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FEASIBILITY OF EXPANDED POTATO PRODUCTION IN WESTERN NEW YORK

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INTRODUCTION

Potatoes are the most important vegetable crop produced in New York. Since 1980, cash receipts from potatoes have averaged $63.1 million annually, or 2.4 percent of total cash receipts for New York farmers. Potato production in New York occurs on Long Island and throughout Upstate New York. Ten years ago, production on Long Island exceeded Upstate production. Since then, production on Long Island has declined substantially due to urban encroachment and problems with the Colorado potato beetle (White and Lazarus). In contrast, harvested acreage and production in Upstate New York have remained stable at about 25,000 acres and 6.4 million hundredweight (cwt.). The average value of production in Western New York was $38.3 million in the most recent five years (appendix table A1).

A number of economic forces underlie these general trends in New York's potato industry. Shifts in consumer demand have changed the utilization of potatoes. Demand has shifted toward baking potatoes and away from the round, white potato commonly produced in New York and elsewhere in the Northeast (How). There has also been continual growth in demand for processed potatoes such as french fries and potato chips. Whether purchasing potatoes for the fresh market or processing, buyers are becoming more demanding, requiring large volumes of a product of consistently high quality.

These changes, combined with changes in the competitive position of agricultural production in general, have caused many Upstate New York potato growers to look for alternative crops and markets. One alternative that has received interest is the location of a french fry processing plant in Western New York. A plant at this location could capitalize on proximity to eastern markets for french fries, and raises new questions about the feasibility of expanding potato acreage in Upstate New York. Can the long, large potato varieties desirable for processing french fries be grown profitably in New York? Can the quality requisites for french fry production be met? What cultural practices and water management practices can be profitably applied in the Upstate New York setting? Is there land well suited to potato culture available within a reasonable transport radius of a centrally located plant?

In this report, we focus on two questions which have an important bearing on the ultimate feasibility of expanded acreage for New York french fry production. The objectives of our research were as follows:

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1. Determine current land use patterns and the physical features of soil resources within 100 miles of a potential plant location in the Dansville-Hornell area.

2. Assess the costs and returns of growing potatoes in Upstate New York and Northern Pennsylvania using: (a) standard cultural practices, or (b) improved practices associated with growing french fry processing potatoes as reflected in test plot results.

The report is organized around two sections. The first deals with the potential for expanded potato acreage in proximity to a proposed Western New York plant location. To make the assessment more comprehensive, some trend data were assembled for counties in Northern Pennsylvania. The second section deals with issues surrounding production costs for potato producers situated near the proposed plant location.

POTENTIAL FOR EXPANDED POTATO ACREAGE IN WESTERN NEW YORK STATE

As a point of departure for determining the economic potential for growing potatoes for french fry processing, trends in land use and the physical features of soil resources were analyzed within a 100-mile radius of a potential processing plant site in the Dansville area. Secondary data from several sources were integrated to describe land use patterns, physical suitability of land for potato production, potential yields for individual soil units, and global estimates of land suited to future potato production. The analysis demonstrates that land availability is not likely to impede expansion in potato acreage. On the contrary, the results indicate that over 550,000 acres of land with potential average yields of 250 cwt. or more per acre are currently used for crop production in Western New York.

Methodology and Sources of Data

With Dansville, New York as its center, two radii were extended at 50 and 100 miles. If the arc of the respective circle passed through a substantial part of the county, it was included in the study. In total, 26 New York and 17 Pennsylvania counties fall within the resultant circles (table 1). These counties become the geographic reference for the study (figure 1).

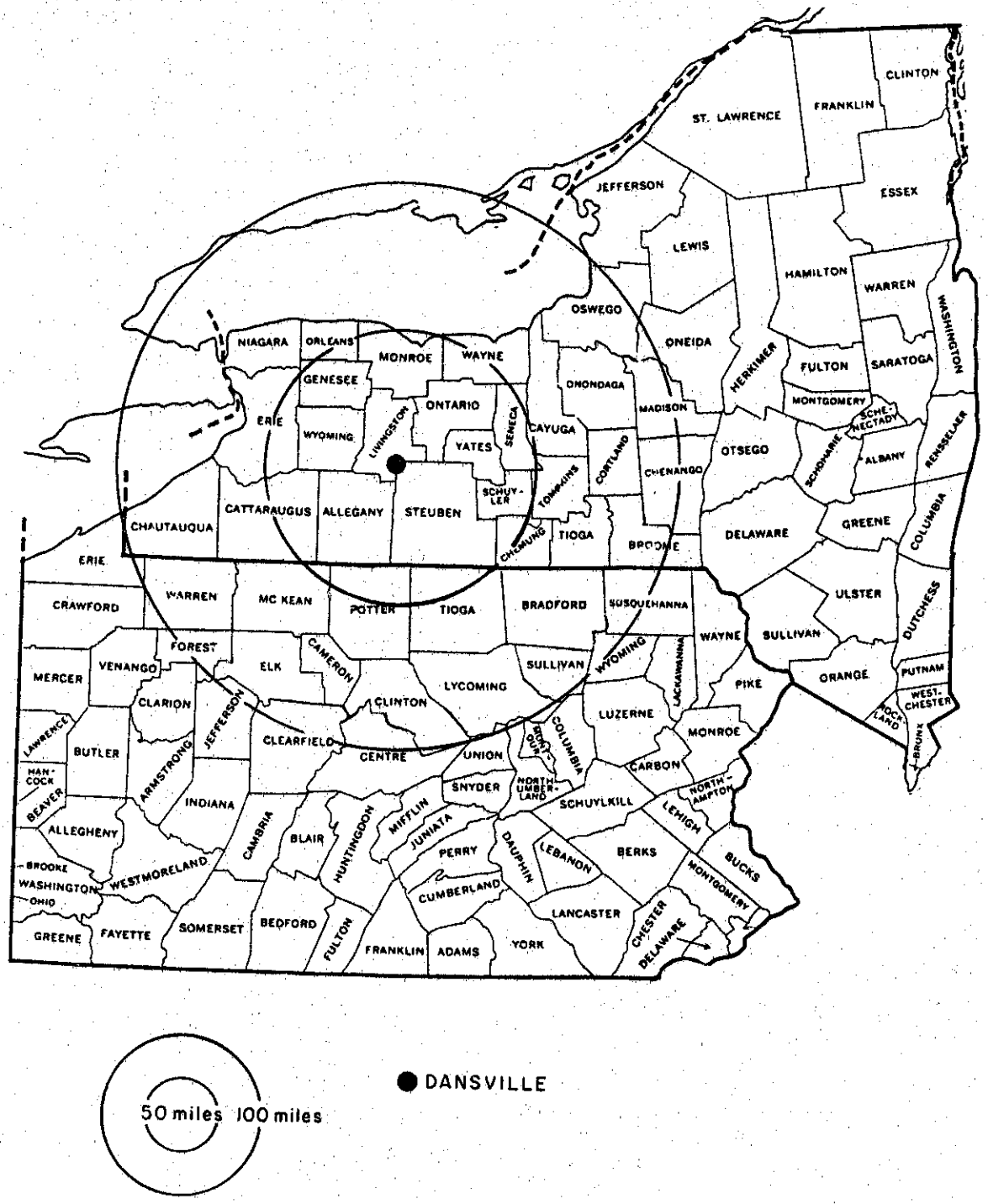
Secondary data were assembled for each county group. Sources used were: (1) U.S. Census of Agriculture, (2) published county soil surveys, (3) National Resources Inventory conducted by the USDA's Soil Conservation Service, (4) New York Agricultural Statistics, published by the New York Crop Reporting Service, and (5) USDA Soil Conservation Service Soils-5 records. Together, these sources provide a comprehensive view of land use and soil characteristics in the study area.

Unfortunately, the time and resources available for compiling such comprehensive data largely limited the analysis to New York counties. An extension of this study would be an effort to assemble companion data for Northern Pennsylvania.

Table 1. New York and Pennsylvania counties within a 50- and 100-mile radius of Dansville, New York

100-mile radius		50-mile radius	
New York	Pennsylvania	New York	Pennsylvania
Allegany	Bradford	Allegany	Potter
Broome	Cameron	Broome	Tioga
Cattaraugus	Centre	Cattaraugus	
Cayuga	Clearfield	Chautauqua	
Chautauqua	Clinton	Chemung	
Chemung	Elk	Chenango	
Chenango	Forest	Erie	
Cortland	Jefferson	Livingston	
Erie	Lycoming	Madison	
Genesee	McKean	Monroe	
Livingston	Potter	Ontario	
Madison	Sullivan	Orleans	
Monroe	Susquehanna	Oswego	
Niagara	Tioga	Schuyler	
Onondaga	Union	Seneca	
Ontario	Warren	Steuben	
Orleans	Wyoming	Wayne	
Oswego		Yates	
Schuyler			
Seneca			
Steuben			
Tioga			
Tompkins			
Wayne			
Wyoming			
Yates			

Figure 1. Counties located within a 50 and 100 mile radius of Dansville, New York



Trends in potato production were derived from annual estimates published by the New York State Crop Reporting Service (CRS) between 1963 and 1985, and from information reported by farm operators in the five-year Census of Agriculture. CRS annual estimates are highly aggregated and encompass all Upstate New York counties. County-level census data for 1950-1982 were tabulated for Western New York and Northern Pennsylvania to determine (1) farms with potato production, (2) harvested potato acres, (3) potato production in cwt., (4) total harvested cropland acres, and (5) irrigation of potatoes (irrigation data were only available for the census years 1974, 1978 and 1982).

The 1982 National Resources Inventory (NRI) was used to develop information on the characteristics of soils now used for crop production. This point sample, area-weighted data base gives information on topography, distance to water, type of irrigation, irrigation water source, erosion rates, hazards encountered in crop production, and measures of land quality.

Information on expected potato yield for individual soil units was also assembled for Western New York. Expected potato yield is available from published soil surveys and from USDA Soils-5 records. Production potential is determined to an important degree by yield response, but soil survey and USDA Soils-5 information give widely disparate impressions of likely potato yield. The differences, unfortunately, cannot be reconciled with current field information. Both sources indicate yields for soil units where potato culture is judged to be feasible under prudent management. Yield data were reported in only 7 of the 26 county soil surveys in Western New York. The yields were reported in surveys for various years and are out of date in some cases. USDA Soils-5 yields, on the other hand, are highly generalized and may not be directly applicable to field conditions encountered in the counties included in this study.

To help overcome these problems, yield data from each source were integrated to produce internally consistent data on expected potato yield. First, yield data in published soil surveys were standardized to the 1982 crop year. A simple linear regression was fitted to five-year census data to estimate the average annual increase in potato yields for each county. Results obtained for each county were reasonably consistent and showed an average annual increase of 2 cwt. per year compared to the base year. Second, the adjusted soil survey data were reviewed by scientists who are familiar with potato culture in Western New York. Their judgements produced some marginal changes in the final yield estimates -- see appendix table A2.

Companion yield estimates reported for cropland soils in the 1982 NRI are shown in appendix table A3. Such data are available for 26 soils, but give a generally consistent picture of the relative suitability for potato production when compared to the updated soil survey yield estimates. When expanded by the acreage weights provided in the merged 1982 NRI data file, Soils-5 data provide a basis for allocating the 1982 cropland base into categories based upon expected potato yield.

Trends in Potato Production

Potato production occurs both on Long Island and in virtually all of the counties located in Upstate New York. In 1985, potatoes were harvested on 24,500 acres in the Upstate area (table 2). Total potato production was about 6.1 million cwt.

Upstate potato production has involved the utilization of approximately 25,000 cropland acres since the early 1970s (see table 2 and figure 2). Production has exceeded 6 million cwt. for most of these years because per acre potato yields have remained in the range of 250 cwt. throughout the 1970s and 1980s.

In sharp contrast, Upstate growers harvested potatoes on well over 30,000 acres during the 1960 decade. Yields were somewhat lower during the 1960s and, in general, yields per acre show an upward trend in the Upstate region (figure 3).

Year-to-year variability in yield is also a distinct feature of the Upstate potato industry. Fluctuations in per acre yield from the previous year have exceeded 10 percent on several occasions since 1963 (figure 4).

Upstate production patterns are clearly mirrored in data assembled for New York and Pennsylvania counties in the vicinity of Dansville, New York. Based on 1950 census reports, over 52,000 acres of potatoes were harvested on New York farms located within 100 miles of Dansville (table 3). Over 10,000 acres were harvested on Pennsylvania farms in the 100-mile radius (table 4). The data do not show the number of farms with potatoes as a principal farm enterprise, but 28 percent and 32 percent, respectively, of all New York and Pennsylvania farms in the Dansville region reported some potato production in 1950.

Production agriculture has undergone a number of structural adjustments in recent decades. The cumulative effect of these adjustments has been to reduce harvested potato acreage by 32,000 acres (60 percent) in Western New York between 1950 and 1982 (table 3).[1] The decrease in Northern Pennsylvania has been from a smaller acreage base, but has been even more dramatic in percentage terms (table 4). In 1982, less than 2,000 acres of potatoes were reported on Pennsylvania farms located in the Dansville area.

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[1] A portion of the acreage reduction is probably due to changes in the Census definition of a farm. In 1950 and 1954, a farm was a place with 10 or more acres and production (for sale or home use) valued at $150 or more; places with 3 or fewer acres were counted if sales of products amounted to $150 or more. For 1959, 1964 and 1969, places with 10 or fewer acres were counted if production was $250 or more during the census year. In 1974, the farm definition was changed to include those places with sales of $1,000 or more during the census year.

Table 2. Potato production in Upstate New York, 1963-1985

Year	Acres planted	Acres harvested	Percent not harvested	Yield	Production
	(ac.)	(ac.)	(pct.)	(cwt.)	(cwt-1,000)
1985	25,000	24,500	2.0	250	6,125
1984	26,000	25,500	1.9	260	6,630
1983	25,500	24,500	3.9	230	5,635
1982	26,000	25,000	3.9	260	6,500
1981	26,500	25,000	5.7	275	6,875
1980	26,000	25,000	3.9	250	6,250
1979	25,500	23,500	7.8	275	6,463
1978	26,000	25,000	3.9	260	6,500
1977	27,500	20,600	25.1	260	5,356
1976	26,200	24,900	5.0	245	6,101
1975	25,000	24,000	4.0	255	6,120
1974	N.A.	26,800	5.6	260	6,968
1973	N.A.	29,000	--	230	6,670
1972	N.A.	25,500	--	195	4,973
1971	N.A.	34,500	--	230	7,935
1970	N.A.	33,400	--	260	8,684
1969	N.A.	35,500	--	235	8,342
1968	N.A.	35,500	--	225	7,988
1967	N.A.	36,000	--	245	8,820
1966	N.A.	39,000	--	220	8,580
1965	N.A.	38,000	--	215	8,170
1964	N.A.	40,000	--	205	8,200
1963	N.A.	42,000	--	230	9,660

N.A. = Not available.
Source: New York Crop Reporting Service.

Figure 2. Potato production for Upstate New York, 1963-1984

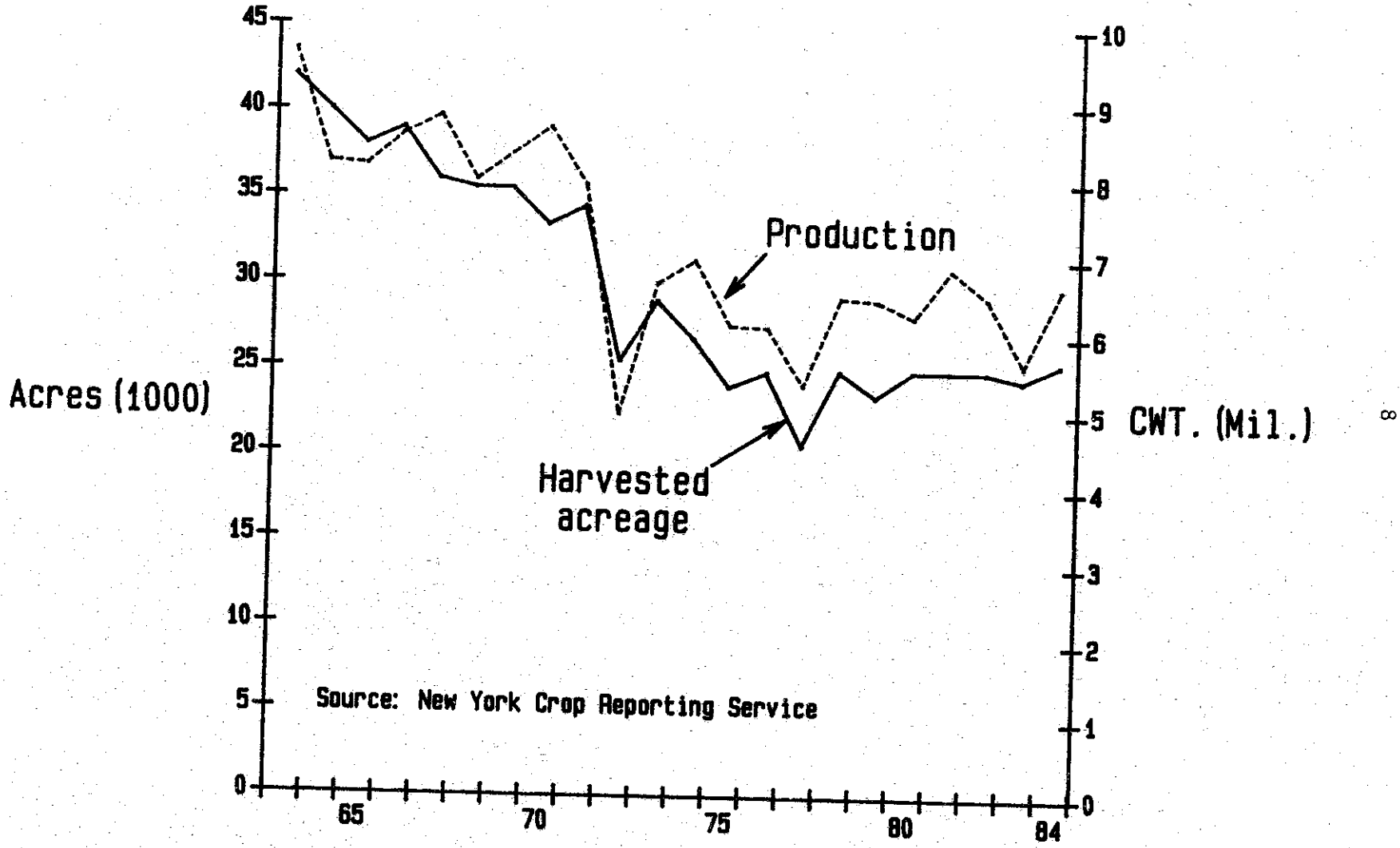
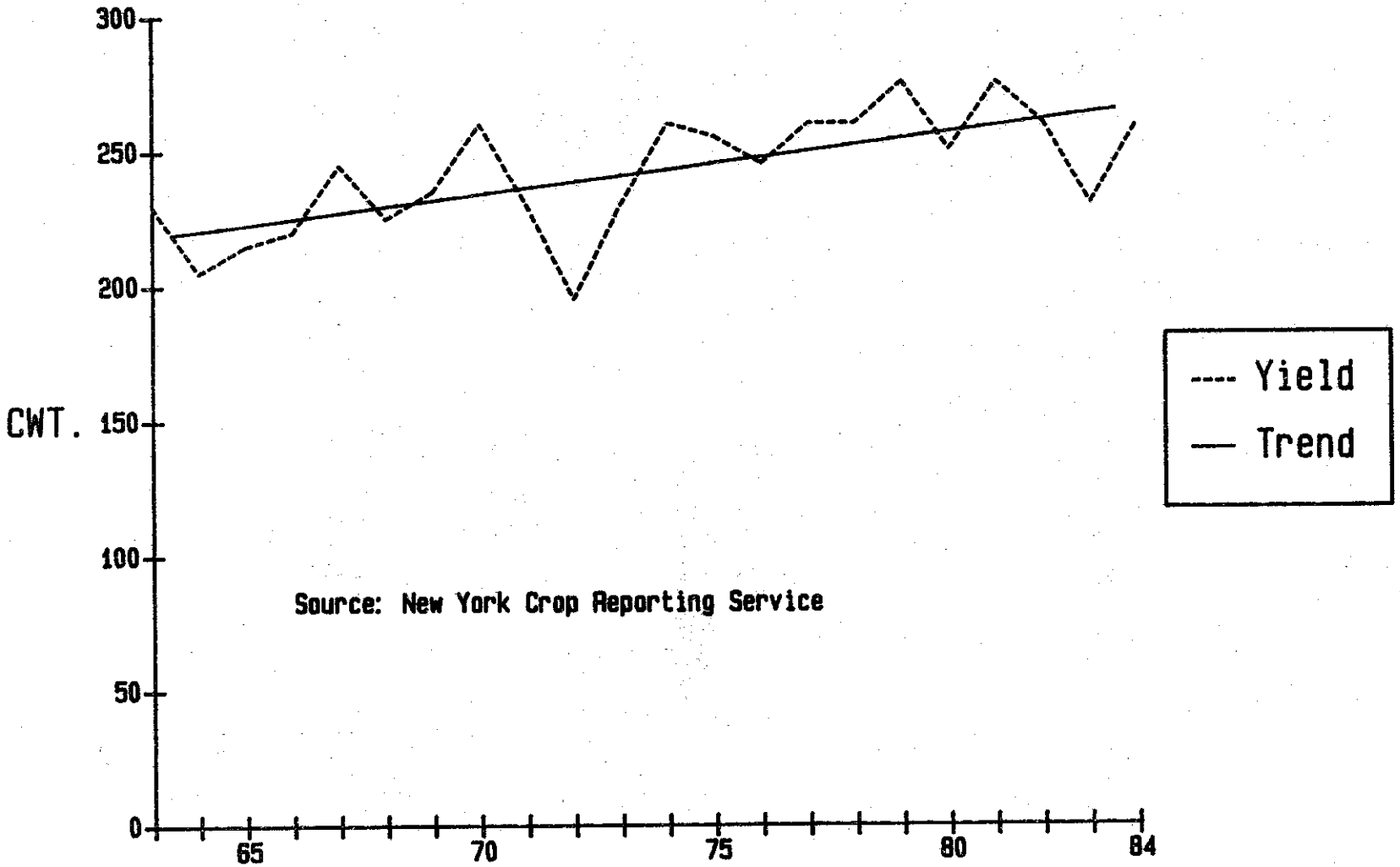


Figure 3. Average potato yield per acre, Upstate New York, 1963-1984



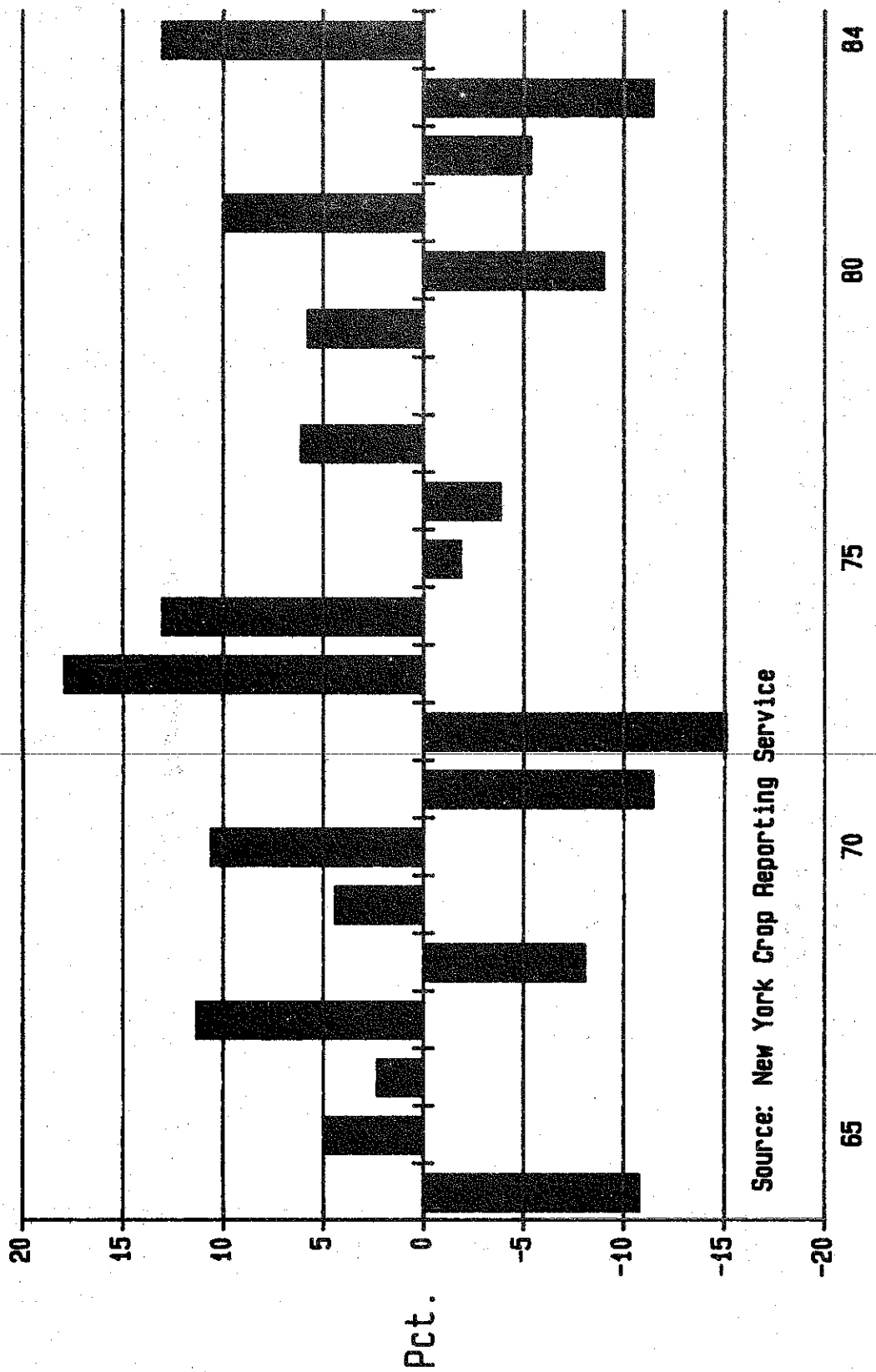


Figure 4. Percentage change in per acre potato yield, Upstate New York, 1964-1984
Pct.
20
15
10
5
0
-5
-10
-15
-20
65
70
75
80
84
Source: New York Crop Reporting Service

Table 3. New York farms reporting potato production within a 50- and 100-mile radius of Dansville, New York, 1950-1982

Item	Year			
	1950	1954	1959	1964
Farms				
100-mile radius	18,903	11,292	4,096	1,349
50-mile radius	13,611	8,095	2,938	975
Harvested acreage (1,000)				
100-mile radius	52.5	34.7	32,8	31.3
50-mile radius	38.0	26.3	25.5	23.2
Production (1,000 cwt.)				
100-mile radius	8,804	6,211	6,231	6,286
50-mile radius	6,304	4,560	5,062	4,495
Yield (cwt.)				
100-mile radius	168	179	197	199
50-mile radius	166	173	198	194

Item	Year			
	1969	1974	1978	1982
Farms				
100-mile radius	612	763	490	466
50-mile radius	438	541	356	336
Harvested acreage (1,000)				
100-mile radius	28.6	24.4	20.7	20.5
50-mile radius	22.4	17.8	14.9	14.8
Production (1,000 cwt.)				
100-mile radius	6,231	5,991	4,531	4,840
50-mile radius	4,762	4,314	3,238	3,509
Yield (cwt.)				
100-mile radius	220	245	220	236
50-mile radius	212	243	217	237

Source: U.S. Census of Agriculture.

Table 4. Pennsylvania farms reporting potato production within a 50- and 100-mile radius of Dansville, New York.

Item	Year			
	1950	1954	1959	1964
Farms				
100-mile radius	8,167	4,646	1,773	422
50-mile radius	1,040	461	759	68
Harvested acreage (1,000)				
100-mile radius	10.6	5.9	4.1	3.7
50-mile radius	3.8	2.4	1.9	2.0
Production (1,000 cwt.)				
100-mile radius	1,483	895	716	738
50-mile radius	663	371	347	414
Yield (cwt.)				
100-mile radius	140	151	176	198
50-mile radius	175	153	184	202

Item	Year			
	1969	1974	1978	1982
Farms				
100-mile radius	196	303	159	160
50-mile radius	40	46	29	23
Harvested acreage (1,000)				
100-mile radius	3.7	2.9	2.3	2.0
50-mile radius	2.1	1.7	1.5	1.5
Production (1,000 cwt.)				
100-mile radius	924	663	525	348
50-mile radius	524	370	313	277
Yield (cwt.)				
100-mile radius	254	225	229	178
50-mile radius	248	216	216	191

Source: U.S. Census of Agriculture.

These adjustments in potato acreage, of course, are merely a subset of those dictated by market conditions and resource availability in the wider farm sector. Potatoes have accounted for a relatively stable proportion of total cropland acreage throughout the 1950-1982 period; a more noteworthy development is that production is concentrated on fewer farms (table 5). Today, probably no more than 450 farms in Western New York produce potatoes (figure 5).

Irrigation. Production of a high-valued crop with supplemental water can enhance yield on soils with low water-holding capacity and/or in regions with rainfall variability during the growing season. Yield enhancement is often sufficient to warrant investments in irrigation equipment if a supplemental water source is available. Although potatoes are a high-valued crop, circumstances in the humid Northeastern states do not generally promote extensive investment in irrigation equipment needed to make supplemental water available. Based on census data, 80 farms in the Dansville region reported some irrigated potato acreage in 1974; about 3,500 acres were irrigated (table 6). This is about 12 percent of the total potato acreage harvested during the 1974 crop year. By 1982, farms irrigating potatoes in Western New York and Northern Pennsylvania had decreased to 67. One cannot be sure, however, that the number of farms with irrigation equipment has decreased in recent years. Rainfall is so variable that the equipment is not necessarily used and, hence, not reported during some census years.

To shed more light on the use of irrigation in Western New York, USDA information for all cropland was reviewed to draw a more complete picture of irrigation practices. The data clearly show the extremely low incidence of irrigation regardless of the crop produced. Fewer than 30,000 acres of cropland had supplemental water in 1982 (National Resources Inventory). Producers who irrigate are almost totally dependent on surface water sources. Similarly, the bulk of all irrigated acreage involves the use of a pressure irrigation system.

Prospects for increased use of supplemental water from surface sources depends, among other things, upon proximity to a water source. According to NRI data, about one-quarter of all cropland is within 200 yards of surface water (figure 6). One cannot determine if utilization of water for irrigation is feasible at these locations, but it would probably not be precluded by the distance required to transport water. At the other extreme, upwards of 50 percent of all Western New York cropland is over 400 yards from a surface water source. This distance would probably adversely affect the feasibility of irrigating from a surface water source.

Crop Yield and Potential for Expanded Potato Acreage. Water availability is but one of the factors which will ultimately affect future efforts to expand potato acreage in this region of New York. Expansion would reverse a long-term decline in potato acreage and, in some cases, would bring land once used for potatoes back into production for that purpose.

Table 5. Percentage of farms producing potatoes and percentage of harvested cropland used for potatoes, 1950-1982

Year	New York				Pennsylvania			
	100-mile radius		50-mile radius		100-mile radius		50-mile radius	
	Farms	Acres	Farms	Acres	Farms	Acres	Farms	Acres
	- - - (Percent) - - -							
1950	28.0	1.7	28.1	1.7	32.6	1.1	29.7	2.3
1954	19.4	1.1	19.4	1.2	22.0	0.6	15.8	1.5
1959	9.1	1.2	9.1	1.3	11.0	*	33.4	1.3
1964	3.7	1.2	3.8	1.3	3.2	0.5	3.4	1.4
1969	2.1	1.3	2.1	1.5	2.0	0.6	2.6	2.0
1974	3.1	1.0	3.1	1.1	3.6	*	3.8	1.5
1978	2.1	0.8	2.1	0.9	1.8	*	2.3	1.1
1982	2.0	0.8	2.0	0.8	1.8	*	1.7	1.0

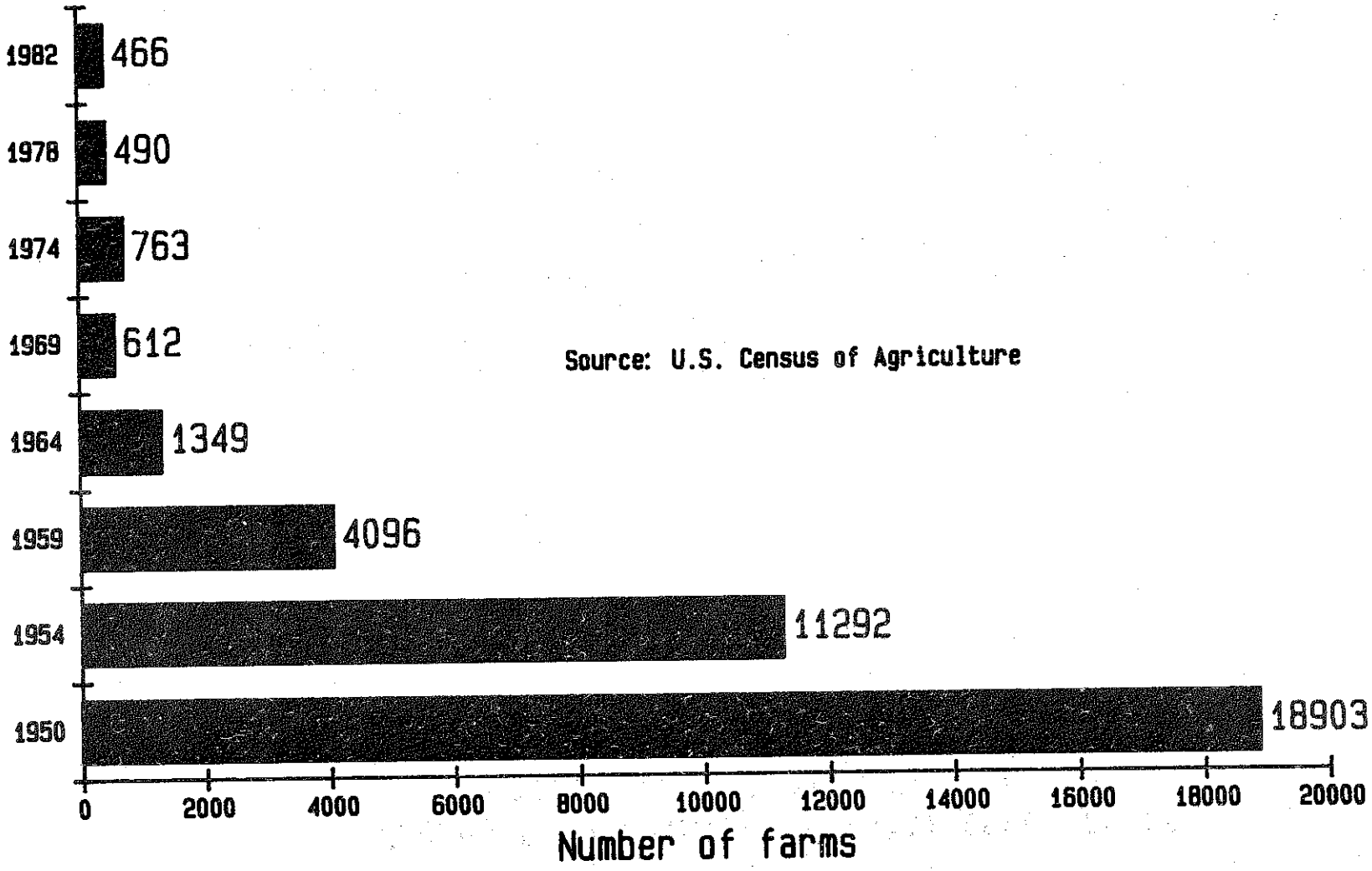
*Under 0.5 percent.
Source: U.S. Census of Agriculture.

Table 6. Farms reporting irrigated potato acreage, 1974-1982

Location from Dansville, NY	1974		1978		1982	
	Farms	Acres	Farms	Acres	Farms	Acres
New York						
100-mile radius	74	3,487	76	3,210	60	N.A.
50-mile radius	47	1,818	53	1,899	42	N.A.
Big four county producers						
Livingston	3	174	5	229	2	N.A.
Steuben	11	880	9	587	7	373
Wayne	6	182	13	650	7	896
Wyoming	11	1,345	9	1,252	4	935
Pennsylvania						
100-mile radius	6	39	6	N.A.	7	N.A.
50-mile radius	0	0	0	0	0	0

N.A. = Not available.
Source: U.S. Census of Agriculture.

Figure 5: Farms with potato production within a 100 mile radius of Dansville, New York



Source: U.S. Census of Agriculture

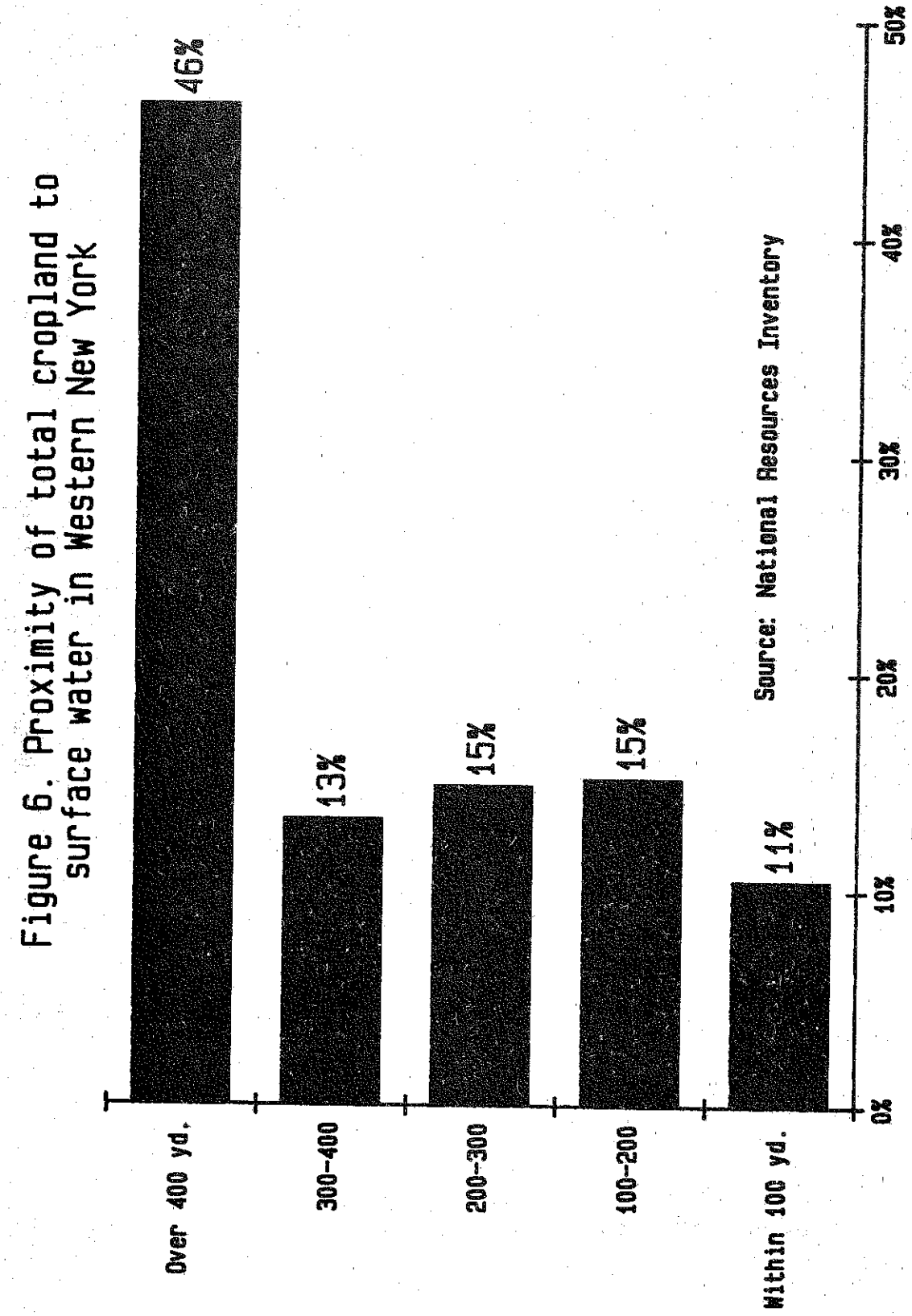


Figure 6. Proximity of total cropland to surface water in Western New York
46%
13%
15%
15%
11%
Over 400 yd.
300-400
200-300
100-200
Within 100 yd.
Source: National Resources Inventory
0%
10%
20%
30%
40%
50%
Percentage of total cropland

To help identify the prospects for such expansion, data were assembled which reflect the suitability of the current cropland base for future crop production. Today, about 3.4 million acres of land in Western New York are used by farmers for crop production within a 100-mile radius of Dansville. Based on commonly used measures of cropland quality, a large fraction of this land is well suited to continued crop production. Over 90 percent of this acreage falls in the USDA's Land Capability Classes I, II and III (table 7). Class I land has few limitations which restrict its use for crop production. Class II and III land has limitations but is suitable for regular cultivation of most field crops. Class IV-VIII land has production hazards -- such as risk of erosion, excessive moisture, shallowness, or droughtiness -- which severely restrict its use for production of annual field crops. More than 50 percent of the total cropland base falls within the USDA's definition of "prime" farmland.[2] The USDA identifies prime farmland on a national basis to designate land best suited to long-term use for crop production.

Unfortunately, yield response on any new potato acreage is more difficult to gauge. Uncertainties are introduced because the proposed development of french fry processing involves new potato varieties and more intensified management. However, an overriding problem in assessing land quality is the limited evidence on expected crop yield for individual soil units. Potential potato yields under prudent management are published in some county soil surveys, but this information is not complete and is often outdated.

Comprehensive information on potato yield in the Dansville area can come from information farmers report in the five-year Census of Agriculture. Average yields have ranged between 150 and 280 cwt. per acre since the 1950s (table 8). Potential yield can also be related to the current cropland base, as noted above with the USDA's 1982 NRI and Soils-5 records. These yields are predicted outcomes under high or very intensive management (USDA, 1975). Such yields are probably achieved by only a small fraction of all growers in Western New York.

About one-fifth of all Western New York cropland is rated for potential potato yield (table 9). The remainder is not rated because the soils involved are not commonly used to grow potatoes (USDA, 1975). About 15 percent of all cropland in Western New York -- some 550,000 acres -- has an estimated yield potential of 250 cwt. per acre or more; the bulk of this acreage is within 50 miles of the Dansville location.

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[2] Prime farmland has the soil quality, growing season and moisture required to produce sustained high yields of crops economically when treated and managed according to modern farming methods (USDA, 1975).

Table 7. Land capability class for New York cropland located within a 100-mile radius of Dansville, New York

Land capability class	Distance to Dansville (miles)		
	Total	Under 50	50-100
	- - - Acres (1,000) - - -		
I	127.5	90.5	37.0
II	1,558.4	1,080.4	478.0
III	1,502.4	1,042.5	459.9
IV-VIII	305.8	194.6	111.2
Total	3,494.1	2,408.0	1,086.1
	- - - Percent (1,000) - - -		
I	3.7	3.8	3.4
II	44.6	44.9	44.0
III	43.0	43.3	42.3
IV-VIII	8.7	8.0	10.2
Total	100.0	100.0	100.0

Source: 1982 National Resource Inventory.

Table 8. Average potato yields reported by farmers in the Census of Agriculture, 1950-1982.

Area	Year							
	1950	1954	1959	1964	1969	1974	1978	1982
	- - - (Cwt. per acre) - - -							
New York								
100-mile radius	168	179	197	199	220	245	220	236
50-mile radius	166	173	198	194	212	243	217	237
Big four county producers								
Livingston	213	219	201	210	207	222	198	210
Steuben	189	177	198	191	217	253	225	234
Wayne	155	172	232	221	201	239	235	276
Wyoming	200	232	204	239	278	265	267	242
Average Big Four (weighted by acres)	190	190	205	207	225	249	233	243
Pennsylvania								
100-mile radius	140	151	176	198	254	225	229	178
50-mile radius	175	153	184	202	248	216	216	191

Source: U.S. Census of Agriculture.

Table 9. Potential potato yields on New York cropland located within a 100-mile radius of Dansville, New York

Potential potato yield (cwt.)	Distance to Dansville (miles)		
	Total	Under 50	50-100
	- - - Acres (1,000) - - -		
Under 250	183.7	126.8	56.9
250-349	327.3	257.9	69.4
350 or more	224.1	186.5	37.6
Not rated	2,759.0	1,836.8	922.2
Total	3,494.1	2,408.0	1,086.1
	- - - Percent - - -		
Under 250	5.2	3.6	1.6
250-349	9.4	7.4	2.0
350 or more	6.4	5.3	1.1
Not rated	79.0	52.6	26.9
Total	100.0	68.9	31.0

Source: Derived from USDA Soils-5 records and the National Resources Inventory.

COST OF PRODUCTION

The preceding section demonstrates that, from the perspective of land suitability, Western New York has the potential to accommodate substantial increases in potato production. The prospects for expanded acreage, however, depend importantly upon the costs and returns growers encounter with a potato enterprise. Factors affecting production costs are investigated in this section.

Methodology and Sources of Data

Two basic approaches were used to determine current production costs for potatoes grown in Western New York. These involve enterprise analysis and a whole farm analysis. The potato enterprise analysis is based on data obtained from nine growers who grew potatoes in variety test plots during 1986. Total potato acreage on these farms was 3,107 acres for the 1986 crop year. This acreage accounts for about 12 percent of all potato acreage in Upstate New York.

Whole farm analysis involves budgeting for a representative potato farm with a variety of possible crop rotations. Potatoes are generally rotated with other crops to enhance quality and maintain yield of raw product. Rotational crops on potato farms in Western New York have historically been limited to small grains with cover crops commonly used. These crops are not high valued and are grown for the benefit to the potato enterprise. In this context, it is important to analyze the farm business as a whole. For the purposes of this study, both current crop rotations

and alternate rotations thought to enhance the performance of new potato varieties are taken into consideration. New varieties may be necessary to meet finished product specifications of the proposed frozen french fry industry.

Enterprise Analysis. On-farm interviews were conducted with growers who participated in test plot trials to obtain data specific to their 1986 potato enterprise. These data included costs for seed, fertilizer, chemicals, land, custom work and other cash expenses. Estimates of labor and tractor hours and costs used for the potato enterprise were also obtained from each grower. Finally, data for machinery and equipment used to grow and harvest the potato crop were obtained.

The procedures used in obtaining and analyzing these enterprise data were based on past research experience dealing with enterprise analysis. Appropriate tractor and equipment costs and relationships were adjusted to estimate 1986 costs for those items (Snyder).

The results generated from these data provide estimated 1986 production costs for total potato acreage on each farm. Production costs for the test plot acres on each farm were also estimated. In this context, production costs include all growing costs and harvesting costs associated with putting the crop in farm storage or loading on a truck for bulk delivery to a buyer at harvest time. Cost differences between test acreage and the remaining potato acreage were noted to allow a comparison between current practices and revised practices associated with the test varieties.

Three average yield levels were assumed for each of these enterprise analyses to illustrate the sensitivity of production costs per cwt. to changes in yield levels. A yield of 250 cwt. per acre was used as the base yield with the other yield levels $\pm$25 cwt. per acre. This base yield approximates the most recent average potato yield for Upstate New York.

Whole Farm Analysis. For the nine farms studied, the median size of the potato enterprise was 230 acres. Therefore, the analysis was based on a representative potato farm of 450 acres of cropland. This permits a farm with 225 acres of potatoes grown in a two-year rotation with 225 acres of oats. This farm size was held constant and formed the basis on which to develop whole farm budgets for four rotations to compare economic results with the base farm rotation.

Each farm budget included data for the potato enterprise and for the rotation crop enterprises chosen. The base farm budget was developed to represent current practices and results. The other four farm budgets were each compared to the base farm results to estimate changes in farm income for alternative crop rotations. The alternative crop rotation budgets used costs and yields for the new potato varieties and included two 3-year and two 4-year rotation programs.

The economic engineering approach was used for the crop budgets. This procedure uses current prices for operating costs such as seed, fertilizer, chemicals and supplies. Other variable costs such as machinery repairs and fuel were calculated using engineering data for the operation of the machinery complements assumed for each crop mix.

Although all costs of production need to be considered to determine enterprise profits, these budgets were designed to aid in making short-run, annual decisions about enterprise size and mix. With relatively stable fixed costs to spread over the crop acreage, the variable costs considered here provide an estimate of the annual operating costs for each crop. These costs and assumed crop values and yields were used to estimate the net contribution each crop made toward meeting the fixed obligations of the farm operator. The budgets shown in the appendix show the net returns over variable costs on both a per acre and per cwt. basis. In table 14, total costs and net returns for the whole farm are shown for each of the five rotations considered.

Three potato yield levels were used for each whole farm budget to reflect possible economic results for each rotation. Results for each alternative crop rotation were compared to the base farm results. In each budget, input levels were adjusted to estimate effects of the rotations on the whole farm profit level. Crop input and yield assumptions were based on the research and test plot experience of agronomy and plant science researchers as well as of the authors of this report.

Finally, the nonpotato crops were assumed to break even under the price and yield levels used. By reducing total farm costs by the total value of those crops, another estimate of potato production costs was calculated for each budget situation.

Enterprise Analysis

Cost of Production -- Current Practices. Data for 1986 potato enterprises were obtained from seven growers in Western New York and two growers in Northern Pennsylvania. Data collected were limited to production costs and did not include costs related to storing or marketing the crop.

Table 10 shows a composite of data from the nine farms for all potato acres on the farms. A total of 3,107 acres of potatoes was grown on these farms; each farm averaged 345 acres of potatoes. Test plot acres totaled 80 acres, with an average of nine acres per farm. A composite of the production costs for the test plot acres on the nine farms is presented in table 11.

The data for all potato acres are considered to be reasonably indicative of current production practices in Western New York. Production costs were separated into growing and harvesting costs with various cost categories for both production phases. Each cost includes both variable and fixed costs. Tractor and equipment costs include repair, maintenance and fuel costs, and the normal ownership costs of depreciation, interest, insurance and housing. Labor costs are for direct crop production activities. Repair and administrative labor are included under equipment and overhead costs. Labor costs include all employer costs for employees, such as fringe benefits and taxes, as well as gross wages. Supervisory labor, as well as management by the operator, is also included.

Table 10. Potato production costs, 3,107 acres on 9 farms, Western New York region, 1986

Item	Rates per acre	Cost	
		Per acre	Per cwt.
Number of farms		9	
Acres per enterprise, average		345	
Assumed yield per acre, cwt.		250	
Growing Costs:			
Labor--direct crop production	6.8 hrs.	$ 60	
Custom work, equipment rent		20	
Lime, cover crop		44	
Fertilizer	lbs. N-168, P-215, K-164	102	
Seed	26.8 cwt.	199	
Chemicals		142	
Interest on operating capital		24	
Tractor	3.8 hrs.	50	
Equipment, large trucks		84	
Land		81	
Overhead, all other		32	
Total growing costs		$ 838	$3.36
Harvesting Costs:			
Labor--direct crop production	18.7 hrs.	$ 111	
Tractor	3.3 hrs.	40	
Equipment, large trucks		148	
Custom work, equipment rent		0	
Overhead, all other		27	
Total harvesting costs		$ 326	$1.30
Total Production Costs*		$1,164	$4.66

*Excludes storage, hauling and marketing costs.

Custom work costs were generally incurred for aerial application of chemicals. Lime was applied to maintain a pH level of about 6.0 for the potato crop in most cases. A cover crop was used extensively. Red clover seeded in a small grain crop was a common practice in a two-year rotation.

Cash costs for seed, fertilizer and chemicals represented a range of application rates and unit costs depending on each grower's judgement of the appropriate practice to follow in his situation. Interest was charged at 10 percent on the use of operating capital, and an overhead charge was made on growing and harvesting costs to cover administrative and other costs not covered elsewhere. These costs include allowances for utilities, the use of pickup trucks, liability insurance, accounting fees, publications and other overhead costs supportive of the enterprise.

Table 11. Potato production costs, 80 acres on 9 test plots, Western New York region, 1986

Item	Rates per acre	Cost Per acre	Cost Per cwt.
Number of farms		9	
Acres per enterprise, average		9	
Assumed yield per acre, cwt.		250	
Growing Costs:			
Labor--direct crop production	6.8 hrs.	$ 60	
Custom work, equipment rent		20	
Lime, cover crop		44	
Fertilizer	lbs. N-185, P-248, K-212	123	
Seed	20.2 cwt.	163	
Chemicals		142	
Interest on operating capital		28	
Tractor	3.8 hrs.	50	
Equipment, large trucks		84	
Land		81	
Overhead, all other		31	
Total growing costs		$ 826	$3.31
Harvesting Costs:			
Labor--direct crop production	18.7 hrs.	$ 111	
Tractor	3.3 hrs.	40	
Equipment, large trucks		148	
Custom work, equipment rent		0	
Overhead, all other		27	
Total harvesting costs		$ 326	$1.30
Total Production Costs*		$1,152	$4.61

*Excludes storage, hauling and marketing costs.

Land costs were estimated by including the actual cost of rented land. Real estate taxes and an interest charge of 10 percent of the agricultural value of cropland comprised the value of owned cropland. On this basis, potato cropland cost an average of $81 per acre.

Growing costs on these farms averaged $838 per acre for all potato acres (table 10). Major cost items were the cash costs for fertilizer, seed and chemicals. Together, these items accounted for over half of the total growing costs of potatoes. Fertilizer nutrients were applied at an average rate per acre of 168 pounds of nitrogen, 215 pounds of phosphorus and 164 pounds of potash. Seeding rates averaged nearly 27 cwt. per acre. Tractor and equipment costs, along with labor and land costs, were other major cost items.

Six of the New York growers had irrigation equipment on hand. This equipment was underutilized in 1986 because of a wet growing season. The reduced need for irrigation tended to lower growing costs for 1986. On the other hand, continued wet weather led to somewhat higher than normal harvesting costs. The feasibility of irrigating potatoes is discussed in a later section of this report.

The harvesting activity required considerably more labor than growing the crop. Cost per hour was less for harvesting because of the seasonal nature of most of the labor required. Harvesting costs included mechanical harvest in the field and the removal of rocks and culls as the potatoes were rough graded into storage or loaded onto road trucks to be hauled from the farm. Harvesting the crop cost an average of $326 per acre for all potato acres. Total costs incurred in growing and harvesting the crop averaged $1,164 per acre (table 10).

Yield information is generally expressed in quantity of potatoes sold. Since this study was concluded with harvesting costs when potatoes went into storage, 1986 yield data were not available. Instead, a yield of 250 cwt. per acre was chosen to represent the experience of Western New York growers. This was based on production data from the New York Agricultural Statistics Service, which shows the most recent five-year yield for Upstate New York growers to average 253 cwt. per acre.

With the assumed yield of 250 cwt. of usable potatoes produced per acre, growing costs averaged $3.36, and harvesting costs averaged $1.30. Total production costs averaged $4.66 per cwt. for all acres on these farms (table 10).

Cost of Production -- Test Plot Acres. Cultural practices for the test plot acres were quite similar to current practices used to produce the normal varieties of potatoes. The only significant exceptions were for fertilizer and seeding rates. Fertilizer costs on test plots averaged $123 per acre, or $21 per acre higher than for all potato acres (table 11). Nutrient rates were higher at 185 pounds of nitrogen, 248 pounds of phosphorus and 212 pounds of potash. Seed rates were lower at 20.2 cwt. per acre, with a lower cost of $163 per acre. These cost differences reduced interest and overhead costs slightly for the test varieties. With these changes, growing costs for the test acres averaged $826 per acre and $3.31 per hundredweight at the 250 cwt. per acre yield level.

Harvesting practices for the test plot acres were identical to those used on the remaining acreage and amounted to $326 per acre and $1.30 per cwt. at the assumed yield. Total production costs averaged $1,152 per acre and $4.61 per acre for these farms (table 11).

Sensitivity Analysis. With mechanical harvesting, production costs per acre are essentially constant regardless of small yield variations. However, potato production is measured and sold by the hundredweight. With a relatively stable cost per acre, the quantity produced per acre has an important effect on production cost per cwt. Table 12 shows the effect of different yield levels on the unit costs of potato production. Data are presented for all potato acres on these farms as well as for the test plot acres.

Table 12. Sensitivity analysis of potato production costs to changes in yield levels, all acres and test plot acres, Western New York region, 1986

	Production costs per acre		
	Grow	Harvest	Total
	($)	($)	($)
All acres (3,107)	838	326	1,164
Test acres (80)	826	326	1,152

		Production costs per cwt.		
Yield level	Acres	Grow	Harvest	Total
		($)	($)	($)
225 cwt/acre	All	3.72	1.45	5.17
	Test	3.67	1.45	5.12
250 cwt/acre	All	3.36	1.30	4.66
	Test	3.31	1.30	4.61
275 cwt/acre	All	3.05	1.18	4.23
	Test	3.01	1.18	4.19

To illustrate cost sensitivity to yield changes, costs per acre obtained from growers for the 1986 crop were held constant at the assumed yield of 250 cwt. per acre. The small change in harvest cost for handling the different yields was considered insignificant and, therefore, was not estimated.

Two alternate yield levels, one 10 percent above and one 10 percent below the base yield, were chosen to represent a range of production experience. The higher growing costs for the "all acres" group resulted in higher growing and total production costs of about 5 cents per cwt. at each yield level.

When yields were reduced from the base yield by 10 percent to 225 cwt. per acre, growing costs increased by 36 cents, harvest costs increased by 15 cents and total production costs increased by 51 cents per cwt. (table 12). Conversely, when the yield was increased by 10 percent to 275 cwt. per acre, growing and harvesting costs decreased by 31 and 12 cents, respectively.

Since only a small (1.5 percent) difference in growing costs per acre existed between the two acre groups, both groups experienced essentially the same changes in costs per cwt. at the different yield levels.

Whole Farm Analysis -- Five Rotations

Potato farms, generally, are quite specialized. It is common, in Western New York State, for growers to produce potatoes as a primary crop for the processing market. A significant portion of the crop is under contract to a potato chip processor. Rotations are a recommended practice to help control insect and disease problems and to maintain soil structure. Potatoes are commonly raised in rotation with a small grain crop with red clover seeded in the spring. The benefits of longer rotations are generally recognized, but economic pressures often encourage a shorter rotation.

Rotational crops are grown for the benefit of the potato crop and generate a much lower profit. Thus, enterprise analysis alone may mask the net benefits and net costs of incorporating a potato enterprise into a farm business unless appropriate adjustments are made. Whole farm analysis allows the enterprise mix to be taken into account so that the farm unit can be examined for its overall profitability. This approach also allows comparisons of farm profitability for various enterprise mixes under stable assumptions about farm size. Whole farm analysis for a single crop is only useful when that enterprise accounts for a major portion of total farm receipts.

This method of analysis was used to compare budgeted whole farm results for four alternative rotations with a base rotation. The base rotation represents the use of current practices in potato production and uses cost factors obtained from the analysis of the potato enterprises of the nine cooperating growers discussed earlier. The alternative rotations were designed to estimate potential results for the farm unit when new varieties are used with good management practices.

Product Yields and Prices and Input Costs. Yields, prices and costs used in the budgets are shown in table 13. Potato yields for the base rotation were set at 250 cwt. per acre to approximate the current Upstate New York average yield for potatoes. A yield of 275 cwt. per acre was used in the four alternative rotations to reflect the expected yield effect of new varieties, new cultural practices, and more intensive grower assistance from processor fieldmen. Yields assumed for other crops are those expected from better than average management in Western New York.

A price of $5.00 per cwt. was used in the budgets to represent current contracted processing potato prices at harvest time at the farm gate or in farm storage. Other input costs are representative of prevailing prices during the 1986 crop year (see appendix table A4 for the machinery investments used in the budgets).

Rotation Descriptions. The representative potato farm has 450 acres of cropland and the equipment complement necessary to grow and harvest the potato and rotational crops. The base farm has 225 acres of potatoes grown in a two-year rotation with 225 acres of oats seeded to red clover as a cover crop. The base farm reflects current production practices, but new potato varieties to meet the specifications of the frozen french fry industry are expected to require rotations longer than two years to maintain quality of the raw product and to enhance yield potential. Therefore, four

Table 13. Product yields, prices and input costs

Yields			Prices		
Crop	Unit	Qty/ac.	Product	Unit	Price
Potatoes, base	cwt	250	Potatoes	cwt	$ 5.00
Potatoes, alternate	cwt	275	Oats	bu	1.25
Oats	bu	80	Straw	ac	20.00
Corn grain	bu	120	Corn grain	bu	2.50
Alfalfa, 1st yr.	tn	2.5	Alfalfa, standing	tn	40.00
Alfalfa, other yr.	tn	3.5			

Costs					
Item	Unit	Cost	Item	Unit	Cost
Seed			Labor		
Potato	cwt	$ 9.45	Regular	hr	$ 8.00
Oats	bu	4.00	Hourly	hr	5.00
Corn	unit	60.00			
Alfalfa	lb	2.90			
Fertilizer			Chemicals		
N	lb	0.24	Potatoes	ac	141.00
P	lb	0.22	Corn	ac	27.50
K	lb	0.14	Seeding	ac	3.25
			Alfalfa	ac	15.00
Lime, spread	tn	25.00	Other		
			Gasoline	gal	1.00
Interest	%	10.00	Diesel fuel	gal	1.10
			Cover crop	ac	20.00

possible alternative rotations were budgeted. These included two 3-year rotations and two 4-year rotations. The alternative rotations included crops common to the region and those most likely to complement the potato crop.

It is important to note that the base situation assumed a potato yield of 250 cwt. per acre to approximate the average current yield level. On the other hand, a higher yield of 275 cwt. per acre was assumed for the alternative rotations to reflect the expected performance of the new varieties under good management and more intensive processor supervision.

The first 3-year rotation included 150 acres each of potatoes followed by oats with a clover cover crop, followed by corn grain with a rye crop applied at cultivation. The other three-year rotation included 150 acres of potatoes followed by two years of alfalfa.

A four-year rotation was budgeted to provide three years of alfalfa before the potato crop. In this case, only 113 acres of potatoes were grown on the representative farm. The second 4-year rotation estimated the results of two years of potatoes followed by two years of alfalfa.

Seeding rates for the new potato varieties used in the alternative budgets were established at 22 cwt. per acre. This is slightly higher than the rate used in the test plot acres and was expected to enhance yield potential.

Fertilizer nutrient levels were based on test plot experience. In rotations where potatoes follow an alfalfa crop, nitrogen applied for the subsequent potato crop was reduced to reflect the value of carryover nitrogen. Chemical costs for seed treatment, vine killing and pesticides were held constant for each rotation. Cover crops were used in the rotation to the extent thought possible with the costs charged to the potato crop.

The labor requirement directly related to growing and harvesting potatoes was held constant at 25.5 hours per acre for all rotations. Changes in machinery complements and use due to changes in enterprise size and mix resulted in minor adjustments in machinery fuel and repair costs. Other variable costs such as operating interest changed only slightly between rotations. The budgets included assumptions that the secondary crops were either sold in the field or custom harvested.

Budget Format. To focus on farm profitability, the budget format incorporates fixed costs and variable or operating costs for each crop. Variable costs include cash costs for seed, fertilizer and chemicals, cover crops, fuel, repairs, operating interest and labor costs for direct crop production. Additional labor costs were included with machinery repair and other administrative costs. Detailed budgets for each crop in each of the five rotations are included in appendix tables A5.1 through A9.4. These costs represent the total annual operating expenses for each crop and were combined with fixed costs in the whole farm summary (table 14).

Fixed costs were added to variable costs to estimate total expenses for the farm unit. Fixed cost items cover ownership charges for machinery, land, and real estate taxes. Machine ownership costs vary as minor changes are made in the machinery complement needed for alternate rotations. Land costs and taxes remain constant for the 450-acre farm.

Rotation Comparisons. Table 14 shows net returns for the five alternate rotations. The first measure of net returns incorporates the potato yield differential between the base rotation and the alternative rotations noted above. The base rotation shows a loss of $4,306 in the whole farm rotation. The alternative rotations and practices produce positive returns for the farm ranging from $1,213 to $38,853.

The second comparison of net returns shows the impact of a constant potato yield for all five rotations. Only one of the five rotations showed a positive net return over all expenses. A net return of $10,728 was estimated for the rotation involving two years of potatoes followed by two years of alfalfa. Returns for the other four rotations were negative and

Table 14. Comparison of total production costs and returns for five potato farm rotations, budgeted whole farm analysis, Western New York, 1986

Item	Rotations*				
	Base	Alternative practices			
	2 year	3 year		4 year	
	PO	POC	PAA	PAAA	PPAA
Crop acres - Potatoes**	225	150	150	113	225
Oats with clover	225	150			
Corn grain		150			
Alfalfa			300	337	225
	($)	($)	($)	($)	($)
Farm totals for all crops					
Crop value	308,250	269,250	242,250	198,035	336,395
Operating expenses					
Seed	59,684	35,685	39,015	29,357	52,650
Fertilizer and lime	34,196	32,166	26,721	22,652	35,752
Chemicals and other	56,025	57,675	35,448	28,589	50,329
Machinery - fuel and repair	22,224	17,241	14,882	11,339	21,820
Interest - operating	7,053	5,627	4,702	3,703	6,589
Labor - direct production	40,457	28,963	26,976	20,522	39,484
Total operating expenses	219,638	177,357	147,745	116,163	206,624
Net over operating exp.	88,612	91,893	94,505	81,872	129,771
Other expenses					
Machine ownership	65,017	58,738	56,706	52,759	63,017
Land	22,500	22,500	22,500	22,500	22,500
Real estate taxes	5,400	5,400	5,400	5,400	5,400
Total other exp.	92,917	86,638	84,606	80,659	90,917
Total farm expenses	312,556	263,995	232,351	196,822	297,542
Net return over expenses**	(4,306)	5,255	9,899	1,213	38,853
Net return over expenses-250 cwt/acre for all rotations	(4,306)	(13,495)	(8,851)	(12,912)	10,728

*P = potatoes; O = oats; C = corn; and A = alfalfa.
**Base potato yield = 250 cwt/ac; yield for other rotations = 275 cwt/ac; other crop yields are held constant.

the loss ranged from $4,306 for the base rotation to $13,495 for the three-year rotation of potatoes, oats and corn.

Cost of Production and Sensitivity Analysis. Using the whole farm analysis enables one to estimate and compare economic results for different rotation combinations for the farm unit. The potato crop value for the five farm budgets represented from 75 to over 90 percent of the total value of all crops when yield is held constant. By assuming the secondary crops were sold at market prices, one can calculate the total cost of producing potatoes (table 15). The resulting total cost of producing potatoes, divided by the potato acreage, provides an estimate of the cost to produce -- that is, the farm expenses required to grow and harvest -- an acre of potatoes.

Table 15. Sensitivity analysis of production costs and break-even yields to changes in yields and prices for five crop rotations, Western New York, 1986

Item	Rotations*				
	Base	Alternative practices			
	2 year	3 year		4 year	
	PO	POC	PAA	PAAA	PPAA
Potato acreage	225	150	150	113	225
Total farm expenses, $	312,556	263,995	232,351	196,822	297,542
Less nonpotato crop value, $	27,000	63,000	36,000	42,660	27,020
Total cost of producing potatoes, $	285,556	200,995	196,351	154,162	270,522
Cost of production, $/ac	1,269	1,340	1,309	1,364	1,202
Yield levels, cwt/ac	Cost of production, $/cwt				
225	5.64	5.96	5.82	6.06	5.34
250	5.08	5.36	5.24	5.46	4.81
275	4.61	4.87	4.76	4.96	4.37
300	4.23	4.47	4.36	4.55	4.01
Price levels, $/cwt	Break-even yields, cwt/acre				
4.50	282	298	291	303	267
4.75	267	282	275	287	253
5.00	254	268	262	273	240
5.25	242	255	249	260	229
Break-even yield change from base yield at a price of $5.00/cwt	254	+5.5%	+3.1%	+7.5%	-5.5%

*P = potatoes; O = oats; C = corn; and A = alfalfa.

As shown in table 15, potato production costs for these five budgets ranged from $1,202 to $1,364 per acre. At the yield level of 250 cwt. per acre, production costs for potatoes ranged from $4.81 to $5.46 per cwt.

Production costs per unit are sensitive to changes in yield. The degree of sensitivity is illustrated in table 15 for four yield levels. Cost of production for potatoes is shown for the base yield of 250 cwt. as well as for yields ranging from 225 to 300 cwt. per acre. The cost of production varies inversely with yield by roughly 2 cents per cwt.

In budgeting for the five potato farm rotations, a price of $5.00 per cwt. was assumed to enable an estimation of net farm returns over all expenses for each budget. This price level at the farm represents a reasonable value for processing potatoes at harvest time in Western New York based on current contract prices.

Break-even potato yields are sensitive to price changes. In table 15, break-even yields are shown for price levels ranging from $4.50 to $5.25 per cwt. The break-even yield increased about 12 to 15 cwt. per acre for each 25 cent decrease in price. At a given price level, break-even yields for three of the four alternate rotations were from 3.1 percent to 7.5 percent above the base rotation break-even yield.

THE FEASIBILITY OF IRRIGATION

As noted earlier in this report, most farms in the Dansville region do not irrigate their potato crop. In contrast, six of the nine farms cooperating in this study had irrigation equipment even though it was not used to a large extent due to a wet growing season. The economic benefits of irrigation for potatoes in Upstate New York are briefly examined in this section.

Potatoes are sensitive to the availability of water, not only in total during the growing season but also at specific stages of plant and tuber development. Therefore, in the absence of adequate or timely rainfall during the growing season, a well-managed irrigation system will enhance potato yields. Ewing and Farkas found that yields of irrigated potatoes exceeded yields on control plots by an average of 28 percent over a three-year period in New York. Adjusting those research results to field conditions, one might reasonably expect an average response to irrigation over time of 20 percent higher potato yields.

To measure the effects of irrigation on potatoes, a comparison was made of whole farm budgets with and without irrigation capability. Budgets were constructed for nonirrigated and irrigated potatoes on the base farm for a normal two-year rotation and a situation using alternative practices including a three-year rotation. The comparisons assumed surface water sources were available and adequate to permit irrigation on all 450 acres of cropland. Investment in irrigation equipment included a traveller system, PTO pump, and enough pipe, fittings and accessories to enable mains to be set up for the potato acreage to be irrigated as necessary during the season.

Data from the nine cooperating growers were adjusted to exclude 1986 irrigation labor. This provided a basis for estimating labor requirements to produce potatoes without irrigation. Contact with agricultural engineering at Cornell, growers and irrigation equipment vendors provided information used to estimate average annual labor, power and equipment costs to be expected for irrigation over a period of years with varying rainfall patterns. An additional 50 pounds of nitrogen was used in the budgets for irrigated potatoes to provide nutrients for an expected higher yield and to compensate for additional nutrient leaching. Other inputs were held constant for the nonirrigated and irrigated potato budgets.

Table 16 provides a comparison of the effects of irrigating potatoes in two situations. The base farm situation represents the estimated differences between nonirrigated and irrigated potatoes using current practices in a common two-year rotation. The second situation involves the use of alternative practices in a three-year rotation typical of what may be necessary to provide the raw product quality required by the french fry industry.

Potato yields were adjusted to reflect reasonable differences between production expectations for each budget due to irrigation. Since irrigation was applied only to potatoes, other crop yields were held constant for all budgets. The potato yield for the base farm with nonirrigated potatoes was assumed to be 240 cwt. per acre. This yield is less than the Upstate New York average to adjust for the effect of irrigation on the average yield of 250 cwt. per acre.

The yield for nonirrigated potatoes using alternative practices was assumed to be 25 cwt. per acre higher than in the base farm situation. As in the budgets shown in table 14, this higher yield reflects the results of using new varieties and practices in close cooperation with processor fieldmen. In both farm situations, potato yields for the budgets with irrigated potatoes reflect a yield increase of about 20 percent over nonirrigated potatoes (adjusted to field conditions from Ewing and Farkas).

Results shown in table 16 for both situations show a clear advantage to irrigation for potatoes. The whole farm budgets show an increase in farm net returns of $22,350 for the base farm and $15,682 for the alternative situation over nonirrigated potatoes. Although irrigation is more advantageous for the base farm, a smaller acreage of irrigated potatoes using the alternative practices results in higher net returns than irrigated potatoes on the base farm.

Detailed budgets of variable costs for each crop enterprise included in the whole farm analysis are included in appendix tables A10.1 through A13.3. Table 16 summarizes these operating expenses along with ownership costs for machinery and land.

Using the results of budgets developed for the alternative situation, table 17 illustrates the effects of different yield levels on production costs per unit for nonirrigated and irrigated potato enterprises. Also illustrated are break-even yields for nonirrigated and irrigated potatoes at several price levels.

Table 16. Comparison of total production costs and returns for non-irrigated and irrigated potatoes for two crop rotations, Western New York, 1986

Item	Base farm		Alternative practices	
Rotation:	Potatoes-Oats		Potatoes-Oats-Corn	
	Non-irrigated	Irrigated	Non-irrigated	Irrigated
Crop acres -- Potatoes	225		150	
Oats	225		150	
Corn	--		150	
Potato yield, cwt/ac	240	285	265	315
	($)	($)	($)	($)
Farm totals for all crops				
Crop value	297,000	347,625	261,750	299,250
Operating expenses				
Seed	59,684	59,684	35,685	35,685
Fertilizer, lime	34,196	36,896	32,166	32,166
Chemicals, other	56,025	56,025	57,675	57,675
Machinery--fuel & repair	19,978	32,476	15,759	26,983
Interest--operating	6,960	7,593	5,565	6,033
Labor--direct production	39,378	42,866	28,244	30,525
Total operating expenses	216,220	235,539	175,095	189,067
Net over operating exp.	80,780	112,086	86,655	110,183
Other expenses				
Machinery ownership	59,617	68,573	53,698	59,669
Land	22,500	22,500	22,500	22,500
Real estate taxes	5,400	5,400	5,400	5,400
Total other expenses	87,517	96,473	81,598	87,569
Total farm expenses	303,737	332,012	256,693	276,636
Farm net returns	(6,737)	15,613	5,057	22,614
Net return/acre	(30)	69	34	138

Table 17. Sensitivity analysis of production costs and break-even yields to changes in yields and prices for nonirrigated and irrigated potatoes, Western New York, 1986

Item	Rotation: Potatoes-Oats-Corn	
	Nonirrigated	Irrigated
Potato acreage	150	150
Total farm expenses ($)	256,693	276,636
Less nonpotato crop value ($)	63,000	63,000
Total cost of producing potatoes ($)	193,693	213,636
Cost of production ($/ac)	1,291	1,424
Yield levels (cwt/ac)	**Cost of production ($/cwt)**	
240	5.38	5.93
265	4.87	5.37
290	4.45	4.91
315	4.10	4.52
340	3.80	4.19
Price levels ($/cwt)	**Break-even yields (cwt/ac)**	
4.25	304	335
4.50	287	316
4.75	272	300
5.00	258	285
5.25	246	271

For these budgets, production costs for irrigated potatoes are $133 per acre higher for irrigated than for nonirrigated potatoes. At the various price levels illustrated in table 17, an additional 25 to 31 cwt. per acre are required to offset this higher cost. An increase of that magnitude is well within the anticipated 20 percent average yield increase attributed to irrigation over time.

SUMMARY AND CONCLUSIONS

Potatoes are the most important vegetable crop produced in New York State. In recent years, cash receipts from potatoes have averaged $63.1 million annually, or about 2.4 percent of the total cash receipts for New York farmers. Acreage and production in Upstate New York have been relatively stable at about 25,000 harvested acres and 6.4 million cwt., while average yield per acre has ranged between 250 and 260 cwt. over the last decade.

Regional competition in production agriculture, particularly in potato production, and the resulting competitive squeeze on prices, have

led New York potato growers to look for alternative crops and markets. This report was prepared to assess the feasibility of expanded potato production for french fry processing. The geographic focus of the study was confined to a 100-mile radius of a potential processing plant site at Dansville, New York. Current land use patterns, physical features of soil resources, and the costs and returns of growing potatoes in Upstate New York were taken into account. Standard cultural practices and practices associated with recent test plot results on Western New York and Northern Pennsylvania farms were incorporated into the analysis.

In 1950 about 19,000 farms in Western New York and 8,000 farms in Northern Pennsylvania grew potatoes within a 100-mile radius of Dansville. Today, fewer than 500 New York farms and fewer than 200 Pennsylvania farms in this region grow potatoes. Acreage per farm has increased from 4 to 36 acres, indicating more specialization in potato production even though potatoes continue to be a secondary enterprise on many farms. This implies some potential for increasing potato acreage if returns are attractive. However, the proportion of harvested potato acreage in relation to total harvested cropland and the proportion of potato farms to total farms has decreased dramatically. Today, farms with a potato enterprise make up only 2 percent of total farms. The profitability of potatoes has not kept pace with the profitability of competing farm enterprises in Western New York, despite annual average yield increases of about 2.0 and 1.5 cwt. per acre, respectively, in New York and Pennsylvania. Supplemental water can enhance yields of this high-valued crop, but irrigated potato acreage in Northern Pennsylvania is virtually nonexistent. In 1982, only 60 New York farms in the Dansville region reported the use of irrigation on potato acreage.

On the other hand, the results of this study show that about 325,000 acres of New York cropland near Dansville have the capability to produce 250 to 350 cwt. of potatoes per acre. An additional 225,000 acres could potentially yield over 350 cwt. per acre.

The available data also indicate some potential for expanded irrigation in the area under consideration. Surface water, the predominant irrigation water source in Western New York, is often in close proximity to high-quality potato acreage. About 90,000 acres of New York cropland have an expected yield of 350 cwt. or more and are situated within 200 yards of a water source; 51,000 acres are within 100 yards of a water source.

Based on data for the 1986 crop year supplied by seven growers in Western New York and two growers in Northern Pennsylvania, the estimated cost of growing and harvesting potatoes was $4.66 per cwt.; this estimated cost does not include costs of storage, transportation to the processor or marketing costs. The cost was determined for an assumed yield of 250 cwt. per acre. Growing and harvesting costs decrease slightly with new varieties and adjusted cultural practices. For test plot acreage, average total cost per cwt. with yields at 250 cwt. was estimated at $4.61 per cwt. Higher fertilizer costs were largely offset by lower seeding rates. Whole farm budgets were developed to account for the impact of proposed rotation plans and the higher yields that might result from the use of new varieties and closer processor supervision. Whole farm plans for a 450-acre potato farm were used to illustrate the impact of rotations and variability in potato yield. Net returns over farm expenses for a base rotation and four

alternate potato, oat, clover, corn grain and alfalfa rotations were compared. Yields of 250 cwt. per acre in the base situation were increased to 275 cwt. in the alternative rotations to reflect the use of new varieties, improved processor supervision and crop rotations.

Whole farm budgets were developed to estimate results of alternative rotations and compare them with a common base rotation. These budgets were based on current practices for the base rotation and revised practices for the new potato varieties used in the four alternative rotations. Potato production costs were calculated for each rotation to demonstrate production cost sensitivity to changes in yield levels and break-even yield sensitivity to price level changes.

In three of the four alternate rotations, potato production costs per acre were higher than for the base rotation representing current practices. This relationship is also the case for unit production costs at the same yield levels. Also, break-even yield levels were higher for three of the four alternate rotations than for the base rotation at the same price level.

This economic analysis is based on the premise that a rotation longer than the present common two-year rotation is necessary for the new varieties' improved yields and to provide the raw product quality desired for the french fry industry. Yields for the new varieties must be higher than current average yields for most longer rotations to be more attractive to growers than their present practices at a given price level. These data indicate an increased yield of at least 8 percent would be sufficient.

Finally, an analysis was made to determine the feasibility of irrigating potatoes. The budgets show that prudent investment in irrigation capability is profitable when combined with good cultural management practices. The additional costs related to irrigation are more than offset by returns generated by higher yields over time.

The french fry industry has specifications which must be met by the processor and ultimately by the producer. Varieties that meet these specifications are new to New York State and, from available test plot data, appear to have higher yield potential than many current varieties. The combination of new varieties, close cooperation with the processor and benefits from longer rotations may result in yield increases of 10 percent or more over current yields for well-managed potato farms. As these improved yields are realized and french fry specifications are met, New York growers will enhance their ability to compete for this new market.

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APPENDIX A

Table A1. Potatoes in Upstate New York, 1976-1985

	1976	1977	1978	1979	1980	Average 1976-80
Acres planted (1,000)	26.2	27.5	26.0	25.5	26.0	26.2
Acres harvested (1,000)	24.9	20.6	25.0	23.5	25.0	23.7
Yield/harvested acre (cwt.)	245	260	260	275	250	258
Production (1,000 cwt.)	6,101	5,356	6,500	6,463	6,250	6,134
Quantity sold (1,000 cwt.)	5,369	4,336	5,705	5,726	5,610	5,349
Price/cwt. ($)	5.75	4.83	4.99	4.65	7.95	5.63
Value of production ($1,000)	35,081	25,869	32,435	30,053	49,688	34,625
Value of sales ($1,000)	30,872	20,943	28,468	26,626	44,600	30,302

	1981	1982	1983	1984	1985	Average 1981-85
Acres planted (1,000)	26.5	26.0	25.5	26.0	25.0	25.8
Acres harvested (1,000)	25.0	25.0	24.5	25.5	24.5	24.9
Yield/harvested acre (cwt.)	275	260	230	260	250	252.7
Production (1,000 cwt.)	6,875	6,500	5,635	6,630	6,125	6,353
Quantity sold (1,000 cwt.)	6,060	5,825	5,030	5,640	N.A.	22,555
Price/cwt.	6.20	5.45	7.75	6.30	4.60	6.37
Value of production ($1,000)	42,625	35,425	43,671	41,769	28,175	38,333
Value of sales ($1,000)	37,572	31,746	38,983	35,532	24,920	33,751

Source: New York Agricultural Statistics, 1985.

Table A2. Estimated average per acre potato yields for selected soil units within a 100-mile radius of Dansville, New York*

Soil	Estimated yield (cwt)	Soil	Estimated yield (cwt)	Soil	Estimated yield (cwt)
Allard	300	Galen	230	Palms	225
Alton	300	Halsey	150	Palmyra	250
Appleton	175	Hamlin	300	Phelps	225
Arkport	300	Herkimer	250	Red Hook	200
Bath	300	Hilton	260	Rhinebeck	275
Berrien	170	Homer	250	Scio	300
Bombay	250	Honeoye	300	Sodus	300
Braceville	300	Howard	300	Teel	300
Canandaigua	170	Hudson	250	Tioga	300
Canaseraga	230	Ira	270	Tunkhannock	300
Canfield	290	Junius	150	Unadilla	300
Carlisle	225	Lackawanna	300	Valois	275
Castile	300	Lairdsville	175	Varysburg	300
Cayuga	225	Langford	270	Wallington	275
Cazenovia	280	Lansing	260	Wallkill	225
Chagrin	270	Lordstown	250	Wampsville	250
Chenango	300	Madrid	300	Wassaic	260
Claverack	200	Mardin	275	Wellsboro	300
Collamer	250	Massena	170	Williamson	280
Colonie	170	Middlebury	300		
Conesus	250	Minoa	180		
Cosad	150	Niagara	170		
Dunkirk	250	Nunda	275		
Elnora	170	Ontario	275		
Fredon	200	Oquaqa	200		
Fremont	250	Ovid	200	71 Soils	

*Adjusted to 1982 from respective soil survey publication dates.
Source: Derived from county soil survey data.

Table A3. Estimated average per acre potato yields for selected soil units within a 100-mile radius of Dansville, New York

Soil	Estimated yield	Soil	Estimated yield
	(cwt)		(cwt)
*Allard	400	Marilla	280
*Alton	300	*Middlebury	360
Blasdell	300	*Sodus	300
*Bath	300	*Teel	360
*Braceville	360	*Tioga	390
*Chenango	300	*Tunkhannock	210
Copake	270	*Valois	300
Dalton	230	*Varysburg	320
Empeyville	270	Volusia	240
Erie	240	*Wallington	240
*Hamlin	390	*Williamson	270
*Ira	270	Worth	300
*Langford	270		
*Mardin	450	26 Soils	

*Names common to soil survey soils for which potato yield estimates were calculated. (See appendix table A2.)
Source: USDA Soils-5 records.

Table A4. Crop machinery investment, 450 acre potato farm, 1986 base farm budget[a]

Item	1986 List price	Purchase price	Annual ownership cost
Tractors -- 140 hp FWA	55,000	48,000	7,680
125 hp	45,000	37,000	5,920
80 hp	27,250	22,500	3,600
60 hp	21,000	17,000	2,720
Trucks -- Pickup	12,000	9,825	2,052
Bulk body trucks (7)	87,500	84,000	13,720
Plow (5-18")	9,950	8,147	1,086
Disc (16')	7,500	6,500	867
Stone picker (6')	12,000	10,000	1,333
Drag (20')	4,000	3,600	480
Seeder/drill	6,500	5,500	733
Potato planter (4R)	22,000	20,000	2,667
Corn planter[b] (4R)	8,000	7,500	1,000
Seeder[b]	3,600	2,950	393
Cultivator/hiller (4R)	5,500	5,000	667
Sprayer	17,000	15,000	2,000
Seed cutter/bin loader equipment	48,000	42,000	5,600
Irrigation equipment	50,000	45,000	5,400
Windrower (2R)	17,000	15,000	2,123
Harvester (2R)	50,000	45,000	6,369

[a] Potato farm with 225 acres of potatoes and 225 acres of oats with a clover cover crop; partial irrigation capability.

[b] Equipment for alternative budgets.

Table A5.1. Potatoes -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs and total cost of production per cwt. for three yield levels: farm with two-year rotation of potatoes and oats

		Potatoes		225 Acres
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Potatoes	cw	250	$5.00	$1,250.00
				0.00
TOTAL VALUE				$1,250.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Potato	cw	26.8	$9.45	$253.26
				0.00
Fertilizer				
N	lb	168	0.24	40.32
P	lb	215	0.22	47.30
K	lb	164	0.14	22.96
Lime	tn	1	25.00	25.00
Chemicals				
Total cost		1	142.00	142.00
				0.00
				0.00
Cover: Clover in oats		1	20.00	20.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				41.95
Repair, main.				49.94
Other			59.00	59.00
Interest, operating		701.72	Rate/yr	
Months		5	10.00%	29.24
LABOR - Machine	Hour	7.8	$6.70	$52.58
Other Labor	Hour	17.7	6.70	118.59
TOTAL ANNUAL OPERATING EXPENSES				$902.13
NET OVER ANNUAL OPERATING EXPENSES				$347.87
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$3.61
Cost of Prod / cwt		Yield =	225	$5.64
Cost of Prod / cwt		Yield =	250	$5.08
Cost of Prod / cwt		Yield =	275	$4.62

Table A5.2. Oats -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with two-year rotation of potatoes and oats

		Oats w/ clover		225 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Oats	bu	80	$1.25	$100.00
Straw	ac	1	20.00	20.00
TOTAL VALUE				$120.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Oats	bu	3	$4.00	$12.00
				0.00
Fertilizer				
N	lb	20	0.24	4.80
P	lb	40	0.22	8.80
K	lb	20	0.14	2.80
Lime		0	0.00	0.00
Chemicals				
None				0.00
				0.00
				0.00
Custom harv, haul		1	25.00	25.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				3.41
Repair, main.				3.48
Other			3.00	3.00
Interest, operating		63.29	Rate/yr	
Months		4	10.00%	2.11
LABOR - Machine	Hour	0.8	$8.00	$6.14
Other Labor	Hour	0.5	5.00	2.50
TOTAL ANNUAL OPERATING EXPENSES				$74.04
NET OVER ANNUAL OPERATING EXPENSES				$45.96
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$0.68

Table A6.1. Potatoes -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs and total cost of production per cwt. for three yield levels: farm with three-year rotation of potatoes, oats, and corn

		Potatoes		150 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Potatoes	cw	275	$5.00	$1,375.00
				0.00
TOTAL VALUE				$1,375.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Potato	cw	22	$9.45	$207.90
				0.00
Fertilizer				
N	lb	185	0.24	44.40
P	lb	248	0.22	54.56
K	lb	212	0.14	29.68
Lime	tn	1	25.00	25.00
Chemicals				
Total cost		1	142.00	142.00
				0.00
				0.00
Cover: Clover in oats		1	20.00	20.00
Rye in corn		1	20.00	20.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				43.20
Repair, main.				48.63
Other			59.00	59.00
Interest, operating		694.37	Rate/yr	
Months		5	10.00%	28.93
LABOR - Machine	Hour	8.4	$6.70	$56.32
Other Labor	Hour	17.1	6.70	114.57
TOTAL ANNUAL OPERATING EXPENSES				$894.19
NET OVER ANNUAL OPERATING EXPENSES				$480.81
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$3.25
Total Cost of Prod / cw :	Yield =	250		$5.36
Total Cost of Prod / cw :	Yield =	275		$4.87
Total Cost of Prod / cw :	Yield =	300		$4.47

Table A6.2. Oats -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with three-year rotation of potatoes, oats, and corn

		Oats w/ clover		150 ACRES
	UNIT	RATE/A	PRICE/UNIT	COST/ACRE
CROP VALUE				
Oats	bu	80	$1.25	$100.00
Straw	ac	1	20.00	20.00
TOTAL VALUE				$120.00
ANNUAL OPERATING EXPENSES				
Seed				
Oats	bu	3	$4.00	$12.00
				0.00
Fertilizer				
N	lb	20	0.24	4.80
P	lb	40	0.22	8.80
K	lb	20	0.14	2.80
Lime		0	0.00	0.00
Chemicals				
None				0.00
				0.00
				0.00
Custom harv, haul		1	25.00	25.00
				0.00
				0.00
				0.00
				0.00
Power,equipment				
Fuel,oil & grease				3.47
Repair,main.				3.41
Other			3.00	3.00
Interest, operating		63.28	Rate/yr	
Months		4	10.00%	2.11
LABOR - Machine	Hour	0.8	$8.00	$6.37
Other Labor	Hour	0.5	5.00	2.50
TOTAL ANNUAL OPERATING EXPENSES				$74.26
NET OVER ANNUAL OPERATING EXPENSES				$45.74
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$0.68

Table A6.3. Corn -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with three-year rotation of potatoes, oats, and corn

		Corn		150 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Corn, shelled	bu	120	$2.50	$300.00
				0.00
TOTAL VALUE				$300.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Corn	80M un	0.3	$60.00	$18.00
				0.00
Fertilizer				
N	lb	125	0.24	30.00
P	lb	40	0.22	8.80
K	lb	40	0.14	5.60
Lime				0.00
Chemicals				
Total cost		1	27.50	27.50
				0.00
				0.00
Custom harv, haul		1	45.00	45.00
Custom drying		1	36.00	36.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				8.63
Repair, main.				7.60
Other			7.00	7.00
Interest, operating		194.14	Rate/yr	
Months		4	10.00%	6.47
LABOR - Machine	Hour	1.7	$8.00	$13.32
Other Labor	Hour		5.00	0.00
TOTAL ANNUAL OPERATING EXPENSES				$213.93
NET OVER ANNUAL OPERATING EXPENSES				$86.07
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$1.78

Table A7.1. Potatoes -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs and total cost of production per cwt. for three yield levels: farm with three-year rotation of potatoes, two years alfalfa

	Potatoes			150 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Potatoes	cw	275	$5.00	$1,375.00
				0.00
TOTAL VALUE				$1,375.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Potato	cw	22	$9.45	$207.90
				0.00
Fertilizer				
N	lb	145	0.24	34.80
P	lb	248	0.22	54.56
K	lb	212	0.14	29.68
Lime	tn	1.5	25.00	37.50
Chemicals				
Total cost		1	142.00	142.00
				0.00
				0.00
Cover: Oats	ac	0.5	20.00	10.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				43.20
Repair, main.				47.89
Other			59.00	59.00
Interest, operating		666.53	Rate/yr	
Months		5	10.00%	27.77
LABOR - Machine	Hour	8.4	$6.70	$56.32
Other Labor	Hour	17.1	6.70	114.57
TOTAL ANNUAL OPERATING EXPENSES				$865.19
NET OVER ANNUAL OPERATING EXPENSES				$509.81
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$3.15
Total Cost of Prod / cw : Yield =			250	$5.24
Total Cost of Prod / cw : Yield =			275	$4.76
Total Cost of Prod / cw : Yield =			300	$4.36

Table A7.2. Alfalfa, 1st year -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with three-year rotation of potatoes, two years alfalfa

		Alfalfa, 1st yr		150 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Alfalfa, stdg	ac	1	$100.00	$100.00
($40*2.5t/a)				0.00
TOTAL VALUE				$100.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed	1/2 cost			
Alfalfa	lb	9	$2.90	$26.10
				0.00
Fertilizer				
N	lb	0	0.24	0.00
P	lb	40	0.22	8.80
K	lb	20	0.14	2.80
Lime		0	0.00	0.00
Chemicals				
Premerge	qt	1.33	3.25	4.32
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				2.41
Repair, main.				1.65
Other			3.00	3.00
Interest, operating		49.08	Rate/yr	
Months		4	10.00%	1.64
LABOR - Machine	Hour	0.6	$8.00	$4.48
Other Labor	Hour		5.00	0.00
TOTAL ANNUAL OPERATING EXPENSES				$55.20
NET OVER ANNUAL OPERATING EXPENSES				$44.80
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$55.20

Table A7.3. Alfalfa, 2nd year -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with three-year rotation of potatoes, two years alfalfa

		Alfalfa, 2nd yr		150 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Alfalfa, stdg ($40*3.5t/a)	ac	1	$140.00	$140.00
				0.00
TOTAL VALUE				$140.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed	1/2 cost			
Alfalfa	lb	9	$2.90	$26.10
				0.00
Fertilizer				
N	lb	0	0.24	0.00
P	lb	20	0.22	4.40
K	lb	40	0.14	5.60
Lime				0.00
Chemicals				
M & M	gl	1	15.00	15.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				2.41
Repair, main.				1.65
Other			3.00	3.00
Interest, operating		58.16	Rate/yr	
Months		4	10.00%	1.94
LABOR - Machine	Hour	0.6	$8.00	$4.48
Other Labor	Hour		5.00	0.00
TOTAL ANNUAL OPERATING EXPENSES				$64.58
NET OVER ANNUAL OPERATING EXPENSES				$75.42
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$64.58

Table A8.1. Potatoes -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs and total cost of production per cwt. for three yield levels: farm with four-year rotation of potatoes, three years alfalfa

		Potatoes		113 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Potatoes	cw	275	$5.00	$1,375.00
				0.00
TOTAL VALUE				$1,375.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Potato	cw	22	$9.45	$207.90
				0.00
Fertilizer				
N	lb	145	0.24	34.80
P	lb	248	0.22	54.56
K	lb	212	0.14	29.68
Lime	tn	2	25.00	50.00
Chemicals				
Total cost		1	141.00	141.00
				0.00
				0.00
Cover: Oats	ac	0.5	20.00	10.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				44.30
Repair, main.				46.80
Other			59.00	59.00
Interest, operating		678.04	Rate/yr	
Months		5	10.00%	28.25
LABOR - Machine	Hour	8.9	$6.70	$59.60
Other Labor	Hour	16.6	6.70	111.22
TOTAL ANNUAL OPERATING EXPENSES				$877.11
NET OVER ANNUAL OPERATING EXPENSES				$497.89
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$3.19
Total Cost of Prod / cw :	Yield =		250	$5.46
Total Cost of Prod / cw :	Yield =		275	$4.96
Total Cost of Prod / cw :	Yield =		300	$4.55

Table A8.2. Alfalfa, 1st year -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with four-year rotation of potatoes, three years alfalfa

		Alfalfa, 1st yr		113 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Alfalfa, stdg	ac	1	$100.00	$100.00
($40*2.5t/a)				0.00
TOTAL VALUE				$100.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed	1/3 cost			
Alfalfa	lb	6	$2.90	$17.40
				0.00
Fertilizer				
N	lb	0	0.24	0.00
P	lb	40	0.22	8.80
K	lb	20	0.14	2.80
Lime		0	0.00	0.00
Chemicals				
Premerge	qt	1.33	3.25	4.32
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				1.80
Repair, main.				1.32
Other			3.00	3.00
Interest, operating		39.45	Rate/yr	
Months		4	10.00%	1.31
LABOR - Machine	Hour	0.5	$8.00	$3.65
Other Labor	Hour		5.00	0.00
TOTAL ANNUAL OPERATING EXPENSES				$44.41
NET OVER ANNUAL OPERATING EXPENSES				$55.59
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$44.41

Table A8.3. Alfalfa, 2nd year -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with four-year rotation of potatoes, three years alfalfa

		Alfalfa, 2nd yr		112 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Alfalfa, stdg	ac	1	$140.00	$140.00
($40*3.5t/a)				0.00
TOTAL VALUE				$140.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed	1/3 cost			
Alfalfa	lb	6	$2.90	$17.40
				0.00
Fertilizer				
N	lb	0	0.24	0.00
P	lb	20	0.22	4.40
K	lb	40	0.14	5.60
Lime				0.00
Chemicals				
M & M	gl	1	15.00	15.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
Power,equipment				
Fuel,oil & grease				1.78
Repair,main.				1.31
Other			3.00	3.00
Interest, operating		48.50	Rate/yr	
Months		4	10.00%	1.62
LABOR - Machine	Hour	0.5	$8.00	$3.61
Other Labor	Hour		5.00	0.00
TOTAL ANNUAL OPERATING EXPENSES				$53.72
NET OVER ANNUAL OPERATING EXPENSES				$86.28
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$53.72

Table A8.4. Alfalfa, 3rd year -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with four-year rotation of potatoes, three years alfalfa

		Alfalfa, 3rd yr		112 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Alfalfa, stdg	ac	1	$140.00	$140.00
($40*3.5t/a)				0.00
TOTAL VALUE				$140.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed	1/3 cost			
Alfalfa	lb	6	$2.90	$17.40
				0.00
Fertilizer				
N	lb	0	0.24	0.00
P	lb	20	0.22	4.40
K	lb	40	0.14	5.60
Lime				0.00
Chemicals				
M & M	gl	1	15.00	15.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				1.78
Repair, main.				1.31
Other			3.00	3.00
Interest, operating		48.48	Rate/yr	
Months		4	10.00%	1.62
LABOR - Machine	Hour	0.4	$8.00	$3.60
Other Labor	Hour		5.00	0.00
TOTAL ANNUAL OPERATING EXPENSES				$53.70
NET OVER ANNUAL OPERATING EXPENSES				$86.30
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$53.70

Table A9.1. Potatoes, 1st year -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs and total cost of production per cwt. for three yield levels: farm with four-year rotation of two years potatoes, two years alfalfa

		Potatoes, 1st yr		113 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Potatoes	cw	275	$5.00	$1,375.00
				0.00
TOTAL VALUE				$1,375.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Potato	cw	22	$9.45	$207.90
				0.00
Fertilizer				
N	lb	150	0.24	36.00
P	lb	243	0.22	53.46
K	lb	201	0.14	28.14
Lime	tn	1	25.00	25.00
Chemicals				
Total cost		1	142.00	142.00
				0.00
				0.00
Cover: Oats	ac	0.5	20.00	10.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				41.80
Repair, main.				50.85
Other			59.00	59.00
Interest, operating		654.15	Rate/yr	
Months		5	10.00%	27.26
LABOR - Machine	Hour	7.8	$6.70	$52.15
Other Labor	Hour	17.7	6.70	118.59
TOTAL ANNUAL OPERATING EXPENSES				$852.15
NET OVER ANNUAL OPERATING EXPENSES				$522.85
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$3.10
Total Cost of Prod / cw :	Yield =		250	$4.81
Total Cost of Prod / cw :	Yield =		275	$4.37
Total Cost of Prod / cw :	Yield =		300	$4.01

Table A9.2. Potatoes, 2nd year -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs and total cost of production per cwt. for three yield levels: farm with four-year rotation of two years potatoes, two years alfalfa

	Potatoes, 2nd yr		112 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Potatoes	cw	275	$5.00	$1,375.00
				0.00
TOTAL VALUE				$1,375.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Potato	cw	22	$9.45	$207.90
				0.00
Fertilizer				
N	lb	190	0.24	45.60
P	lb	243	0.22	53.46
K	lb	201	0.14	28.14
Lime	tn	1	25.00	25.00
Chemicals				
Total cost		1	142.00	142.00
				0.00
				0.00
Cover: Oats	ac	0.5	20.00	10.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				41.83
Repair, main.				50.88
Other			59.00	59.00
Interest, operating		663.81	Rate/yr	
Months		5	10.00%	27.66
LABOR - Machine	Hour	7.8	$6.70	$52.23
Other Labor	Hour	17.7	6.70	118.59
TOTAL ANNUAL OPERATING EXPENSES				$862.28
NET OVER ANNUAL OPERATING EXPENSES				$512.72
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$3.14
Total Cost of Prod / cw : Yield =			250	$4.81
Total Cost of Prod / cw : Yield =			275	$4.37
Total Cost of Prod / cw : Yield =			300	$4.01

Table A9.3. Alfalfa, 1st year -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with four-year rotation of two years potatoes, two years alfalfa

		Alfalfa, 1st yr		112 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Alfalfa, stdg	ac	1	$100.00	$100.00
($40*2.5t/a)				0.00
TOTAL VALUE				$100.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed	1/2 cost			
Alfalfa	lb	9	$2.90	$26.10
				0.00
Fertilizer				
N	lb	0	0.24	0.00
P	lb	40	0.22	8.80
K	lb	20	0.14	2.80
Lime				0.00
Chemicals				
Premerge	qt	1.33	3.25	4.32
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
Power,equipment				
Fuel,oil & grease				2.48
Repair,main.				1.82
Other			3.00	3.00
Interest, operating		49.32	Rate/yr	
Months		4	10.00%	1.64
LABOR - Machine	Hour	0.6	$8.00	$4.71
Other Labor	Hour		5.00	0.00
TOTAL ANNUAL OPERATING EXPENSES				$55.68
NET OVER ANNUAL OPERATING EXPENSES				$44.32
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$55.68

Table A9.4. Alfalfa, 2nd year -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with four-year rotation of two years potatoes, two years alfalfa

		Alfalfa, 2nd yr		113 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Alfalfa, stdg ($40*3.5t/a)	ac	1	$140.00	$140.00 0.00
TOTAL VALUE				$140.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed	1/2 cost			
Alfalfa	lb	9	$2.90	$26.10
				0.00
Fertilizer				
N	lb	0	0.24	0.00
P	lb	20	0.22	4.40
K	lb	40	0.14	5.60
Lime				0.00
Chemicals				
M & M	gl	1	15.00	15.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				2.48
Repair, main.				1.82
Other			3.00	3.00
Interest, operating		58.40	Rate/yr	
Months		4	10.00%	1.95
LABOR - Machine	Hour	0.6	$8.00	$4.70
Other Labor	Hour		5.00	0.00
TOTAL ANNUAL OPERATING EXPENSES				$65.05
NET OVER ANNUAL OPERATING EXPENSES				$74.95
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$65.05

Table A10.1. Potatoes, nonirrigated -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs and total cost of production per cwt. for three yield levels: farm with two-year rotation of potatoes and oats

		Potatoes w/o irrig		225 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Potatoes	cw	240	$5.00	$1,200.00
				0.00
TOTAL VALUE				$1,200.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Potato	cw	26.8	$9.45	$253.26
				0.00
Fertilizer				
N	lb	168	0.24	40.32
P	lb	215	0.22	47.30
K	lb	164	0.14	22.96
Lime	tn	1	25.00	25.00
Chemicals				
Total cost		1	142.00	142.00
				0.00
				0.00
Cover: Clover in oats		1	20.00	20.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				36.48
Repair, main.				45.49
Other			59.00	59.00
Interest, operating		691.81	Rate/yr	
Months		5	10.00%	28.83
LABOR - Machine	Hour	6.9	$6.70	$46.44
Other Labor	Hour	17.9	6.70	119.93
TOTAL ANNUAL OPERATING EXPENSES				$887.01
NET OVER ANNUAL OPERATING EXPENSES				$312.99
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$3.70
Total Cost of Prod / cwt	Yield =	215		$5.72
Total Cost of Prod / cwt	Yield =	240		$5.12
Total Cost of Prod / cwt	Yield =	265		$4.64

Table A10.2. Oats -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with two-year rotation of nonirrigated potatoes and oats

	Oats w/ clover		225 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Oats	bu	80	$1.25	$100.00
Straw	ac	1	20.00	20.00
TOTAL VALUE				$120.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Oats	bu	3	$4.00	$12.00
				0.00
Fertilizer				
N	lb	20	0.24	4.80
P	lb	40	0.22	8.80
K	lb	20	0.14	2.80
Lime		0	0.00	0.00
Chemicals				
None				0.00
				0.00
				0.00
Custom harv, haul		1	25.00	25.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				3.41
Repair, main.				3.41
Other			3.00	3.00
Interest, operating		63.22	Rate/yr	
Months		4	10.00%	2.11
LABOR - Machine	Hour	0.8	$8.00	$6.14
Other Labor	Hour	0.5	5.00	2.50
TOTAL ANNUAL OPERATING EXPENSES				$73.97
NET OVER ANNUAL OPERATING EXPENSES				$46.03
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$0.67

Table A11.1. Potatoes, irrigated -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs and total cost of production per cwt. for three yield levels: farm with two-year rotation of irrigated potatoes, and oats

		Potatoes w/ irrig		225 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Potatoes	cw	285	$5.00	$1,425.00
				0.00
TOTAL VALUE				$1,425.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Potato	cw	26.8	$9.45	$253.26
				0.00
Fertilizer				
N	lb	218	0.24	52.32
P	lb	215	0.22	47.30
K	lb	164	0.14	22.96
Lime	tn	1	25.00	25.00
Chemicals				
Total cost		1	142.00	142.00
				0.00
				0.00
Cover: Clover in oats		1	20.00	20.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				61.39
Repair, main.				75.97
Other			59.00	59.00
Interest, operating		759.20	Rate/yr	
Months		5	10.00%	31.63
LABOR - Machine	Hour	10.4	$6.70	$69.98
Other Labor	Hour	16.7	6.70	111.89
TOTAL ANNUAL OPERATING EXPENSES				$972.71
NET OVER ANNUAL OPERATING EXPENSES				$452.29
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$3.41
Total Cost of Prod / cwt	Yield =	260		$5.21
Total Cost of Prod / cwt	Yield =	285		$4.76
Total Cost of Prod / cwt	Yield =	310		$4.37

Table A11.2. Oats -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with two-year rotation of irrigated potatoes, and oats

	Oats w/ clover		225 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Oats	bu	80	$1.25	$100.00
Straw	ac	1	20.00	20.00
TOTAL VALUE				$120.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Oats	bu	3	$4.00	$12.00
				0.00
Fertilizer				
N	lb	20	0.24	4.80
P	lb	40	0.22	8.80
K	lb	20	0.14	2.80
Lime		0	0.00	0.00
Chemicals				
None				0.00
				0.00
				0.00
Custom harv, haul		1	25.00	25.00
				0.00
				0.00
				0.00
				0.00
Power,equipment				
Fuel,oil & grease				3.41
Repair,main.				3.57
Other			3.00	3.00
Interest, operating		63.37	Rate/yr	
Months		4	10.00%	2.11
LABOR - Machine	Hour	0.8	$8.00	$6.14
Other Labor	Hour	0.5	5.00	2.50
TOTAL ANNUAL OPERATING EXPENSES				$74.13
NET OVER ANNUAL OPERATING EXPENSES				$45.87
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$0.68

Table A12.1. Potatoes, nonirrigated -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs and total cost of production per cwt. for three yield levels: farm with three-year rotation of nonirrigated potatoes, oats and corn

		Potatoes w/o irrig		150 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Potatoes	cw	265	$5.00	$1,325.00
				0.00
TOTAL VALUE				$1,325.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Potato	cw	22	$9.45	$207.90
				0.00
Fertilizer				
N	lb	185	0.24	44.40
P	lb	248	0.22	54.56
K	lb	212	0.14	29.68
Lime	tn	1	25.00	25.00
Chemicals				
Total cost		1	142.00	142.00
				0.00
				0.00
Cover: Clover in oats		1	20.00	20.00
Rye in corn		1	20.00	20.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				37.73
Repair, main.				44.48
Other			59.00	59.00
Interest, operating		684.75	Rate/yr	
Months		5	10.00%	28.53
LABOR - Machine	Hour	7.5	$6.70	$50.18
Other Labor	Hour	17.3	6.70	115.91
TOTAL ANNUAL OPERATING EXPENSES				$879.38
NET OVER ANNUAL OPERATING EXPENSES				$445.62
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$3.32
Total Cost of Prod / cwt	Yield =		240	$5.38
Total Cost of Prod / cwt	Yield =		265	$4.87
Total Cost of Prod / cwt	Yield =		290	$4.45

Table A12.2. Oats -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with three-year rotation of nonirrigated potatoes, oats and corn

	Oats w/ clover			150 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Oats	bu	80	$1.25	$100.00
Straw	ac	1	20.00	20.00
TOTAL VALUE				$120.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Oats	bu	3	$4.00	$12.00
				0.00
Fertilizer				
N	lb	20	0.24	4.80
P	lb	40	0.22	8.80
K	lb	20	0.14	2.80
Lime		0	0.00	0.00
Chemicals				
None				0.00
				0.00
				0.00
Custom harv, haul		1	25.00	25.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				3.47
Repair, main.				3.35
Other			3.00	3.00
Interest, operating		63.22	Rate/yr	
Months		4	10.00%	2.11
LABOR - Machine	Hour	0.8	$8.00	$6.37
Other Labor	Hour	0.5	5.00	2.50
TOTAL ANNUAL OPERATING EXPENSES				$74.20
NET OVER ANNUAL OPERATING EXPENSES				$45.80
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$0.68

Table A12.3. Corn -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with three-year rotation of nonirrigated potatoes, oats and corn

		Corn		150 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Corn, shelled	bu	120	$2.50	$300.00
				0.00
TOTAL VALUE				$300.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Corn	80M un	0.3	$60.00	$18.00
				0.00
Fertilizer				
N	lb	125	0.24	30.00
P	lb	40	0.22	8.80
K	lb	40	0.14	5.60
Lime				0.00
Chemicals				
Total cost		1	27.50	27.50
				0.00
				0.00
Custom harv, haul		1	45.00	45.00
Custom drying		1	36.00	36.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				8.63
Repair, main.				7.40
Other			7.00	7.00
Interest, operating		193.93	Rate/yr	
Months		4	10.00%	6.46
LABOR - Machine	Hour	1.7	$8.00	$13.32
Other Labor	Hour		5.00	0.00
TOTAL ANNUAL OPERATING EXPENSES				$213.72
NET OVER ANNUAL OPERATING EXPENSES				$86.28
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$1.78

Table A13.1. Potatoes, irrigated -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs and total cost of production per cwt. for three yield levels: farm with three-year rotation of irrigated potatoes, oats and corn

		Potatoes w/ irrig		150 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Potatoes	cw	315	$5.00	$1,575.00
				0.00
TOTAL VALUE				$1,575.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Potato	cw	22	$9.45	$207.90
				0.00
Fertilizer				
N	lb	235	0.24	56.40
P	lb	248	0.22	54.56
K	lb	212	0.14	29.68
Lime	tn	1	25.00	25.00
Chemicals		1		
Total cost		1	142.00	142.00
				0.00
				0.00
Cover: Clover in oats		1	20.00	20.00
Rye in corn		1	20.00	20.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				75.10
Repair, main.				81.55
Other			59.00	59.00
Interest, operating		771.19	Rate/yr	
Months		5	10.00%	32.13
LABOR - Machine	Hour	12.8	$6.70	$85.49
Other Labor	Hour	14.3	6.70	95.81
TOTAL ANNUAL OPERATING EXPENSES				$984.63
NET OVER ANNUAL OPERATING EXPENSES				$590.37
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$3.13
Total Cost of Prod / cwt	Yield =	290		$4.95
Total Cost of Prod / cwt	Yield =	315		$4.56
Total Cost of Prod / cwt	Yield =	340		$4.23

Table A13.2. Oats -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with three-year rotation of irrigated potatoes, oats and corn

	Oats w/ clover			150 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Oats	bu	80	$1.25	$100.00
Straw	ac	1	20.00	20.00
TOTAL VALUE				$120.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Oats	bu	3	$4.00	$12.00
				0.00
Fertilizer				
N	lb	20	0.24	4.80
P	lb	40	0.22	8.80
K	lb	20	0.14	2.80
Lime		0	0.00	0.00
Chemicals				
None				0.00
				0.00
				0.00
Custom harv, haul		1	25.00	25.00
				0.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				3.47
Repair, main.				3.54
Other			3.00	3.00
Interest, operating		63.41	Rate/yr	
Months		4	10.00%	2.11
LABOR - Machine	Hour	0.8	$8.00	$6.37
Other Labor	Hour	0.5	5.00	2.50
TOTAL ANNUAL OPERATING EXPENSES				$74.40
NET OVER ANNUAL OPERATING EXPENSES				$45.60
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$0.68

Table A13.3. Corn -- Budgeted variable costs per acre with breakeven price per unit needed to cover variable costs: farm with three-year rotation of irrigated potatoes, oats, and corn

		Corn		150 ACRES
	UNIT	RATE/A	PRICE/UNIT	VALUE/ACRE
CROP VALUE				
Corn, shelled	bu	120	$2.50	$300.00
				0.00
TOTAL VALUE				$300.00
ANNUAL OPERATING EXPENSES				COST/ACRE
Seed				
Corn	80M un	0.3	$60.00	$18.00
				0.00
Fertilizer				
N	lb	125	0.24	30.00
P	lb	40	0.22	8.80
K	lb	40	0.14	5.60
Lime				0.00
Chemicals				
Total cost		1	27.50	27.50
				0.00
				0.00
Custom harv, haul		1	45.00	45.00
Custom drying		1	36.00	36.00
				0.00
				0.00
				0.00
Power, equipment				
Fuel, oil & grease				8.63
Repair, main.				7.59
Other			7.00	7.00
Interest, operating		194.12	Rate/yr	
Months		4	10.00%	6.47
LABOR - Machine	Hour	1.7	$8.00	$13.32
Other Labor	Hour		5.00	0.00
TOTAL ANNUAL OPERATING EXPENSES				$213.92
NET OVER ANNUAL OPERATING EXPENSES				$86.08
BREAKEVEN PRICE/UNIT FOR PRIMARY PRODUCT TO COVER ANNUAL OPERATING EXPENSES				$1.78