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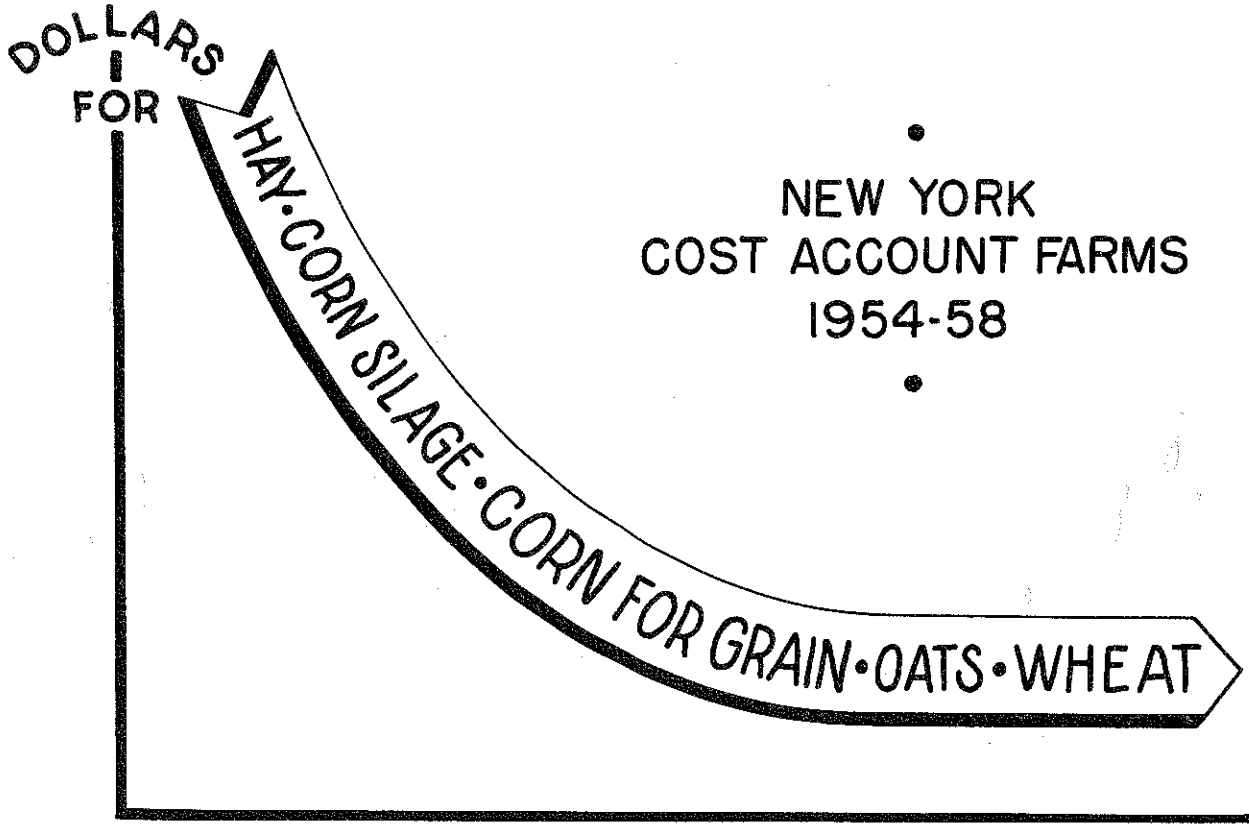
RELATION OF YIELD AND COST



NEW YORK COST ACCOUNT FARMS 1954-58

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RELATION OF YIELD TO COST

Farmers are continually faced with the problems of how much fertilizer to apply, how much grain to feed, how thoroughly to weed and the like. The answers to these and similar questions are difficult to determine because of differences in farms and in conditions. Physical response to added inputs are different from farm to farm and year to year. Weather and technology are constantly changing.

This is further complicated in today's commercial agriculture by the fact that optimum level of intensity of production is seldom that of the maximum level of production. High levels of production are frequently purchased at costs that exceed the value of the products.

Yet another problem is the lack of records on farms which can be used to determine the best level of intensity of farming. Farmers neither do the controlled experimentation nor keep the records necessary to determine the best level for their operations.

The Principle of Diminishing Returns

Basic to the problem of determining the best level of intensity of operation lies a principle which observation has led us to develop but which has not often been demonstrated with empirical evidence. This is the principle of diminishing returns.

The principle of diminishing returns is a basic natural law affecting many phases of the management of a farm business. Briefly stated it is: when a variable factor (for example, fertilizer) is applied to a fixed factor (for example, land), the production per acre will increase but at a diminishing rate.

This principle has two aspects, diminishing physical returns and diminishing economic returns. Diminishing physical returns usually develop with the first added application of an input item, are slow in developing and may not reach a point of diminishing total returns until a large number of units of an input item have been applied. On the other hand, diminishing economic returns usually develop more rapidly and result in diminishing total returns at an earlier point than in the case of physical returns. In other words, the point where it is not profitable to continue to apply fertilizer, for example, is reached before the point where no additional response in physical yield is obtained.

The principle of diminishing economic returns indicates that at some point in the production schedule it is no longer profitable to continue to make additional application of one or more of the input items. The question is, "where is this point?" For any given situation, it is the point where the highest possible total net returns (profits) for a given enterprise are realized and beyond which declining total net returns are obtained. This is the point of marginal net returns.

The point of marginal net returns is that point on the curve of economic diminishing returns where the application of labor or capital items results in an income just equal to the total expenses of applying the item. Beyond the marginal application, additional applications cause a decline in total returns.

Application to Field Crops

In agriculture, because of good communication and lack of differentiation of products, prices of commodities are about the same for all producers within a market area and differ from market to market

only by the differences in transportation and handling charges. For this reason a study of the costs of production to determine the average cost at different levels of intensity will provide information as to the level of intensity of operation at which the net returns (profits) will be the greatest.

With relatively constant prices for the years 1954-58 the New York Farm Cost Account records kept during those years provide information showing the average cost per farm of farm products at different yield levels (table 1).

Table 1. 1954-58 PRICES

Year	Index U.S. prices articles farmers buy	Index New York farm prices	New York Cost Account farm prices: Hay (per ton)	Corn silage (per ton)	Corn for grain (per bushel)	Oats (per bushel)	Wheat (per bushel)
1954	281	226	$20	*	$1.52	$ .88	$2.16
1955	281	225	20	*	1.36	0.75	2.07
1956	286	230	23	*	1.29	0.89	2.04
1957	296	241	25	*	1.26	0.83	2.06
1958	293	248	21	*	1.26	0.76	1.83
Average	287	234	$22	*	$1.34	$0.82	$2.03

* Not available

The graphs which follow show the yield per acre for hay, corn silage, corn for grain, oats and wheat on which the production costs are least. The curves show the average cost at different levels of yield. If all farms had the same conditions and yield were the only factor causing the costs to vary, all dots would lie on one line, the curve drawn. Even though this is not the case, yields are nearly

enough related to costs that when individual observations are plotted they present a curvilinear pattern which can be represented by a line. This line follows the theoretical pattern of decreasing marginal gain discussed previously.

Curves are made for growing, harvesting and total cost. The latter are generally a little higher than the sum of growing and harvesting costs because they include also some storing and selling costs. In a few instances allowances for by-products results in a net cost slightly less than the sum of the growing and harvesting costs. All curves were plotted free hand.

The approximate level of the lowest average cost for 1954-58 for the crops studied is as follows:

Hay:

Growing cost per ton	$ 6.40
Harvesting cost per ton	9.50
Total net cost per ton	19.00

This corresponds to a yield of about 2.8 tons per acre.

Corn Silage:

Growing cost per ton	$ 4.30
Harvesting cost per ton	2.50
Total net cost per ton	8.00

This corresponds to a yield of about 13 tons per acre.

Corn for Grain:

Growing cost per bushel	$ 0.70
Harvesting cost per bushel	0.20
Total net cost per bushel	0.96

This corresponds to a yield of about 90 bushels per acre.

Oats:

Growing cost per bushel	$ 0.56
Harvesting cost per bushel	0.19
Total net cost per bushel	0.74

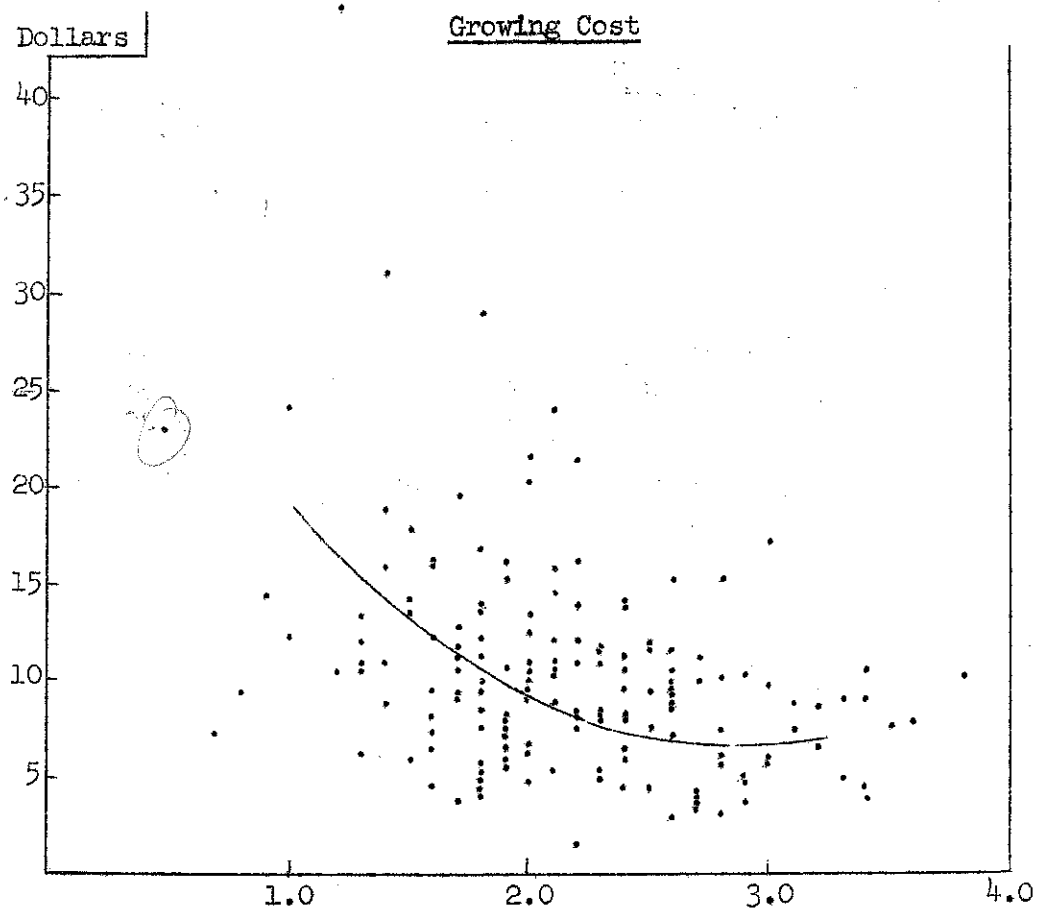
This corresponds to a yield of about 70 bushels per acre.

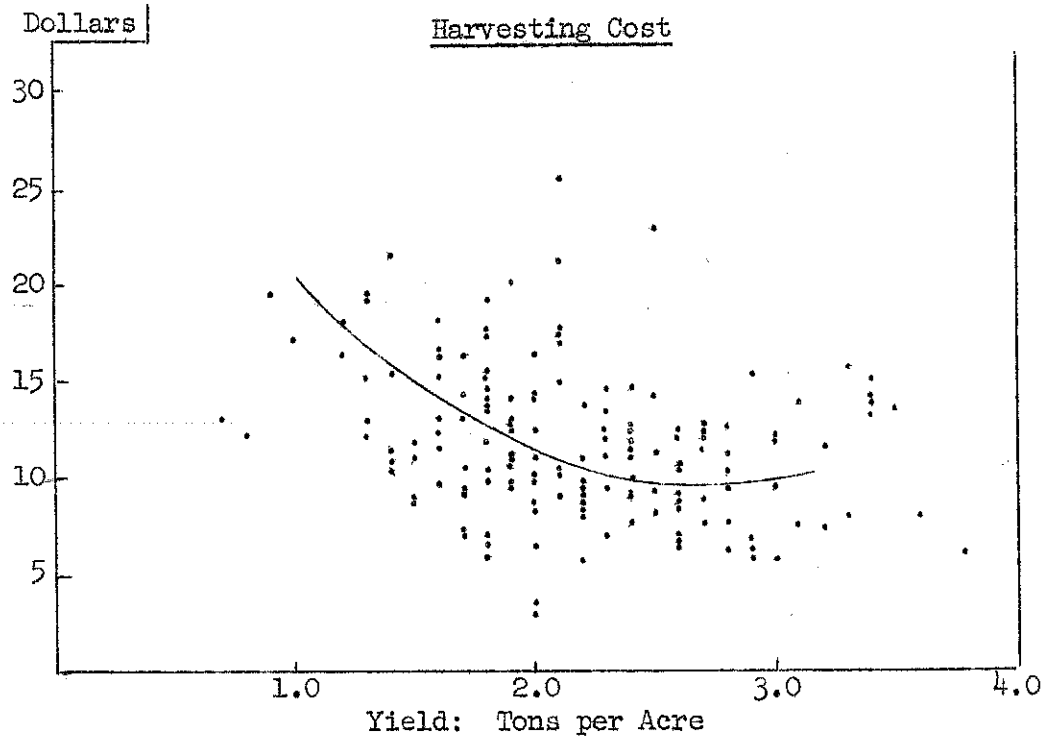
Wheat:

Growing cost per bushel	$ 0.86
Harvesting cost per bushel	0.36
Total net cost per bushel	1.20

This corresponds to a yield of about 50 bushels per acre.

RELATION OF YIELD AND COST PER TON FOR HAY
158 Records, New York, 1954-58





Hay

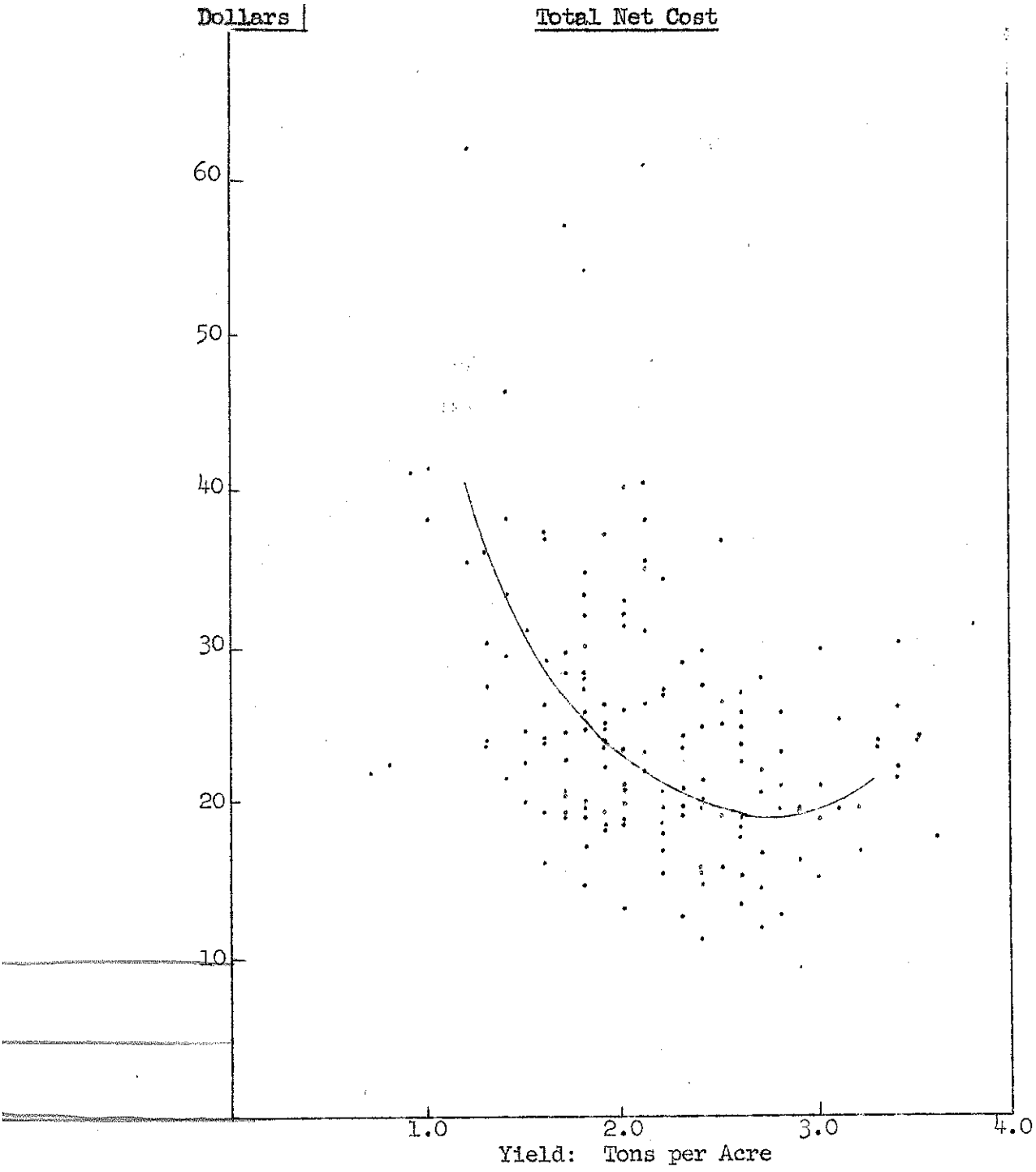
Costs of growing are somewhat lower per ton than those of harvesting hay. Both, however, decreased as yields increased to a level of about 2.8 tons per acre. At that yield level there is little indication of further increases in efficiency of production as measured by cost per ton.

Both growing and harvesting costs approached their lowest level at about the same yield per acre. Total net cost, which includes added costs of storage but which is netted for pasturage and the like, was also a minimum at about that yield level.

At each level of yield there were wide variations in costs. This means, of course, that more than the one factor "yield per acre" had an effect on costs.

This wide variation indicates a need to study its causes and provide suggestions to producers as to how to adjust those inputs within their control to achieve, as nearly as possible, the lowest cost production.

RELATION OF YIELD AND COST PER TON FOR HAY
158 Records, New York, 1954-58

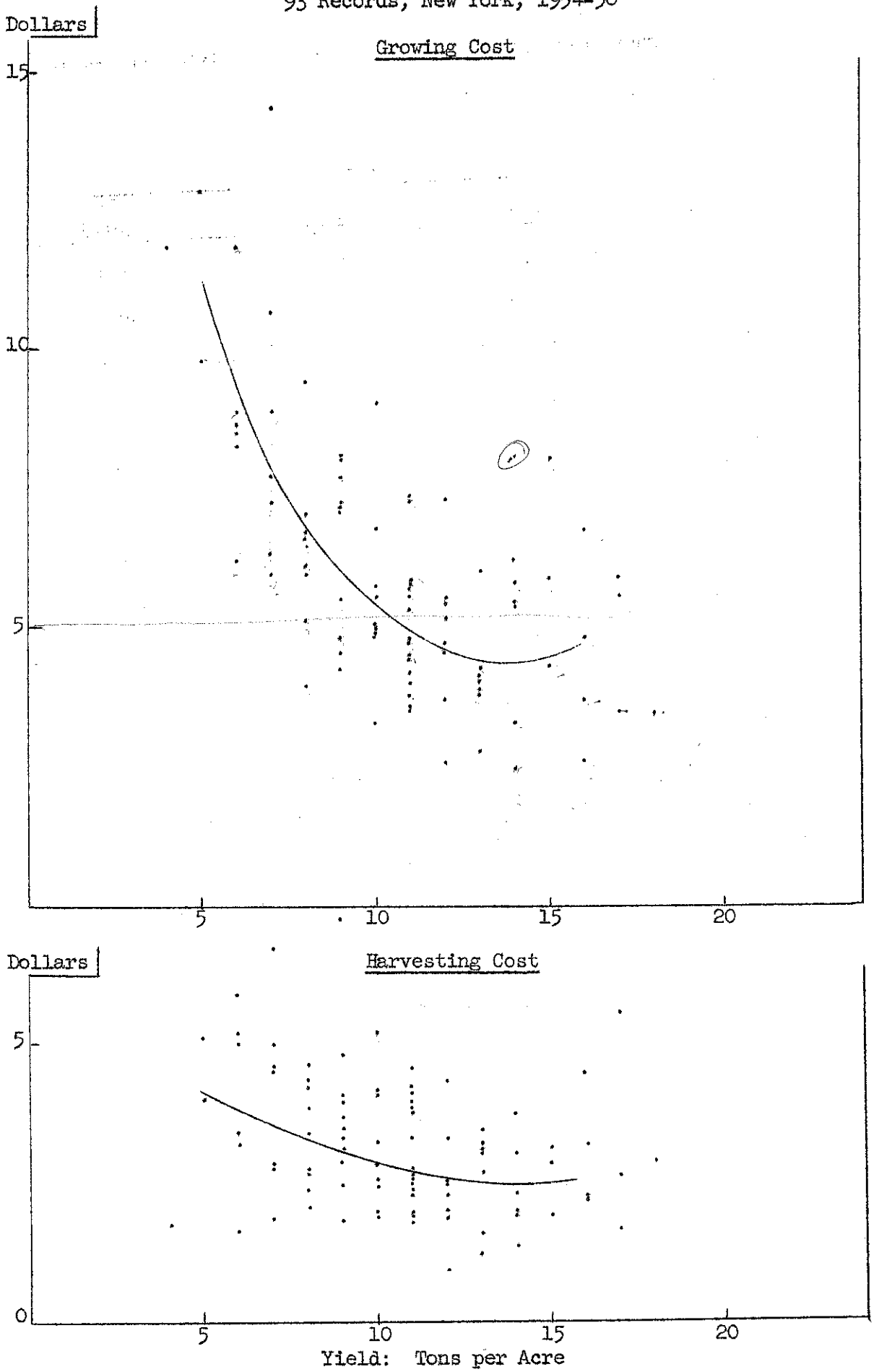


The average costs derived from the curve at different levels of production are:

Tons produced per acre	Cost per ton		
	Growing	Harvesting	Net total
1.2	$16.50	$18.00	$40.50
1.4	14.00	16.00	32.20
1.6	12.00	14.00	28.20
1.8	10.50	12.50	25.50
2.0	9.00	11.30	23.00
2.2	8.00	10.40	21.50
2.4	7.20	9.90	20.00
2.6	6.70	9.50	19.20
2.8	6.40	9.50	19.00
3.0	6.50	9.80	19.70
3.2	6.80	10.40	21.00

It should also be recognized that although "on the average" the most nearly optimum economic level of production was 2.8 tons of hay per acre, individual farmers can have optimum economic levels of production well above that yield. Others may find that at high levels of production the added inputs actually result in costs that exceed the value of the product.

RELATION OF YIELD AND COST PER TON FOR CORN SILAGE
93 Records, New York, 1954-58



Corn Silage

Corn silage costs declined rapidly as yields increased. This was especially true of growing costs. Decreases in harvesting costs were less marked as yields went up. Both growing and harvesting as well as net total costs had their lowest level at about 13 tons per acre.

Average costs at different levels of production per acre as derived from the curves are shown below:

Tons produced per acre	Cost per ton		
	Growing	Harvesting	Net total
5	$11.20	$4.10	$14.60
6	9.30	3.80	13.20
7	7.80	3.60	11.90
8	6.70	3.40	10.80
9	6.00	3.10	10.00
10	5.40	2.90	9.30
11	4.90	2.70	8.70
12	4.50	2.60	8.20
13	4.30	2.50	8.00
14	4.30	2.50	8.00

RELATION OF YIELD AND COST PER TON FOR CORN SILAGE
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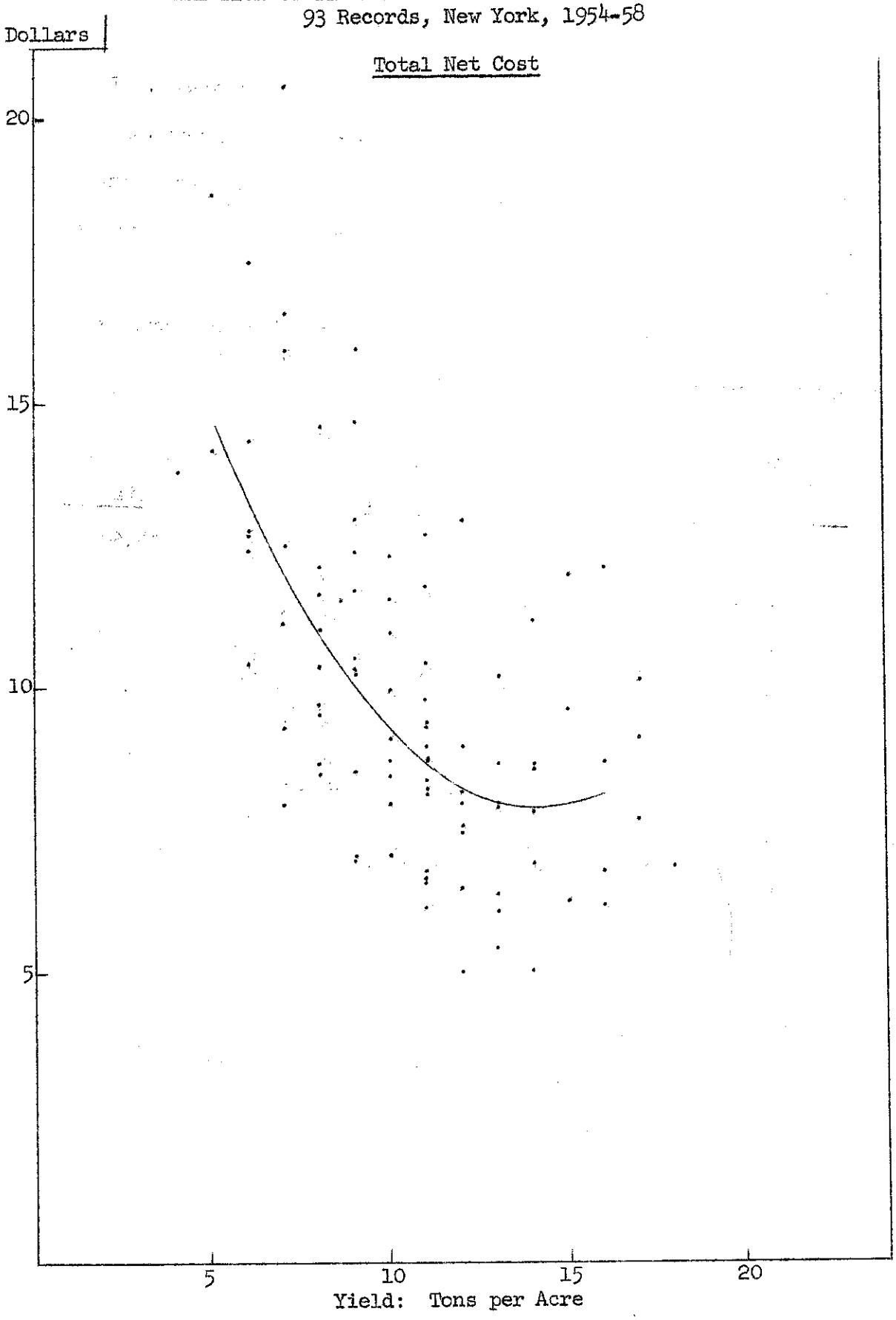
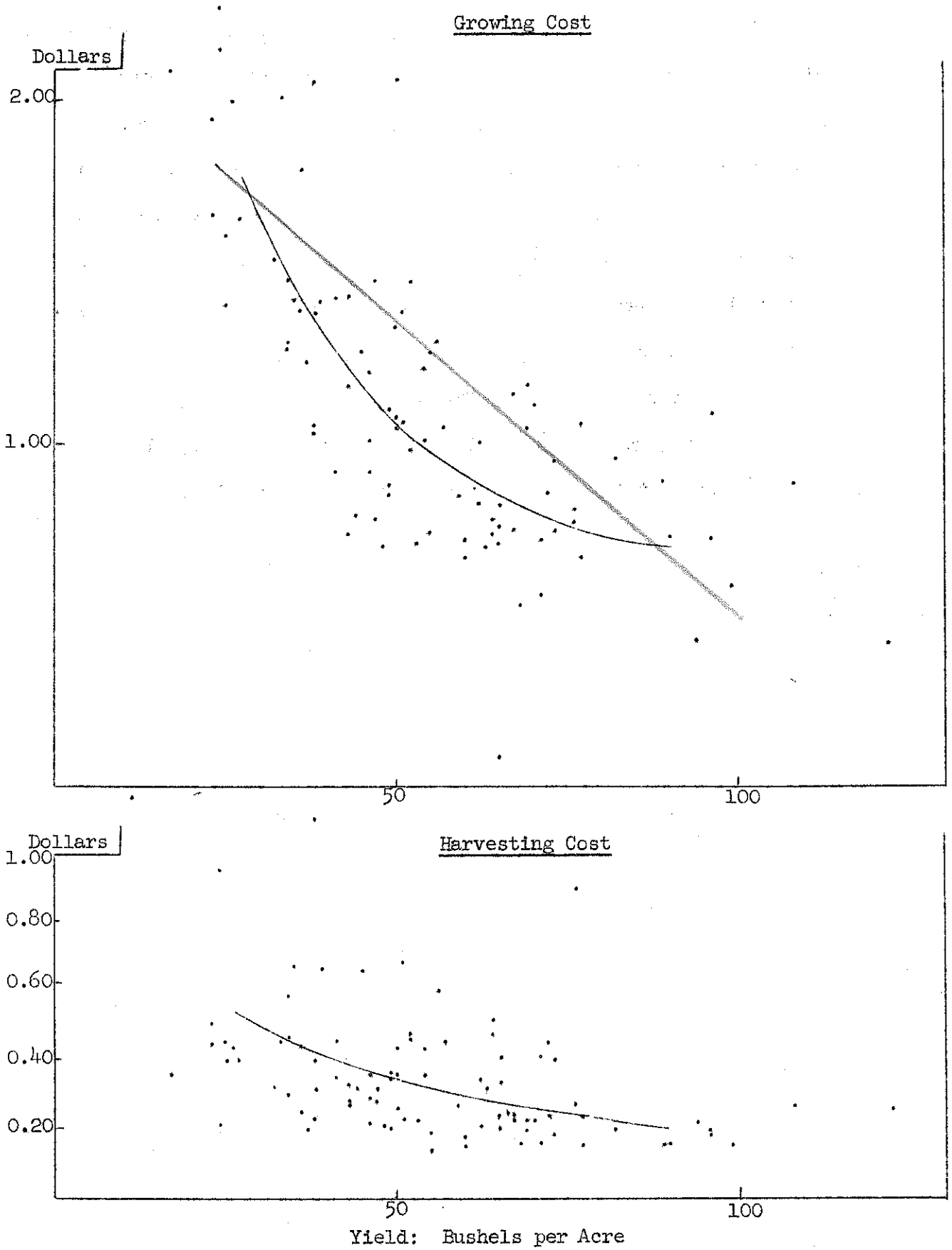


Although average costs tended to level out and increase after a yield of 13 tons per acre, some individual farmers may have optimum levels above this. On the other hand, others with less responsive soils will have optimum yield levels well below 13 tons per acre.

A further consideration, especially with hay and silage, is that a farmer who is short of land but who has a very profitable dairy may wish to exceed the yield which will give him the lowest cost of roughage production to enable him to have more feed and thus keep more cows. In other words, he may be willing to lose on his forage in order to gain on his dairy herd. With this in mind, he must determine the level of operation which will enable him to maximize his overall farm profits and not just the profits from his forage production.

RELATION OF YIELD AND COST PER BUSHEL FOR CORN FOR GRAIN
94 Records, New York, 1954-58



Corn for Grain

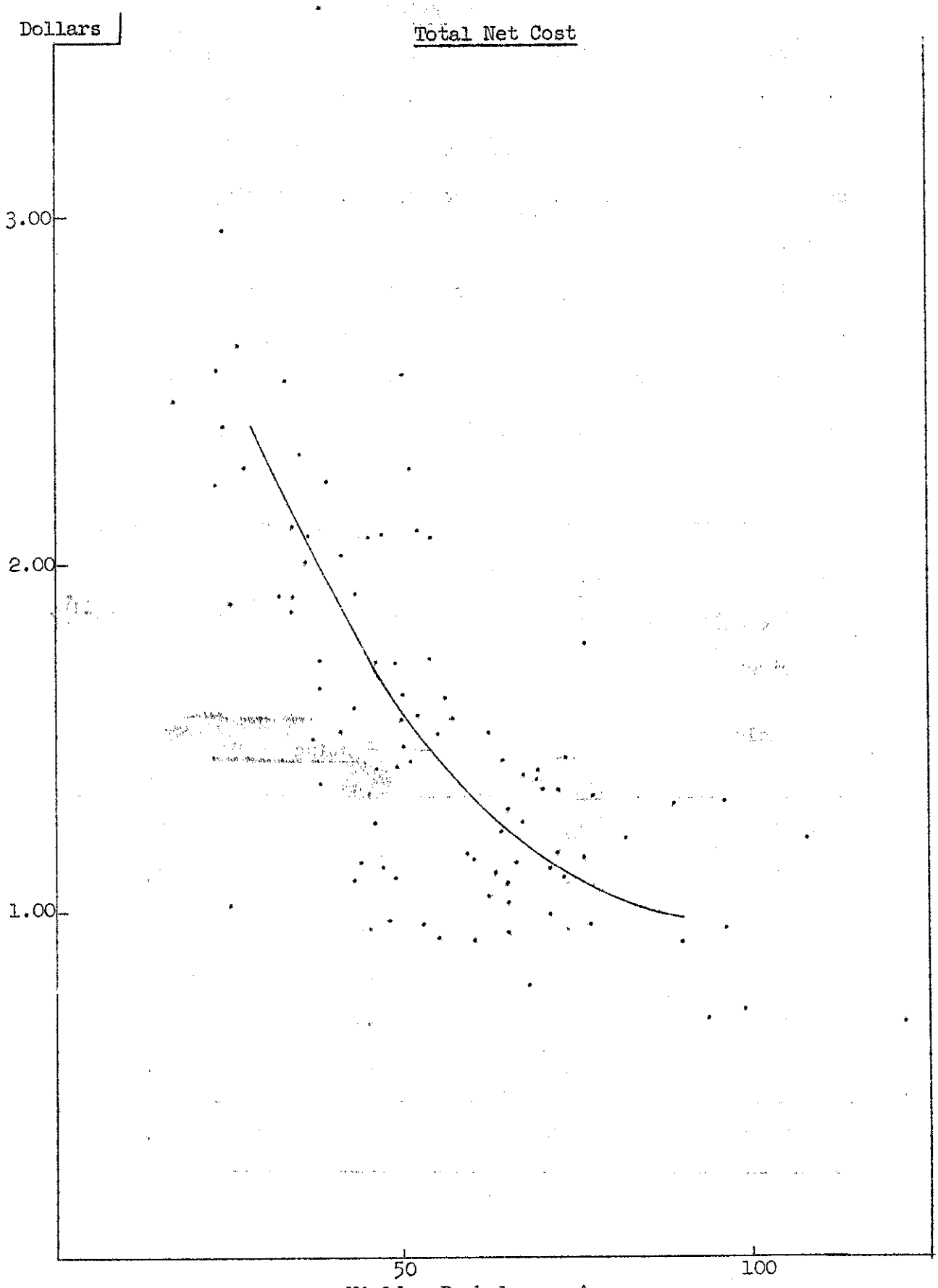
The pattern of declining costs of growing and harvesting as yields increase is evident for corn for grain. The level of least cost is more difficult to determine but seems to be at about 90 bushels per acre. This is true for growing, harvesting and total costs.

Harvesting costs declined less in absolute terms but more in relative terms than did growing costs. Growing costs declined from $1.30 with a 40 bushel yield to 70 cents with a 90 bushel yield. This was an absolute decline of 60 cents but a relative decline of 46 per cent. Harvesting costs declined from 41 cents with a 40 bushel yield to 20 cents with a 90 bushel yield, an absolute decline of only 21 cents while the relative decline was 51 per cent.

The following indicates the average cost at various yield levels as derived from the curves:

Bushels produced per acre	Cost per bushel		
	Growing	Harvesting	Net total
30	$1.66	$0.50	$2.32
40	1.30	0.41	1.90
50	1.06	0.36	1.56
60	0.91	0.31	1.33
70	0.80	0.26	1.16
80	0.73	0.23	1.04
90	0.70	0.20	0.96

RELATION OF YIELD AND COST PER BUSHEL FOR CORN FOR GRAIN
94 Records, New York, 1954-58

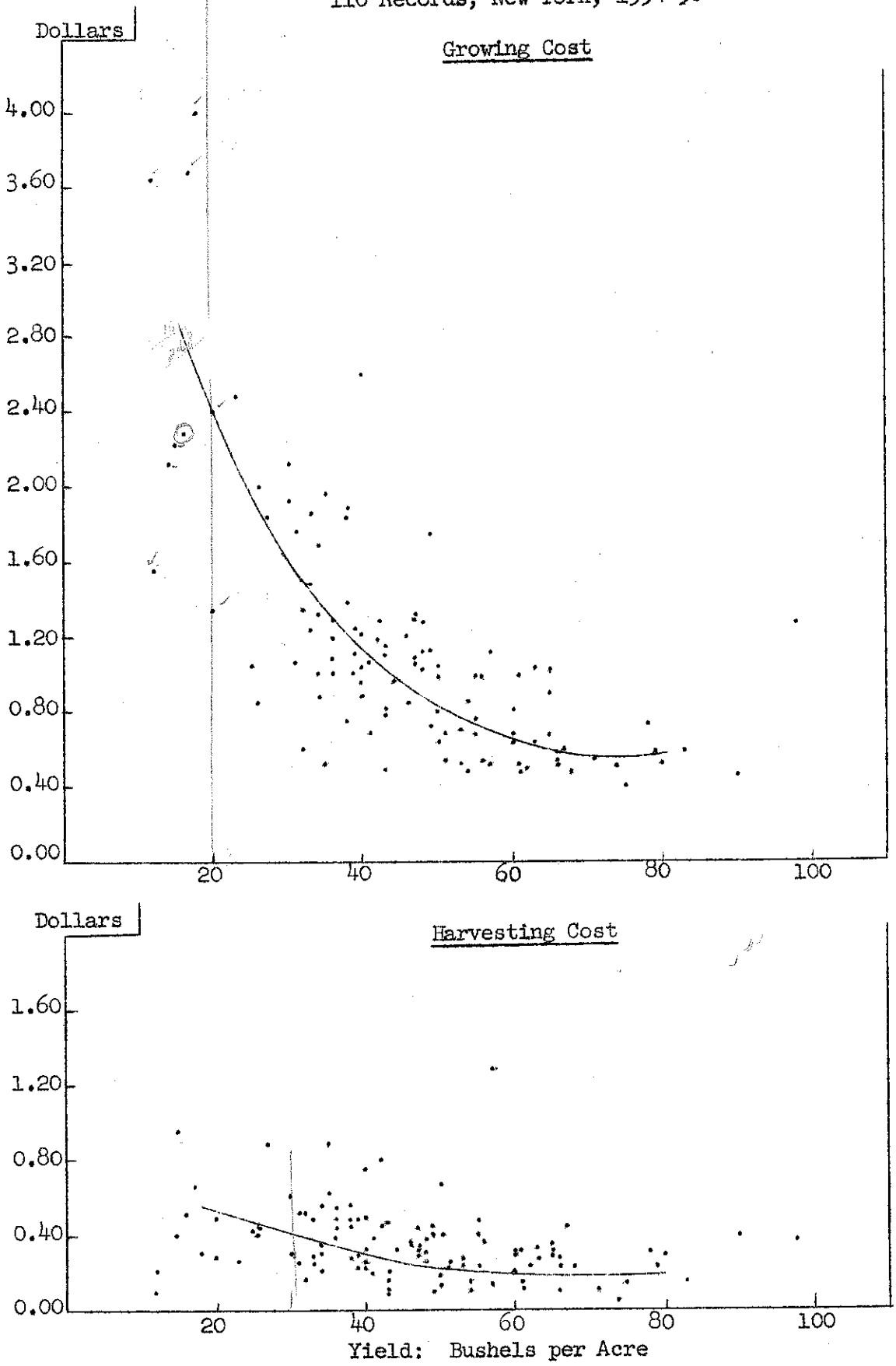


Since corn for grain production is not generally essential to dairy farming, the economic analysis is not so complicated as in the case of hay and silage. Grain corn can readily be purchased and shipped. The farmers therefore can find little justification for producing it at a loss.

As indicated by these data most New York farmers who grow corn can afford to aim for yields of upwards of 100 bushels per acre. They should realize, however, that the economically optimum level of yield will vary from farm to farm.

Since corn for grain on many farms is considered a cash crop, a break-even point should be borne in mind. This is the yield level at which the price just equals costs. Above this level the crop is, on the average, profitable. Below this level farmers are likely to lose. With the average price of $1.34 for grain corn for the Cost Account farms during 1954-58 period, approximately 65 bushels per acre were required for farmers to break even.

RELATION OF YIELD AND COST PER BUSHEL FOR OATS
110 Records, New York, 1954-58



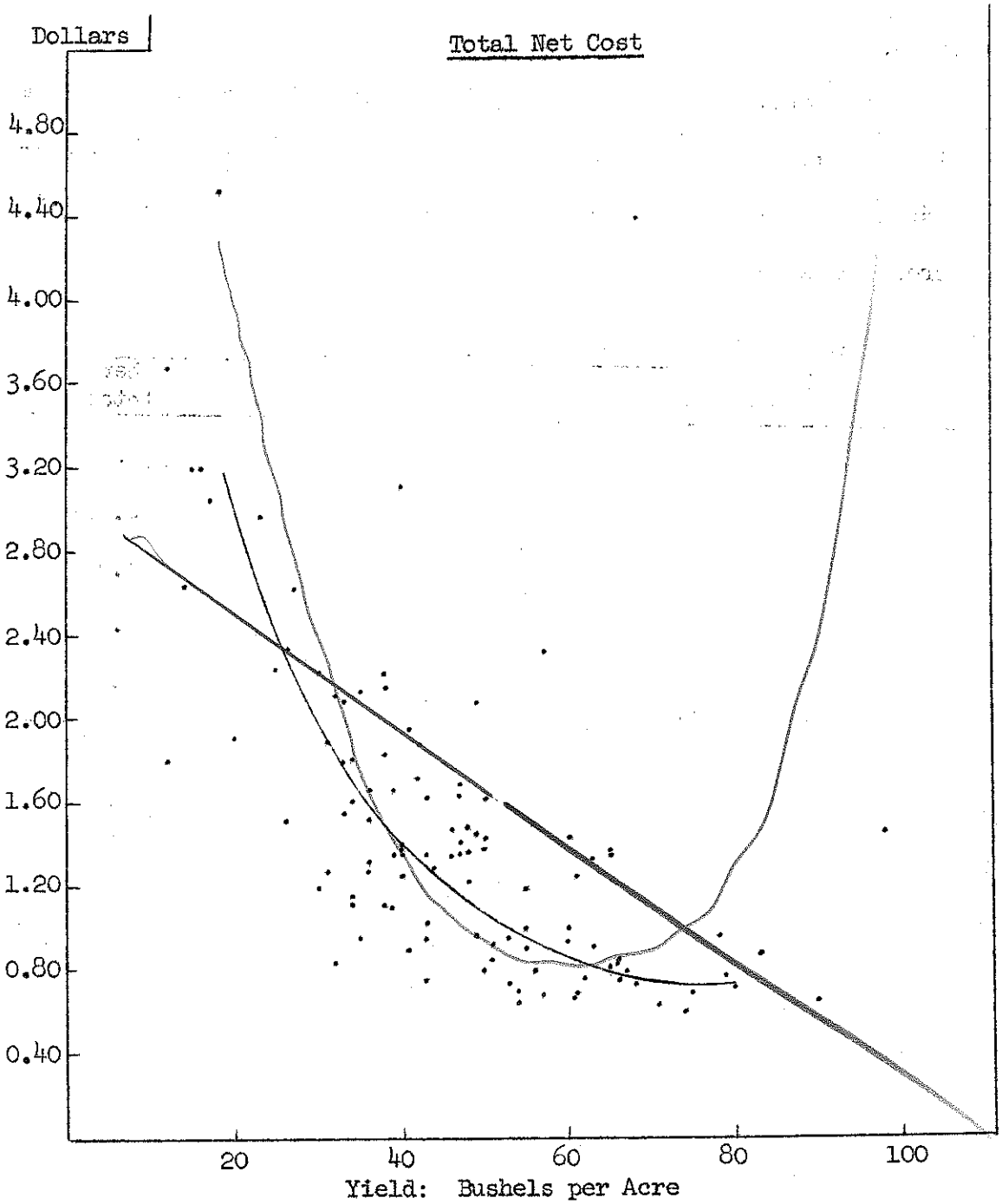
Oats

As with the previous crops, oats showed a striking trend of lower per bushel growing and harvesting costs as yields increased. The effect, both in absolute and relative terms, was greater on the growing costs.

The lowest average cost, as derived from the curves, was with a yield of about 70 bushels per acre. This was true for growing, harvesting and total costs. The following are the average costs at different yield levels:

Bushels produced per acre	Cost per bushel		
	Growing	Harvesting	Net total
20	$2.40	$0.52	$3.00
30	1.64	0.40	2.00
40	1.10	0.30	1.40
50	0.82	0.22	1.06
60	0.66	0.20	0.84
70	0.56	0.19	0.74
80	0.56	0.19	0.74

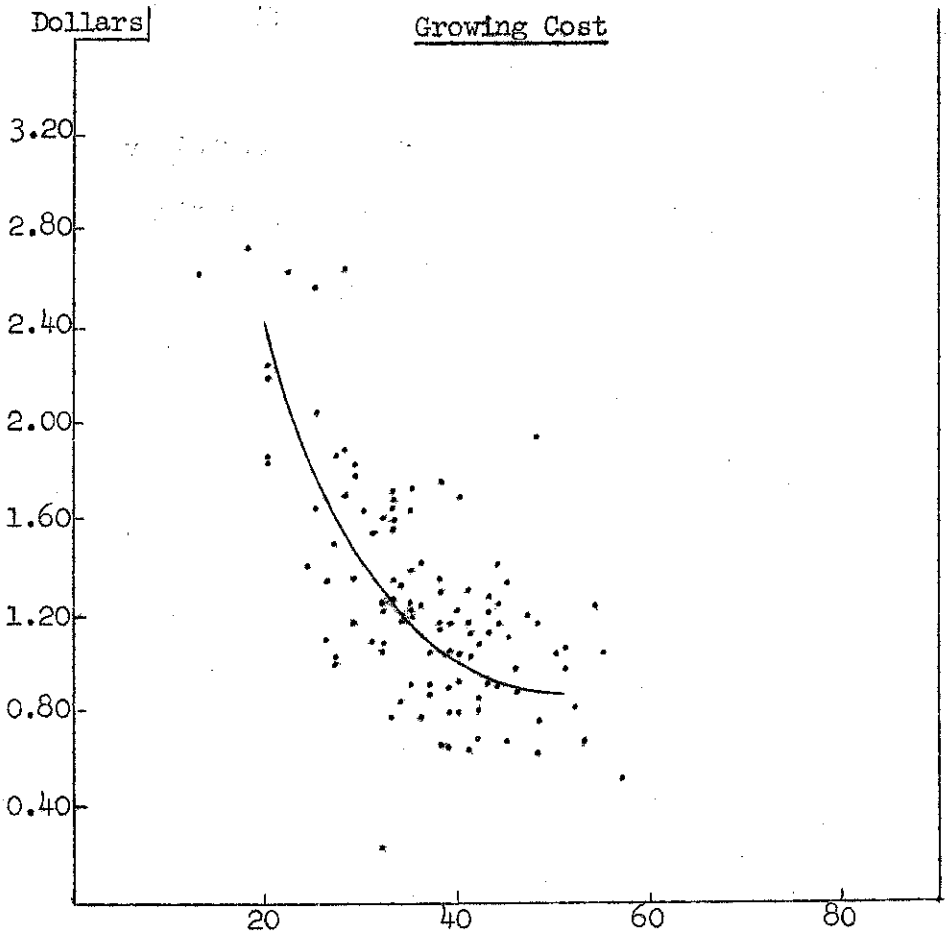
RELATION OF YIELD AND COST PER BUSHEL FOR OATS
110 Records, New York, 1954-58

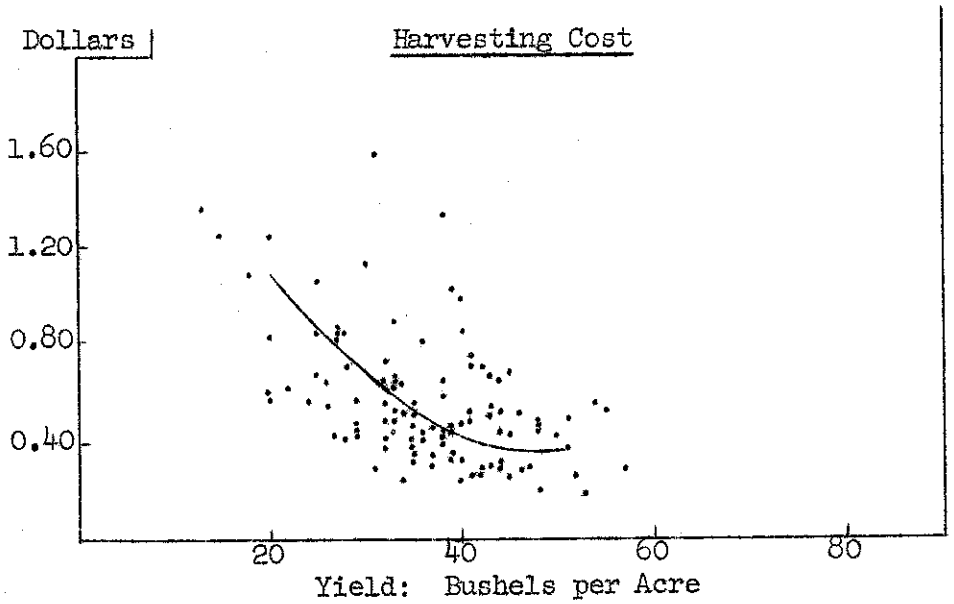


Oats are grown by most farmers primarily as a crop that fits in the rotation as they reseed hay meadows. As such, losses may be justified if more than balanced by the profits from the dairy enterprise.

With an average price of 82 cents per bushel over the 1954-58 period, the break-even point for the oat enterprise was about 63 bushels per acre.

RELATION OF YIELD AND COST PER BUSHEL FOR WHEAT
109 Records, New York, 1954-58





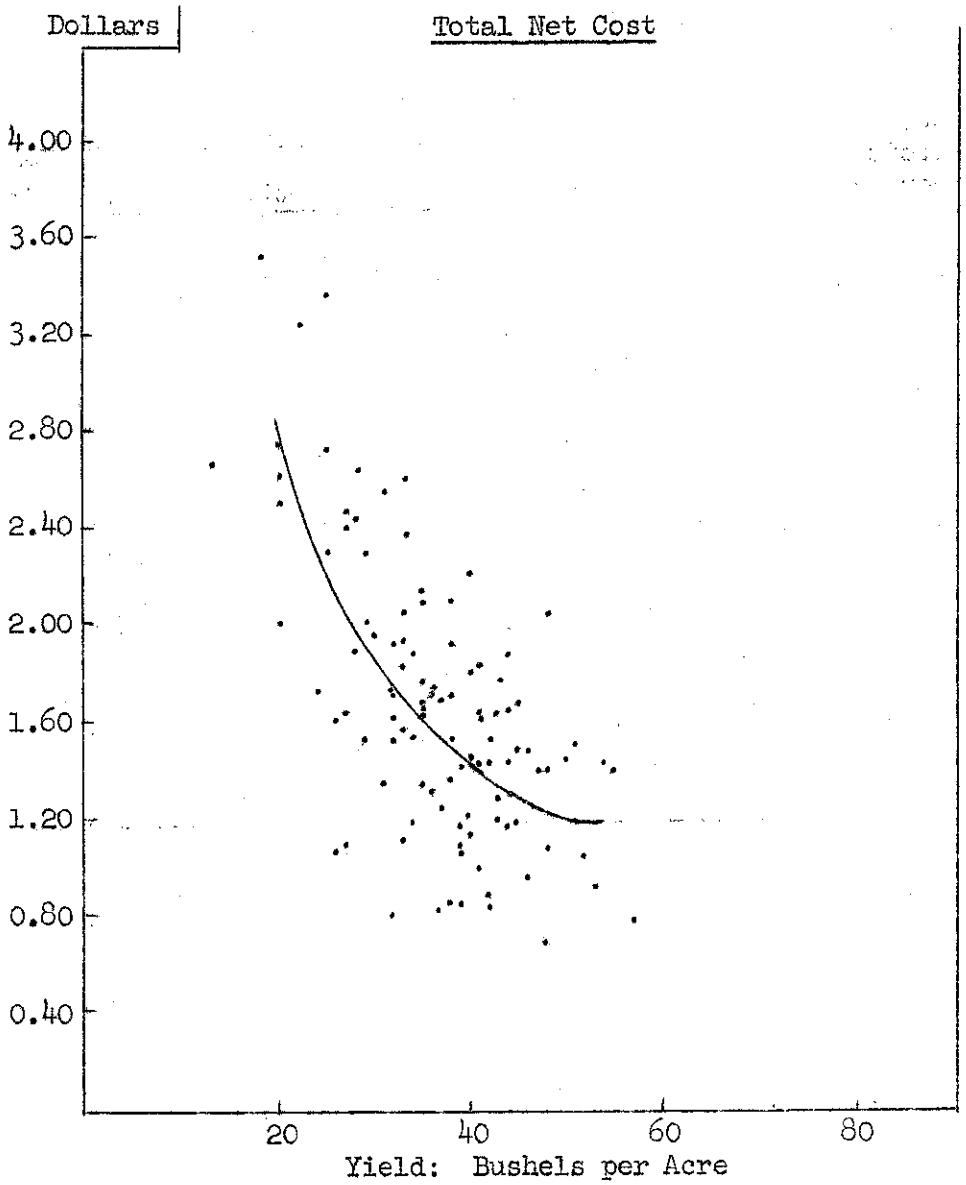
Wheat

Wheat is primarily a cash crop on most New York State farms and the principle of diminishing returns is of particular importance. With this crop the costs, growing, harvesting and total, declined sharply as yield increased to a level of about 40 bushels per acre. From that yield on, the reduction was less. The lowest level of cost was about 50 bushels per acre yield.

The average costs at different yields are:

Bushels produced per acre	Cost per bushel		
	Growing	Harvesting	Net total
20	$2.44	$1.10	$2.84
25	1.86	0.85	2.16
30	1.40	0.66	1.86
35	1.16	0.52	1.60
40	1.00	0.40	1.44
45	0.88	0.36	1.28
50	0.86	0.36	1.20
55	0.86	0.36	1.20

RELATION OF YIELD AND COST PER BUSHEL FOR WHEAT
109 Records, New York, 1954-58



With an average Cost Account farm price of $2.03 per bushel for the years 1954-58 the break-even point for the average wheat enterprise was at a relatively low yield of about 27 bushels per acre. This, of course, has meant that most farmers received substantial profits from this enterprise.

As with the other crops, yield was not the only thing that caused costs per unit to decline, and the optimum economic level of production, although about 50 bushels per acre on the average, differs from farm to farm and year to year as soils, climate, management, etc., differ.