE BEEF WEANERS

This South Island light land farm derives its revenue solely from the wintering of weaner cattle, and their subsequent sale on the spring store market. The ration fed is largely tower silage made from lucerne, which is grown on practically the whole farm area. The annual work load of the one man enterprise is distributed conveniently over harvesting of the silage in the summer, and feeding and managing the cattle in the winter. Considerable casual labour is employed at various times to help with lucerne silage harvesting and certain items of livestock work. The animals are not housed.

Once again, budgets of capital involved, and of annual income and expenditure, appear below. Here the development has resulted in an increase in total farm capital from $55, 000 to $136, 000, and a whole farm pre-tax interest surplus of $1, 788. For details see Appendix B (p. 55 ).

## CAPITAL & ANNUAL BUDGETS FOR FARM (B)

(Wintering store weaner steers)

| | Capital Cost $ | Annual Fixed Charge % | $ |
|---|---|---|---|
| **1. Capital Involvement** | | | |
| Original Land & Buildings: | | | |
| 320 acres (1 house) @ $120/ac. = 38,400 less non-farm portion of house 7,000 | 31,400 | | |
| Of this, buildings etc. = $8,000 | | 5 | 400 |
| New Buildings & Structures: | | | |
| Five 25' x 60' Tower silos @ $11,300 (erected) | 56,500 | 6.5 | 3,673 |
| 20 sled-type 25' feeding troughs @ $4/foot | 2,000 | 10 | 200 |
| Electric power & wiring | 400 | 5 | 20 |
| Grain bins plus unloading auger & motor | 750 | 15 | 112 |
| Machinery: | | | |
| Tractors: One 72h.p. (4000) & one 65h.p. (3400) | 7,400 | 20 | 1,480 |
| One 25' silo-unloader plus 7½h.p. el. motor | 1,600 | 20 | 320 |
| One self-unloading forage waggon | 2,000 | 15 | 300 |
| One sickle bar mower & one conditioner | 1,500 | 15 | 225 |
| One silo loading blower with distributor | 1,100 | 20 | 220 |
| One 5' forage harvester (2,100) plus windrow pick-up (650) attachment | 2,750 | 20 | 550 |
| One grain crusher (440) plus 3h.p. el. motor | 500 | 15 | 75 |
| Other machinery: Plough, discs, harrows, cultivator, roller, rake, boom spray | 2,500 | 10 | 250 |
| Livestock: | | | |
| (Take 5/12 of capital value for interest purposes as finance required for 4 months only) 5/12 x 1000 head x $40/head | 16,666 | | |

Working Capital:

| | | |
|---|---|---|
| Average requirement for interest purposes (for other than livestock purchase) | 9,000 | |
| Annual Fixed Charge (Depreciation plus Repairs/ Maintenance) - cf. to annual budget. | | 7,825 |
| Total Farm Capital (for annual interest purposes) After Development | 136,066 | |
| Estimated Original Total Farm Capital (320ac. light land farm) | $55,000 | |
| Therefore Capital Investment in Tower Silo Enterprise Development | $81,066 | |

## 2. Annual Budget

| | $ | $ |
|---|---|---|
| **Expenditure** | | |
| Depreciation & Repairs/Maintenance b.f. | | 7,825 |
| Other Overheads: | | |
| Accountant, administrative, phone | 250 | |
| Insurance (Buildings 150, Plant 60, Personal 30, Employers Liab. 20) | 210 | |
| Rates (Land Tax nil) | 175 | |
| | | 635 |
| Electricity: | | |
| (Silo etc. 50) | | 150 |
| Labour: | | |
| Wages of management | 2,600 | |
| Casual | 800 | |
| | | 3,400 |
| Animal Health | | |
| Vet. club membership, visits & drugs | 60 | |
| Lice spray: 1000hd. x $0.03/hd. (av. 3 times) | 90 | |
| Drench: 1000hd. x $.5/hd. (av. twice) | 1,000 | |
| | | 1,150 |
| Fertiliser: | | |
| Lime: 50ac. @ 1 ton/ac. = 50 tons @ $2.70/ton (spread) | 135 | |
| Rev. super: 50ac. 2cwt./ac. = 5 tons @ $25.25/ton | 126 | |
| Bulk Cu-super: 250ac. @ 3cwt./ac. = 37.5 tons @ $33.5/ton | 1,256 | |
| Spreading: 500ac. (2 applications) @ $15/ac. | 250 | |
| | | 1,767 |

| | | $ | $ |
|---|---|---|---|
| Freight: | | | |
| Grain: 3,000 bush. (av. 25 miles) @ $.05/bush. | | 150 | |
| Fert. & Lime: 93 ton (av. 30 miles) @ $3.5/ton | | 326 | |
| Livestock: In 1,000 weaners (av. 100 miles) @ $2/hd. | | 2,000 | |
| Out 950 yearlings (av. 25 miles) @ $1/hd. | | 950 | |
| | | | 3,426 |
| Seed: | | | |
| 50ac. lucerne @ 8lbs./ac. = 400lbs. @ $.5/lb. | | | 200 |
| Weed & Pest Control: | | | 200 |
| Vehicle Expenses: | | | |
| Tractors (fuel & lub.) 2,000 hrs. @ $.35/hr. (av.) | | 700 | |
| Car (full hire) 5,000 miles @ $.1/mile | | 500 | |
| Other travel expenses | | 200 | |
| | | | 1,400 |
| Stock Food: | | | |
| 3,000 bush. barley @ $.85/bush. | | | 2,550 |
| TOTAL ANNUAL EXPENSES | | | 22,703 |

<u>Income</u>

| | | $ | $ |
|---|---|---|---|
| Cattle Account: | | | |
| Sales: 950 @ $70 | = 66,500 | | |
| less 3% commission | 2,000 | | |
| | 64,500 | | |
| less Purchases: 1000 @ $40 | 40,000 | | |
| | | | 24,500 |
| Pre-tax Interest Surplus (Income-Expenditure) | | | 1,788 |

This represents an overall pre-tax return on total farm capital ($136,066) of 1.3%.

If interest at 3.5% on the original capital of $55,000 (=$1,925) is deducted then:-

(i) The incremental pre-tax interest return on development capital is less than zero. $\left(\frac{1788 - 1925}{81,066}\right)$

(ii) If an interest charge of 6% of total development capital of $81,066 (= $4,864) is also deducted, then the development shows a net pre-tax <u>loss</u> of $(1925 + 4864 - 1788) = <u>$5001</u>.

(3) <u>FARM (C)</u> TOWN SUPPLY DAIRY (NORTHLAND)

A town supply dairy proposition in Northland, in an area where soil conditions in the winter typically make pasture pugging damage by the grazing animal a major problem. Excess spring/summer pasture growth is conserved as haylage in towers, and is fed as the sole supplementary feed for a large part of the year, and particularly in the winter, when, for a period, more than one half of the total daily DM intake of the milking cows may be provided from this source. A fairly high level of quota, as a proportion of total farm production, is assumed. The herd is grazed for one half of the day only (not at all in bad weather) in the winter period. The capital budget below shows a level in total farm capital after development of nearly $135,000. Prior to development this total is estimated at $101,000. The annual income and expenditure budget shows a pre-tax interest surplus (after development) of $12,643. Details are given in Appendix C (p.58).

## CAPITAL & ANNUAL BUDGETS FOR FARM (C)

(Town supply dairy)

| | Capital Cost | Annual Fixed Charge | |
|---|---|---|---|
| | $ | % | $ |
| **1. Capital Involvement** | | | |
| Original Land & Buildings: | | | |
| 160ac. (2 houses, h/bone milk shed) @ $550/ac. less non-farm portion of 1 house ($7,000) | 81,000 | | |
| Of this, buildings etc. $23,000 | | 5 | 1,150 |
| New Buildings & Structures: | | | |
| Two 20'x55' Tower Silos @ $6,700 erected | 13,400 | 6.5 | 871 |
| 120 uncovered loafing cubicles @ $15/cubicle | 1,800 | 5 | 90 |
| New concrete yard area | 750 | 5 | 38 |
| 60' feed bunk plus chain conveyor at $18/ft. | 1,080 | 10 | 108 |
| 53,500 gal. effluent tank | 800 | 5 | 40 |
| Electric power & wiring (from milk shed only) | 500 | 5 | 25 |
| Machinery: | | | |
| Electric motors: One 5h.p. (unloader) $85, One 2h.p. (conveyor) $48 | 133 | 15 | 21 |
| One unloader for 20' diam. silo | 1,300 | 20 | 260 |
| One silo loading blower plus distributor | 1,100 | 20 | 220 |
| One sickle bar mower, one conditioner | 1,100 | 15 | 150 |
| One 5' Forage harvester plus windrow pick-up | 2,750 | 20 | 550 |
| One self-unloading forage waggon | 2,000 | 15 | 300 |
| Tractors: One 72h.p. (4000), one 65h.p. (3400) | 7,400 | 20 | 1,480 |
| One vacuum slurry waggon plus pump, and one agitation auger | 1,000 | 15 | 150 |
| Other machinery: Discs, plough, harrow, cultivator, roller, boom spray, rake | 2,000 | 10 | 200 |

| | | | |
|---|---|---|---|
| **Livestock:** | $ | $ | |
| 120 cows @ $100 = | 12,000 | | |
| 22 yearling heif. @ $80 = | 1,760 | | |
| 24 heif. calves @ $50 = | 1,200 | | |
| 2 bulls @ $120 = | 240 | | |
| | | 15,200 | |
| **Working Capital:** | | | |
| Average requirements for interest purposes | | 1,500 | |
| Annual Fixed Charge (Depreciation plus Repairs/Maintenance) - cf. to annual budget | | | 5,653 |
| Total Farm Capital (for annual interest purposes) | | 134,713 | |
| Estimated Original Total Farm Capital | | $101,000 | |
| Therefore incremental capital Investment in Tower Silo Enterprise Development | | $33,713 | |

2. Annual Budget

| | $ | $ |
|---|---|---|
| **Expenditure** | | |
| Depreciation & Repairs/Maintenance b.f. | | 5,653 |
| Other Overheads: | | |
| Accountant, administrative, phone | 250 | |
| Insurance (Buildings 120, Plant 60, Personal 30, Employers Liab. 20) | 230 | |
| Rates | 250 | |
| | | 730 |
| Electricity: | | |
| (Silo etc. 120, M. shed 340, Rest 150) | | 610 |
| Shed Expenses: | | |
| 120 cows @ $2.5/cow | | 300 |
| Herd Testing: | | 200 |
| Artifical Breeding: | | 350 |
| Animal Health: | | |
| Vet. club membership, visits, drugs, vaccinations | 300 | |
| Lice spray & worm drench | 50 | |
| | | 350 |
| Labour: | | |
| Wages of management | 3,500 | |
| Married man | 2,500 | |
| Casual | 300 | |
| | | 6,300 |
| Fertiliser: | | |
| Lime: 20ac. @ 1 ton = 20 ton @ $4.ton (spread) | 80 | |
| New grass: 10ac. @ 3cwt. Super ($NH_4$) = 1.5 ton @ $35/ton | 53 | |
| 10ac. @ 2cwt. Super (30%K) = 1 ton @ $30/ton | 30 | |

| | $ | $ |
|---|---|---|
| Rest pasture: 140ac. @ 4cwt. Super (30%K) = | | |
| 28 ton @ $30/ton | 840 | |
| 50ac. @ 2cwt. Nitrog. fert. = | | |
| 5 ton @ $55/ton | 275 | |
| Spreading: Fert. - 340ac. @ $.5/ac. | 170 | |
| | | 1,448 |
| **Freight:** | | |
| Cull cows: 19 (for 30 miles) @ $1.7/head | 32 | |
| Fertiliser & lime: 56 ton @ $4/ton (av.) | 224 | |
| | | 256 |
| **Weed & Pest Control:** | | 500 |
| **Seeds:** | | |
| 10 ac. New Grass @ $3/ac. (W. clover 5 lb. @ $.35/lb., P. Ryegrass 0.4 bush. @ $1.5/bush, H1 Ryegrass 0.2 bush. @ $1.5/bush.) | | 30 |
| **Vehicle Expenses:** | | |
| Tractors (fuel & lub.) 2000 hrs. @ $.35/hr. | 700 | |
| Car (full hire) 2000 miles @ $.1/mile | 200 | |
| | | 900 |
| TOTAL ANNUAL EXPENSES | | 17,627 |

## Income

| | $ | $ |
|---|---|---|
| **Milk Sales:** | | |
| (inclusive of estimated end of season bonuses) | | |
| Feb., March, April (Q+10%) | | |
| 220 gal. @ 29c. = $63.8 } x 89 days | 5,678 | |
| 76gal. @ 16c. = $12.2 } x 89 days | 1,086 | |
| May, June, July, August, (Q+10%) | | |
| 220 gal @ 35c. = $77.0 } x 123 days | 9,471 | |
| 76 gal. @ 16c. = $12.2 } x 123 days | 1,501 | |
| September, October, November, December, January, (Q+17%) | | |
| 234gal. @ 24c = $56.2 } x 153 days | 8,599 | |
| 62gal. @16c = $ 9.9 } x 153 days | 1,515 | |
| | | 27,850 |

| | $ | $ |
|---|---|---|
| Bobby Calves: | | |
| 90 @ $10/head | | 900 |
| Cull Cows: (deaths 1%) | | |
| 19 @ $80/head | | 1,520 |
| Total Income | | 30,270 |
| Pre-tax Interest Surplus (Income-Expenditure) | | 12,643 |

This represents an overall pre-tax return on total farm capital ($134,713) of 9.4%.

If interest at 10% on the original capital of $101,000 (=$10,100) is deducted then:-

(i) The incremental pre-tax interest return on development capital is 7.5% $\left( \frac{12,643 - 10,100}{33,713} = 7.5 \right)$

(ii) If an interest charge of 6% of total development capital of $33,713 (= $2,023) is also deducted, then the development shows a net pre-tax profit of $(12,643 - 10,100 - 2,023) = $520.

## SECTION C : INTERPRETATION OF AND CONCLUSIONS FROM THE PROGRAM BUDGET RESULTS

### (1) FARM (A) WINTER BEEF FATTENING

#### (a) Profitability before tax

The pre-tax figures give an indication of the profitability of an enterprise from the country's point of view, but not from that of the individual with whom we are more concerned here.

At the prices adopted and under the present assumptions this overall enterprise shows a pre-tax interest surplus of $5,219. The tower silo development has resulted in an increase in total farm capital from the original of $75,000 to the new level of nearly $187,000, - an increase of $112,000 representing a considerable capital intensification on the farm concerned.

It is estimated that the farm in its original state would probably be earning about 3.5 per cent on capital. In this case the pre-tax return to the incremental capital of tower silo development would be 2.3 per cent. Alternatively, if an interest charge of 6 per cent is made against this incremental capital (as would be the case if it was all borrowed at this rate) then the development would show a net pre-tax loss of $4,101; i.e. net income before tax would be $4,101 lower after development than before.

Under the same assumptions (development capital borrowed at 6 per cent) the break even beef price level, at which point the development would be worthwhile in a pre-tax analysis, can be estimated. A purchase to sale margin of $50 per beast has been used in the budget. An increase in this margin of about $7 would be required before the development would become profitable by this criterion. Such an increase in the fattening margin would be expected if the spring prime slaughter price level were to rise above the $19.5 per 100 lb. carcase weight assumed here.

It seems reasonable to expect that an increase in the margin of \$7 per head would imply an increase in the value of the slaughtered animal of some \$18 per head, or about 14 per cent. This in turn implies a rise in the spring price paid by the butcher to about \$22-22.5 per 100 lb. carcase weight. Such spring fat-stock market prices could be expected when the beef export schedule for G.A.Q. ox is at approximately \$20.5 - 21 per 100 lb. The North Island schedule was at roughly this level at the time of writing.

It should be noted that so far no quality premium has been assumed for these feed lot/corn silage fattened cattle. They have been taken as of average butcher-acceptability spring prime cattle. In fact there is some evidence to suggest that these cattle are of above-average attractiveness to the local butcher. Some reported sales in the 1968 spring season were at values considerably above average ruling at this time. If future experience offers further evidence to confirm the claims of some that such a quality premium also exists (apart from the normal seasonal premium at this time of year already allowed for) then the present budget will have to be modified. A \$50 margin may prove to be ultra-conservative even at an export schedule level (G.A.Q. ox) of \$18 per 100 lb. carcase weight.

(b) Profitability after tax.

Very little of the capital expenditure involved in a tower silo development program could be incorporated in the taxation accounts as current expenditure (cf. some other types of farm development). Consequently most taxation benefits in such cases accrue through the special depreciation allowance on those assets (mainly buildings) which can be depreciated on a cost price basis, and higher-than-actual depreciation allowances on some such assets. The development proposed for Farm A, unlike the other examples, includes quite a large proportion of investment in assets qualifying in both above cases (approximately $40,000 out of a total of $112,000).

Tax savings through the claiming of special depreciation can be spread over not more than the first 5 years of an asset's life. Savings derived from higher-than-actual depreciation rates continue as long as such levels are allowed. Illustrative calculations of the post-tax profitability presented below aim to find the average situation for the first 5 years. In later years when the special depreciation benefits do not accrue the after-tax position will be somewhat less attractive.

It is assumed that over all farm assets the total of 'ordinary' depreciation allowable for taxation purposes, approximates to the estimated total of real depreciation. This takes into consideration the fact that allowable rates on some non-motorised plant items are probably too low, but that on the other hand allowances for house and private car are probably liberal. The Inland Revenue Department advise that, following a submission in 1966, the decision was made to allow tower silos to be depreciated at 10 per cent D.V., which is in line with the 5 per cent C.P. used in these budgets.

It is assumed that there is no long run advantage to be gained from claiming 'special depreciation' on assets depreciable only on a D.V. basis, and that no such claims are made.

The case being considered is for a man with total personal income tax deductions (both before and after development) of $1,910, made up of personal exemption $936, wife exemption $312, allowances for 2 children at $156 each, donations and school fees $100, and insurance premiums $250. Social security tax is paid on all assessable income less $208.

In the first instance no off-farm income will be assumed. Then before development assessable income will be $5, 425 (wages of management $2, 800, plus $3\frac{1}{2}$ per cent of $75, 000), and total tax paid will be $1, 158, leaving a net income after tax of $4, 267. After development into tower silos cash income will be $1, 324 (wages of management $2, 800, plus surplus $5, 219, less interest on development capital $6, 695) according to the budget. However, this net income is more than covered by the average value of special depreciation allowable on all buildings ($^1/5$ x 20% x $40, 000= $1, 600) plus ordinary depreciation allowed on wintering barns in excess of real rates ($7\frac{1}{2}$% x $36, 000 = $2,700) and no tax will therefore be paid. In this case the development has resulted in a reduction in pre-tax income (after interest charges) of $4, 101, and a reduction in post-tax income of $2, 943.

Far more benefit is obtained from the taxation incentives where the level of income is initially high. If there is an additional off-farm income of $6, 000 per year, then assessable income before development totals $11, 425 and tax paid totals $4, 645 leaving a net post-tax income of $6, 780. The position after development is an assessable income of $3, 024, a tax bill of $364, and a net post-tax income of $6, 960. In this case the fall in pre-tax net income with development is the same ($4, 101) but post-tax net income has <u>increased</u> by $180. In these income circumstances the beef fattening margin per head adopted in the budget is sufficiently high for the tower silo development to be profitable using capital borrowed at 6 per cent interest.

For the development to break even at 6 per cent in the pre-tax analysis, an increase in the fattening margin of \$7/head, and in the spring sale price of \$2.5-3 per 100 lb. carcase weight to \$22-22.5 per 100 lb., was estimated to be required. However with a high initial or pre-development income, the development appears to be already profitable in the post-tax analysis. In other words, under such circumstances the taxation incentives have the effect of reducing by up to \$3 the break even beef sale price (per 100 lb. carcase weight). This break even price is now estimated at \$19.4 per 100 lb., or a lower price than might be expected by the average supplier on the spring fatstock market with the existing beef export price schedule level.

It seems reasonable to conclude that for all cases the spring sale value required for the development to break even at 6 per cent will lie somewhere between \$19.0 and \$23.0 per 100 lb. carcase weight depending on the personal income tax position of the individual concerned.

(2) FARM (B) WINTERING STORE BEEF WEANERS

(a) Profitability before tax

Less confidence must be placed in the input/output feed relationships used for an environment like this, where far less evidence is available for animal intakes and performances. A pre-tax interest surplus of \$1,788 after development is budgeted. Incremental development capital totals approximately \$81,000. Following the same procedures used in the Farm (A) analysis, we allow for pre-development earnings (after wages of management have been deducted) of 3.5 per cent on the original farm capital of

$55,000.

Under these assumptions, if development is carried out with owner's capital then there is no positive return to this capital, annual income is actually slightly depressed. Where development capital is borrowed, and a 6 per cent interest change has to be met, then the development results in a fall in total farm net income of $5,001 before tax.

To make up this deficit, and thus make the development worthwhile, an increase in the wintering margin by some $6 per head to $36 per head is needed. This would imply an increase in the beef schedule level from the $18 per 100 lb. carcase (GAQ ox) on which the budget is based by some 20 per cent to $21.6 per 100 lb. It may be argued by some that a wintering margin of more than $30 per head could be obtained under such conditions with the beef schedule at a level of $18 per 100 lb., in which case the required beef price level for the development to break even may be less than the above $21.6 per 100 lb. The converse would also apply.

(b) Profitability after tax

The development proposed for Farm (B) includes no investment in buildings, and therefore there is not the same taxation incentive in this case through special depreciation or high ordinary depreciation allowances. Once again the amount of capital expenditure which can be deducted is negligable. Thus the effect of tax here is merely to reduce the net profit, or the loss, as a result of development, which is indicated in the pre-tax analyses.

After-tax net profits before and after development are estimated for this farm, under the same assumptions of personal exemptions as were taken previously for Farm (A) (see p. 35), and assuming an off-farm income of $2,000. Pre-tax net income is then $6,525 before development and $1,524 after development (interest on development capital paid at 6 per cent), a change of -$5,001. Post-tax net income is $4,891 before development and $1,425 after development, a change of -$3,466.

The increase in the wintering margin (and the general beef price level) for the development to break even in the post-tax analysis would be similar in this case to that increase required to reach the break-even point in the pre-tax analysis. Note that the beef export price schedule level estimated to correspond to the break-even wintering margin of $36 is $21.6 per 100 lb. carcase weight (GAQ ox).

## (3) FARM (C) TOWN MILK SUPPLY (NORTHLAND)

### (a) Profitability before tax

The budget for this enterprise shows a pre-tax interest surplus of $12,643 which represents a return on total farm capital ($134,713) of 9.4 per cent. On this basis it would appear that where such a high-valued product as town milk is involved, the use of tower silos for forage conservation may be well justified, even without the use of higher yielding plant crops. Note that animal health expenses in the budget have been set at a fairly low level, on the assumption that metabolic upsets and bloat will be kept to a minimum in the herd with this type of feeding.

The marginal or incremental analysis may not present quite such a favourable picture for the tower silo enterprise, depending on the rate of return expected on such a farm under more conventional methods. For instance, it may well be argued that a town supply unit with this level of quota should be able to achieve a 10 per cent (or perhaps even more) return on total farm capital, even after allowing a rather higher labour/management reward per man (as has been done here) to compensate for the extra effort involved in milking cows all the year round. When 10 per cent of the original farm capital ($101, 000) is deducted from the interest surplus shown, then $2, 543 remains as a return to the additional 'tower-silo' capital input of $33, 713. The incremental return to the tower-silo development would thus be 7. 5 per cent, which, if the required capital can be borrowed at 6 per cent, would make the tower silo development worthwhile. After interest on this capital had been paid, net pre-tax profit would be $520 per year higher than before development.

In this town milk farm example, it is apparent that there will not only be a 'break even' average milk price (other things than milk price being equal), and a 'break even' interest rate (other things than interest rate being equal), but also a 'break even' <u>quota</u> level on any one specified farm. Where the quota is realtively low, then the tower-silo development may not be economically justified. The quota level in this example is very high.

(b) Profitability after tax

A small, but significant, proportion of development expenditure is proposed in this case on assets which are depreciable for taxation purposes on a cost price basis, and thus offer some taxation incentive in the first few years after development through the special depreciation allowance. Such assets would total approximately $2, 000, and consist largely of the covered feeding bunk and the effluent storage tank. In fact, deductions for such assets of this value could be spread over the first 2 years only, but to keep this analysis consistent with that for Farm (A) the average tax for the first 5 years will be calculated. Average special depreciation deductions on $2,000 over this period would amount to $80 per year.

Assuming no off-farm income, and the same mix of personal income tax deductions is adopted for the Farm (A) post-tax analysis (see p. 35), post-tax net income would show a rise of $223 from $7,487 to $7,710 with the tower silo development as programmed here. This assumes that capital borrowed at 6 per cent is used for the development, and that in its pre-development state the farm was earning (pre-tax) 10 per cent on total farm capital after deduction of wages of management. This post-tax rise ($223) in net income through development is much less, due to the high level of taxable income and hence high marginal tax rate, than the pre-tax rise of $520.

It would appear that there may be considerable incentive, through taxation considerations, to include in the development a roof over the free-stall area. Then special depreciation, and the high ordinary (10 per cent C.P.) depreciation rates for loafing barns could be allowed on not only the roofing structure but also the stalls structure, resulting in considerable taxation savings. These savings, in addition to greater milk production per head due to decreased food demands for animal maintenance (therefore leaving more consumption available for production) as a result of providing more shelter in the form of a complete roof over the cubicles, may justify such additional expense, which may be thought necessary for other reasons.

## (4) GENERAL CONCLUSIONS

The present profitability of the use of tower silos under certain special circumstances, some examples of which were cited in Part I of this double report, has not been questioned here. Rather, an attempt has been made to analyse the profitability of chosen enterprises involving towers on farms without such special characteristics and not running pedigree livestock. Projections for hypothetical units have been the basis for these analyses because of the lack of sufficient historical data for existing tower silo units. Even if sufficient data were available most present operators feel that the efficiency of their operations with tower silos to date, due to the lack of information and advice available in New Zealand with respect to this new technology, has been well below what they, and others, will be able to achieve in the future.

The overall enterprise of a high quota town-supply dairy farm with tower silos appears to be a profitable one, though the value of the incremental investment in tower silos will vary considerably depending on the rate of return assumed for the farm in its original state. The use of tower silos and associated plant on seasonal factory-supply dairy units has not as yet been subject to the same thoroughness of analysis, and no conclusion in this direction can follow here.

On the basis of the results obtained it would seem that beef prices are now at or closely approaching the level at which the use of tower silos for fodder conservation with specialist beef enterprises concentrating on out-of-season production can be profitable for the individual after tax. Maintenance of the relevant seasonal price margin in each case, however, depends on such out-of-season production from all farms in total being limited. As total out-of-season production increases in volume, then the size of the seasonal price premium, on which the profitability of these enterprises tends to depend, can be expected to be eroded.

'All-season' or 'in-season' beef production by tower-silo/feedlot methods, where no dependence is put on seasonal price premiums, and which therefore offers much more scope for general expansion, has not been examined in this bulletin. With the gradual improvement of poorer hill country wich is taking place, it is likely that the supply of older store cattle will gradually diminish. For this reason it appears that the fattening of younger animals should be considered in long run planning of enterprises such as this. For growth rates of over 2 lb. per day with such younger animals, American evidence would suggest that supplementation of tower silage with grain, vitamins,, minerals, antibiotics, and in the case of corn silage, with protein (e.g. pea meal) and/or urea may be necessary. These would considerably increase the feed stuff cost. In addition a lower average fattening margin per head would have to be accepted with all-year-round fattening. On the credit side capital costs of machinery and housing would be lower per head of stock fattened than in the FARM (A) analysis, and feed requirements per animal lower. Preliminary calculations indicate that beef prices would have to rise to a level corresponding to a beef export schedule price for GAQ ox of $25-30 per 100 lb. carcase weight before such a system would be profitable under New Zealand conditions. This observation must be very tentative at this stage.

In comparing tower silo and feed lot systems with other alternative methods of beef production, some will argue that if any one system is less profitable than another system at a given beef price, then it will be relatively less profitable at all beef prices. This conclusion is challenged here with the hypothesis, implied in the discussion above, that, as product (e.g. beef) prices rise, tower silo/feed lot systems will gain in relative profitability as compared to grazing systems. The reasons for this belief depend basically on tower silo/feed lot systems being relatively capital-intensive and grazing systems being relatively land-intensive, in terms of their input value ratios. As product prices rise, then land market values can be expected to respond so that in the long run rates of return earned in farming are maintained at 'normal' levels. With capital-intensive systems, however, land price increases will not decrease the profitability of the whole enterprise to the same extent as with land-intensive (grazing) systems unless matched by equivalent increases in the values and new costs of capital assets. This latter is unlikely to happen : physical capital costs have in the past shown much more constancy through time than land values. It would appear to be logical that, as the value of extra production,[1] which can be obtained from a given area of land by the use of more capital-intensive methods of farming, increases, than at some stage a point will be reached where it becomes more profitable to obtain this extra production by such capital intensification rather than by the purchase of additional land. It appears from the present analysis that on some farm types, in some districts, and for some products, this point has already been reached in New Zealand.

The above discussion has concentrated on summing up the profitability of various types of tower-silo investments before

1. It is taken as established that, on suitable land types, the quantity of utilisable and digestable dry matter obtainable from a given area of land with a non-grazing cropping system including summer corn and winter greenfeed will exceed that obtainable from grazed pasture.

tax. In general terms it may be concluded that where management aims at obtaining seasonal premiums for out-of-season production of beef or milk, then prices are at present at, or not far below levels which would justify the investment in a tower silo system by the arbitrary, though commonly accepted criterion, of earning 6 per cent annual return on capital.

Because the pre-tax situation comes so close to being profitable, or is profitable, in these examples at present, it seems very likely that there are already situations where the investment would be a profitable one for the individual when taxation considerations are taken into account. It is apparent that the farmer already paying income tax on a considerable part of his income at the maximum rate, and who, takes advantage of the taxation allowances available to him, can achieve considerable savings in taxation which may not be obtainable with alternative investments with a higher pre-tax rate of return on capital.

So far, in the discussion of results and conclusions, the emphasis has been on determining whether a tower-silo development program would be worthwhile for the individual who already owns a farm, and who has the opportunity of borrowing capital for this development, but only for this development, at a 6 per cent interest rate. Some readers will be more interested in choosing between alternative dispositions of money capital for farm development or for investment in general. Their concern will be in deciding which types of farm development (or investment) yield the highest rates of return (before or after tax) rather than whether any one program returns more than 6 per cent, on results in an increase in net income after tax. The object of this study has been to give indications of the profitabilities of tower-silo based developments. The reader must look elsewhere for similar information on other new farming techniques and types of development, and make his own comparisons.

Considerable further investigatory work remains to be done in the field of tower-silos, and other capital-intensive farming systems. If the reports of this study succeed in shedding some light on the subject and providing some quidelines, then its purpose will have been served.

# APPENDIX A

## Budget notes for Farm (A)

(1) Land:

110 acres of arable land in the North/South Auckland area, capable of 15,000 lbs. D.M. production from improved pasture, and purchased for $500 per acre. This figure includes land, plus normal levels of buildings and improvements, including one house. A second house is built for $12,000 for the owner-manager, but only $2,000 worth of this is regarded as farm capital (office facilities).

(2) Utilisation:

| | |
|---|---|
| 60ac. | Summer hybrid corn (15,000 lbs. D.M./ac.) $\longrightarrow$ winter short rotation ryegrass/white clover greenfeed (7,000 lbs. D.M./ac.). |
| 40ac. | Improved permanent pasture; perennial ryegrass/white clover dominant (15,000 lbs. D.M./ac.). |
| 10ac. | House, buildings, shelter. |

10 acres of new permanent pasture sown each year after six years of corn/winter greenfeed. In pasture for 4 years before corn cropping program begins again.

Corn crop and summer/autumn pasture growth (Nov.-May) all conserved as silage in towers for winter feeding. Winter production of permanent pasture and temporary pasture fed to housed animals as greenchop material.

| (3) Storage Requirements for Silage | | D.M. |
|---|---|---|
| Haylage from 40ac. permanent pasture at 5 short tons/ac. (summer production) | = | 200s tons |
| Corn silage from 60 ac. at 7.5 short tons/ac. | = | 450s tons |
| Total tower silo capacity requirement (D.M.) | | 650s tons |

For flexibility in silo and unloading machinery usage it is desirable to have silos of the same size.

Proposed diet is a mixture of haylage and corn silage, and therefore unloading will proceed from 2 silos at once. It is recommended that unloading rate be not less than 3 inches per day, to avoid excessive aeration damage at the air interface. Thus, a minimum desirable total silo height can be deduced:

(120 days x $\frac{1}{4}$ft/day x 2 silos from which fed) feet = 60 feet. Three 25' diam. x 60' high silos, each of 225 tons D.M. capacity, would easily meet this constraint (total height 180 feet exceeds the required 60 feet), and would also satisfy the requirement of 650 short tons D.M. total capacity.

Quoted prices for unsealed types of tower silo of this size are mainly in the range of $45-60 per ton of D.M. capacity (erected cost on farm).

This price does not include transport to the farm. Most silo manufacturers offer concessions up to a certain mileage. However, a nominal allowance of 50 miles at $5 per mile for materials and construction personnel transport is made in this case.

A deduction can be made where farm labour is used in silo erection. If such labour is supplied at no opportunity cost, then total cost saving may be of the order of $400 with the silo base, and $400 with the actual erection.

| | | |
|---|---|---|
| 225s. tons silo at $50/s. ton capacity | = | 11,250 |
| Add $250 for transport costs, and | | |
| Deduct $800 for farm labour used in erection | = | -550 |
| Net Cost per Silo | | $10,700 |

(4) Fodder available for feeding winter (D.M. basis)

| | | | |
|---|---|---|---|
| Haylage | : 200 s. tons stored less 21% wasted | = | 158 s. tons |
| Corn Silage | : 450 s. tons stored less 13% wasted | = | 391 s. tons |
| Direct cut forage | : (a) 60ac. SR ryegrass at $3\frac{1}{2}$ s. tons per ac. - say 3 s. tons/ac. after wastage (field loss, inability to harvest) | = | 180 s. tons |
| | (b) 40ac. p. pasture at $2\frac{1}{2}$ s. tons per ac. - say $1\frac{1}{2}$ s. tons after wastage and some grazing | = | 60 s. tons |

| | | |
|---|---|---|
| Summary | : Corn silage | 391 s. tons |
| | Haylage & greenchop | 398 s. tons |
| | | 790 s. tons |
| | | (1,580,000 lb D.M.) |

(5) Livestock program

Buy: av. $2\frac{1}{2}$ yr. store steers (AA, Hfd., or AAx Hfd.) in May-June.

Average L.W. 900 lb.

Average price $79 ( this is $4 above their value as boners with schedule at $16/100 lb. carcase weight and assuming a 470 lb. carcase).

Diet: Ad lib. feeding of a mixture of approximately 50 per cent corn silage and 50 per cent greenchop pasture of haylage (D.M. Basis),

Expected ave. intake : 21 lb. D.M./day

Expected ave. growth rate : 2.5 lb. L.W./day (under housed conditions)

Sell: In September-October prime, either privately to butchers, or on local fat stock market.

Average time on hand - 120 days

Ave. Growth at 2.5 lb./day = 300 lb. L.W.

Ave. Selling L.W. = 900 + 300 = 1,200 lb.

Ave. Selling carcase weight assumed 660 lb.

Average sale value (at G.A.Q. schedule price \$18 per 100 lb. carcase weight + \$1.5/100 lb. premium in these months = \$19.5/100 lb. carcase) \$129.

Margin per head: \$50 (purchase to sale)

A buying price of \$80 and a selling price of \$130 will be used in the budget.)

Deaths: 1 per cent.

Carrying Capacity: D.M. available 1,580,000 lb.

Requirement per head = 120 days x 21 lb. D.M./day

= 1,520 lb. D.M.

Therefore carrying capacity on basis of feed available = 627

Conservative round figure adopted = 620

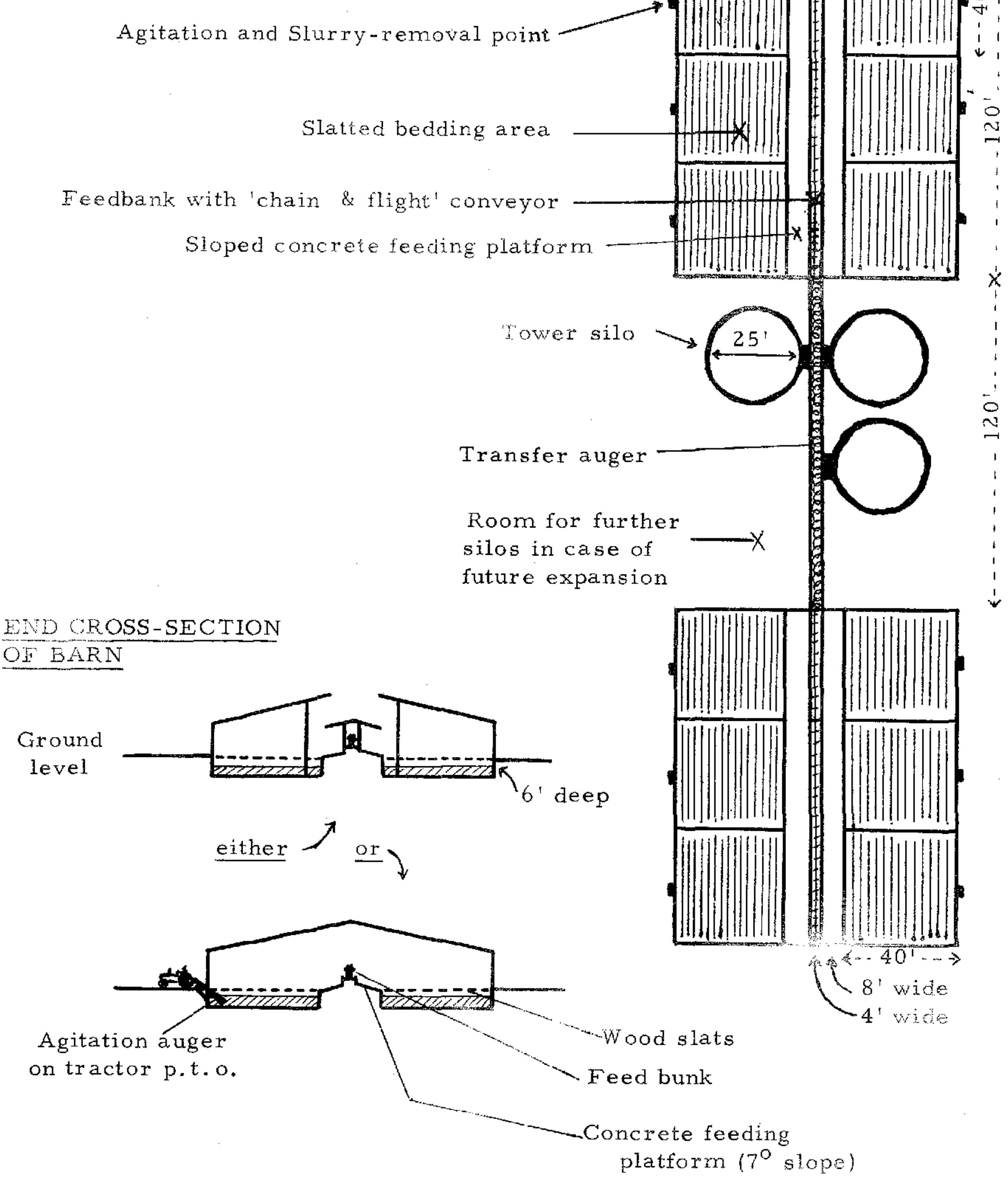
(6) Housing Requirements

It is proposed to house cattle on wooden slats, the effluent storage tank being directly below the slats. These being fairly large animals, 30 square feet per animal will be allowed, and therefore 30 x 620 = 18,600 sq. ft. of standing space is required.

The other main constraint on design depends on the feed bunk space required per animal. As feeding will be on an *ad lib.* basis this can be kept fairly low - 9 inches per animal would appear to be sufficient. Where feeding takes place on both sides of the feed bunk then the length of bunk required will be: $\frac{1}{2}$ x 620 head x 0. 75 ft/hd. = 240ft.

The following double unit feeding barn plan would meet the requirements:

## FARM (A): PLAN OF CATTLE BARNS AND MECHANISED-FEEDING SET-UP




(Dimensions only approximate)

Depth of Slurry Pits required

Pits are divided by partition walls, which must be constructed to withstand pressures when one pit is full and the adjacent one empty. This allows ready agitation of each 40' x 40' area by a single p.t.o. driven agitation auger.

Volume requirement (total)

$$= 620 \text{ beasts} \times 120 \text{ days} \times 8 \text{ gal/hd/day} = 595,200 \text{ gals.}$$

(Sufficient capacity so that no labour requirements for manure disposal over the period for which cattle on hand.)

At 6.24 gal/cu.ft., 595,200 gals, needs 95,385 cu.ft.

$$\text{Therefore Depth requirement} = \frac{95,385 \text{ cu. ft.}}{40' \times 40' \times 12 \text{ pits}}$$

$$= 4.97 \text{ ft.}$$

Allowing for 1' depth of water to begin with, 6' depth would satisfy the requirement.

Choice of Slats

It is believed that this represents the cheapest method of bedding when all things are taken into consideration. Straw is not readily available in the area, and prices, possibly largely due to the demand of the racing stables, are high. Wood shavings are being used satisfactorily by a few farmers at present, but again supply is rather limited, and the cost to new enterprises likely to prove too high.

Capital Cost of Barns (excluding feed bunk and conveyors)

| | |
|---|---|
| Material and specialist hired labour | $1.5 per sq. ft. |
| Erection labour (provided by farm) | 1.0 per sq. ft. |
| Total erected new value | $2.5 per sq. ft. |

(7) Pasture & Crop Husbandry

(a) Summer Corn

Cultivation of ground late October, early November. Animal effluent, 3 cwt (30 per cent Potassic) super, and 1 ton lime (on 20 ac. only) worked in to soil.

Hybrid seed planted 2" deep in 30" rows at $6\frac{1}{2}$" intervals (approximately $\frac{1}{4}$ bushel per acre) towards end November as soon as soil warm enough (soil thermometer used). Starter fertiliser - 1 cwt Ammophos. Side dressing of 1 cwt urea when plants 18" high.

Weeds and pests: Bank spraying (diazinon, trichlorfor or aldrin) for wireworm and cutworm at planting or emergence. Post emergence spraying for flat weeds with 24D-amine or MCPA/ dicamba mix depending on the weeds. Two interrow cultivations with scarifier for grassy weeds. Spraying for armyworm by air February-March when plant at tassel stage - average $1\frac{1}{2}$ applications of methomyl, diazinon or trichlorfon etc.

Direct-harvested when grains showing dentation, lower leaves browning off - probably during April. Dry matter content at this stage should be up to about 30 per cent.

(b) Winter short-rotation ryegrass and clover

Overdrilled as soon as possible after corn silage harvest in April. Fertiliser - 2 cwt (30 per cent K) super (a nitrogenous fertiliser may be more desirable at this stage).

(c) Permanent Pasture

10 acres new grass sown April after corn harvest, at $^2/_3$ bushel ryegrass plus 5 lb mixed clover per acre.

Fertiliser on all permanent pasture - 4 cwt (30 per cent K) super per year in two dressings.

DDT prills for grass grub and/or porina on $^1/_3$ (13 acres).

## APPENDIX B

Budget notes for Farm (B)

Program Details:

(1) Land:

320 acres of non-irrigated light land (e.g. Lismore soil type in Canterbury) bought, with normal farm buildings and one house, for $120 per acre.

Annual production capacity: 8,000 lb D.M. with lucerne, 5,500 lb D.M. with grass/clover (including sub. clover) pasture.

(2) Utilisation:

300 productive acres, all in lucerne. This is all harvested for tower silage in the summer/early autumn period, and fed over the winter/early spring. Renewal of lucerne stands at 50 ac. per year (every 6 years).

(3) Storage Requirements

It is assumed that 7,000 of the 8,000 lb D.M. produced per acre can be harvested in this way for silage. The other 1,000 lb is partly wasted, and partly goes to providing a very limited amount of winter grazing.

Thus capacity required : 1,050 s. tons.

This would be provided by 5 25'x60' silos (225 tons D.M. each) giving a capacity of 1,125 short tons.

Silo prices: as for Farm (A), except that

(i) This being a one-man farm, savings in erection costs due to use of farm labour will be less.
This is reduced to $500 in this instance.

(ii) Higher transport costs to the South Island, the present suppliers being concentrated in the North.

$300 has been added here.

Thus the net erected cost per silo in this instance becomes $11,300.

In this instance the rate of silo unloading is well above the minimum required to avoid air damage during feeding.

(4) <u>Silage fodder available</u> for feeding in winter (D.M. basis): 1,050 s. tons stored less 21 per cent wastage leaves 830 s. tons D.M. available.

(5) <u>Livestock Program</u>

<u>Purchases:</u>

April-May. Weaner cattle, average or slightly below average in size and condition. Average price $40 per head.

<u>Feeding:</u>

Average 11 lb. D.M. wilted lucerne silage plus 1 lb. crushed barley per head per day over the 150 day period for which held. Slight amounts of lucerne also available for grazing over this period.

Expected weight gains 1 lb/hd/day

Expected average L.W. over the 150 days - 500 - 550 lb.

Fed out in the paddock in roofed wooden feed troughs on sleds, which are moved frequently. Transport of silage from silo to paddock is per self-unloading trailer. Animals spread over farm early winter, but concentrated on sacrifice paddocks (to be cultivated and renewed) towards end of winter, early spring. All paddocks supplied with good shelter belt areas.

<u>Sales:</u>

In September/October as yearlings in forward store condition. Average price $70, giving a wintering (5 month) margin of $30, at this growth rate.

Deaths:

Assumed 5 per cent over the 5 month period.

Carrying Capacity:

Silage requirements per animal

= 150 days x 11 lb. D.M./day

= 1650 lb D.M.

Silage D.M. available = 830 s. tons

$$\text{Therefore carrying capacity} = \frac{830 \times 2000}{1650}$$

$$= 1,006$$

say 1,000 head.

(7) Feeding Trough Requirements

As feeding is on a rationed rather than ad lib. basis, and only once per day, 12" of trough space per weaner will be allowed. Thus 500 ft. of double sided trough length is needed. This would be provided by 20 troughs, each 25 ft. long. The cost of these is calculated at $4 per foot.

(8) Grain storage requirements

Barley requirements

1,000 head x 1 lb/day x 150 days = 150,000 lb

= 3,000 bushels

This stored in existing hayshed in plywood bins constructed for $0.1 per bushel. The cost of moisture and vermin proofing the floor is estimated at $150. In addition a loading and unloading auger, plus motor, are needed at total cost of approximately $300.

(9) Lucerne Husbandry

New lucerne sown at 8 lbs. seed/acre plus 2 cwt of reverted superphosphate.

Other fertiliser : 3 cwt Cu Super in two dressings on all established lucerne. Lime at 1 ton per acre on new lucerne paddocks.

# APPENDIX C

## Budget Notes for Farm (C)

Program Details

(1) Land & Utilisation

160 acres plus normal dairy farm buildings including a herringbone milking shed and two houses bought for $550 per acre. Of this, the 150 productive acres are all in improved ryegrass/clover pasture. The estimated annual production from this pasture, given the present restricted grazing practices in the winter to considerably reduce pugging damage, is 15,000 lbs D.M.

(2) Tower Storage Requirements

As a proportion of total daily diet, the conserved silage varies over the course of the year from a negligible amount in the summer to a major portion in the winter. It is assumed that one-third of the annual pasture production is ensiled. Furthermore, some double filling of the silos will be possible, with some haylage being fed out over the period bounded by the first and last cropping for the season. If one half of the total capacity can be used twice in the year (one third of total silage fed out in the above period), then the storage capacity needed will be for

$^2/_3 \times {}^1/_3 = {}^2/_9$ of total annual D.M. production.

i.e.

150 ac. x 0.22 x $7\frac{1}{2}$ s. tons D.M./ac. = 250 s tons

This capacity could be provided by

20' x 55' (130 s. ton D.M.) silos.

The erected cost for this size of silo is estimated here at $55 per s. ton D.M. capacity. A saving of $450 per silo on total cost, due to the use of farm labour in erection less an estimate of extra transport costs, is allowed. Net cost, therefore, is \$6,700 per silo.

(3) Fodder available for feeding

(a) Haylage 250 s. tons D.M. conserved less 20 per cent wastage leaves 200 s. tons D.M. available.

(b) Total production at $7\frac{1}{2}$ s. tons/ac. gives 1,125 s. tons D.M. 250 s. tons of this is conserved as haylage, leaving 875 s. tons as available standing pasture. It is assumed that the utilisation rate possible with the grazing dairy beast is 80 per cent and therefore 700 s. tons is available for intake.

Total available for intake: 700 + 200 = 900 s. tons D.M. Note that the assumed D.M. wastage rates are the same here as between conserving as haylage and grazing in situ.

(4) Livestock Program

It is assumed that the Friesian cows carried each produce on average 900 gallons of milk in a $9\frac{1}{2}$ month lactation, and consume 12,000 lb D.M. per year.[1]

Replacements carried: Heifer calves, yearling heifers, plus bulls to use for the yearlings. Total - 0.4 per cow, or 0.25 cow equivalents per cow.

Thus of total feed available, replacement stock requires one-fifth and the milking herd four-fifths. Therefore the carrying capacity, in terms of the size of the milking herd, is

$$\frac{4/5 \times 900 \text{ s. tons D.M.}}{6 \text{ s. tons D.M./cow}} = 120 \text{ cows.}$$

---

1. This will vary, of course, not only between animals, but for a single animal, depending on the season of calving.

Replacements - 46 heifers (calf & yearling) and 2 bulls.

Milk Production

120 cows at 900 gallons each per year yield 108,000 gallons annually, or an average of 296 gallons per day (approximately $2\frac{1}{2}$ gallons/cow/day). It is assumed that calving is organised so that daily production is maintained at a fairly constant figure, close to this average, throughout the year.

The assumed quota level in this case is 200 gallons/day.

| | |
|---|---|
| Herd replacement rate | 17% |
| Herd death rate | 1% |

Prices used are representative of recent levels, and it is assumed that full price is paid on 117 per cent of quota gallons from September to January inclusive, and on 110 per cent of quota gallons for the rest of the year.

Feeding

In the winter, cows are pastured only during the day. At night they are retained on an uncovered cubicle area. Haylage is fed after each milking throughout the winter, early spring and bloat seasons, and later in the season when any pasture shortages occur due to drought conditions. The quantity offered will vary depending on the season, and small quantities may be fed as a supplement to pasture all the year round.

Existing tower silo farmers have shown that good production figures (better than assumed here) can be obtained through the winter, under North/South Auckland conditions at least, feeding haylage as the only pasture supplement.

(5) Bedding and Feeding Area Requirements

It is assumed here that one cubicle per cow is desirable. It should be noted, however, that the experience of some farmers is that as some cows are always standing at any one time, the required ratio is less than 1 cubicle per cow.

A rough plan of the proposed layout is given below:

A maximum of tree shelter is envisaged around the cubicle area.

A 60' feed bunk would allow 12" of trough space per cow, which should be sufficient considering that the cows will normally be feeding in a staggered fashion as they finish being milked.

Effluent Disposal

It is proposed to store effluent from cubicle, feeding and milking shed areas in one common effluent tank. Drainage from all these areas is designed to fall towards one focal point from which effluent (but not rain water) can be easily pushed into the storage tank. Races between cubicles are cleaned with a tractor mounted scraper blade, and the other areas with hosing in moderation plus some use of the tractor blade. Ulitmate disposal on to pasture is via a vacuum slurry waggon.

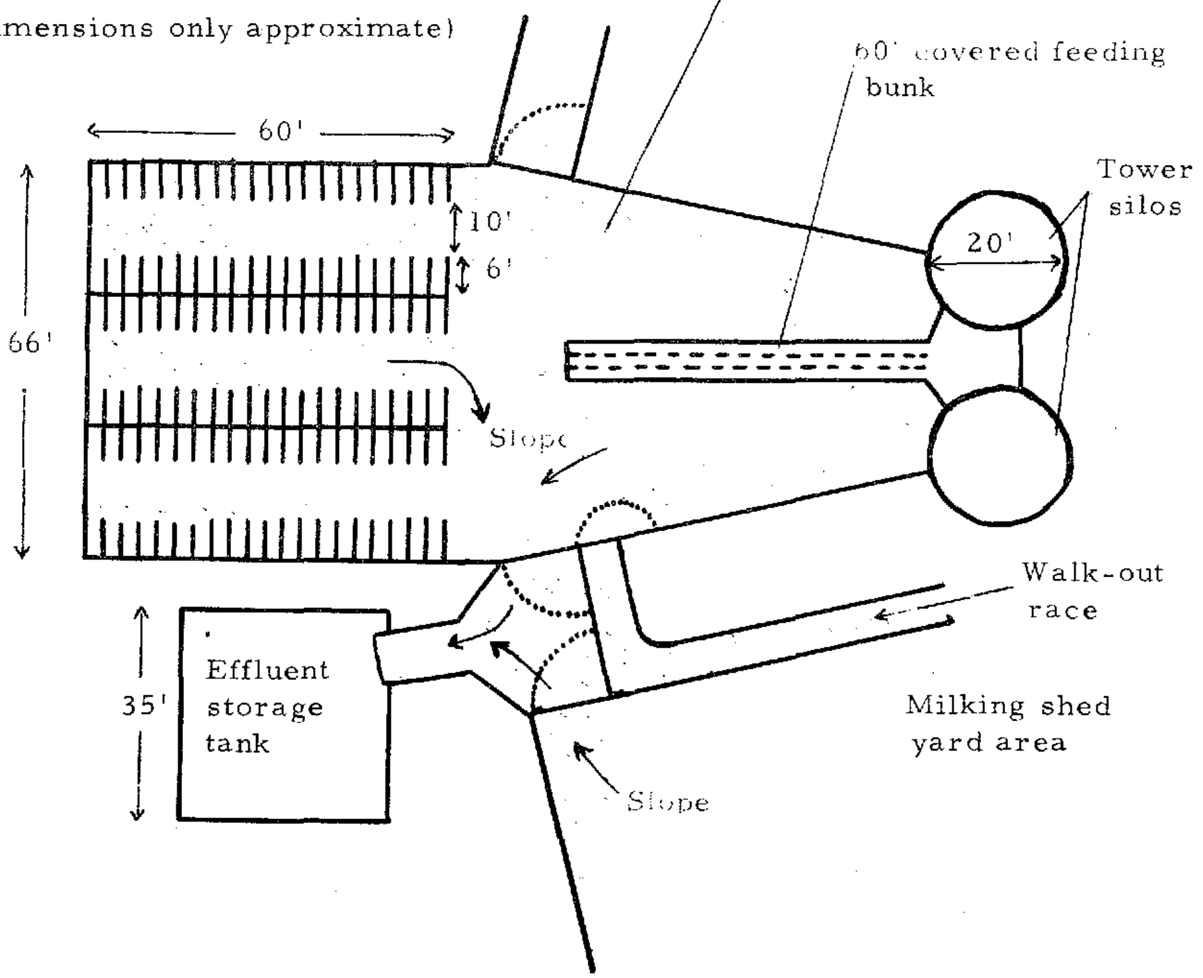
One month's storage is planned here. 15 gallons per cow per day deposited in the milking shed and overall yards areas, and after some dilution with cleaning-hose water, will be allowed. Then volume of storage tank required -

30 days x 15 gal/cow/day x 120 cows = 54,000 gals
= 8,650 cu. ft.

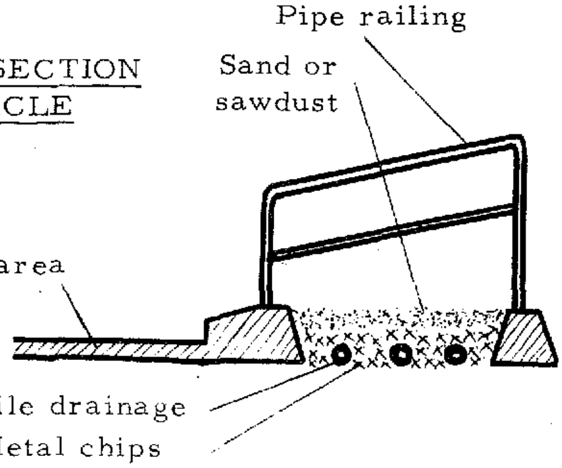
This requirement will be approximately met by the dimensions 35' x 35' x 7' deep, which in turn would require approximately 28 cu. yds. of concrete.

FARM (C): PLAN OF OPEN (UNCOVERED) CUBICLES & MECHANISED FEEDING SET-UP

(Dimensions only approximate)




LENGTHWISE SECTION OF OPEN CUBICLE



Costs

| | |
|---|---|
| Cubicle area 120 at $15/cubicle | = $1,800 |
| Concrete yard area 2,500 sq.ft. at $13/sq.ft. (incl. fence) | = $ 750 |
| Feed bunk (covered) with chain conveyor 60' at $18/ft. | = $1,080 |
| Effluent tank: 28 yards concrete at $16/yard + reinforcing boxing, wooden lid, excavations | = $ 800 |

## RECENT PUBLICATIONS

### RESEARCH REPORTS

15. *The Problem of Scheduling Sales of New Zealand Butter on the United Kingdom Market,* Robert Townsley, 1965.
16. *A Market Target for the New Zealand Dairy Industry,* A. R. Frampton, 1965.
17. *Breeding Flock Composition in Relation to Economic Criteria,* R. J. Townsley and W. Schroder, 1965.*
18. *Trends in Production, Trade and Consumption of Wool and Wool Textiles,* B. P. Philpott and D. M. Beggs, 1965.
19. *Standardisation of Farm Accounts for Managerial Analysis,* J. W. B. Guise, 1965.
20. *The Use of Linear Programming in Least-cost Feed Compounding,* N. W. Taylor, 1965.
21. *The Maximisation of Revenue from New Zealand Sales of Butter on the United Kingdom Market—A Dynamic Programming Problem,* R. J. Townsley, (reprint) 1965.*
22. *The Economic Approach to Resource Development in New Zealand,* J. T. Ward, (reprint) 1965.*
23. *An Analysis of the Retail Demand for Meat in the United Kingdom,* B. P. Philpott and M. J. Matheson, 1965.
24. *The Profitability of Hill Country Development—Part 2: Case History Results,* J. S. Holden, 1965.
25. *Strategic and Tactical Planning in International Marketing Policies,* B. P. Philpott, (reprint) 1965.*
26. *Indexes of Cost of Investment Goods 1949-50 to 1963-4,* G. C. Scott, 1966.
27. *An Economic Analysis of Large-scale Land Development for Agriculture and Forestry,* J. T. Ward and E. D. Parkes, 1966.
28. *A Review of the Argentine Beef Cattle Situation,* R. J. Townsley and R. W. M. Johnson, 1966.
29. *Aspects of Productivity and Economic Growth in New Zealand 1926-64,* B. P. Philpott, 1966.
30. *Estimates of Farm Income and Productivity in New Zealand 1921-65,* B. P. Philpott, B. J. Ross, C. J. McKenzie, C. A. Yandle and D. D. Hussey, 1967.
31. *The Regional Pattern of the Demand for Meat in the United Kingdom,* Mary J. Matheson and B. P. Philpott, 1967.
32. *Long-Run Swings in Wool Prices,* B. P. Philpott, in preparation.
33. *The Economics of Hill Country Development,* J. S. Holden, (reprint) 1966.*
34. *Report on a Survey of Farm Labour in Patangata County, Hawkes Bay 1965-6,* D. McClatchy, 1966.*
35. *Programming Farm Development,* G. A. G. Frengley, R. H. B. Tonkin and R. W. M. Johnson, 1966.
36. *Productivity, Planning and the Price Mechanism in the Zealand Manufacturing Industry,* B. P. Philpott, 1966.
37. *Some Projections of Retail Consumption in New Zealand,* R. H. Court, 1966.
38. *The Nature and Extent of the Farm Labour Shortage in Cheviot County, Canterbury,* J. L. Morris and R. G. Cant, 1967.
39. *Index to New Zealand Agricultural Publications, 1964,* G. A. G. Frengley, 1967.
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