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An Economic Analysis of Trends in Production of Selected Crops in Utah and Their Causative Factors, 1948-1968

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AN ECONOMIC ANALYSIS OF TRENDS IN PRODUCTION OF SELECTED CROPS IN UTAH AND THEIR CAUSATIVE FACTORS, 1948-1968

by

Eldon Gene Olsen

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ABSTRACT

An Economic Analysis of Trends in Production

Of Selected Crops in Utah and Their

Causative Factors, 1948-1968

by

Eldon Gene Olsen, Master of Science

Utah State University, 1971

Major Professor: Dr. Lynn H. Davis
Department: Economics

Trends in Utah's agriculture and some factors influencing farmer's decisions concerning eight crops produced on irrigated lands in Utah were studied. Trend lines were calculated and compared with statistics of acreages and yields. Simple and multiple regression tests were made.

An increasing number of Utah farmers have taken off-farm employment and operate their farms on a part-time basis. Forage and grain crops both adapt readily to part-time farm operations and these crops do not entail the degree of risk involved in the production of most cash crops. Variety improvements have caused some shifting to wheat production. Product prices, costs, weather, government programs, and labor problems were also found to be important factors influencing farmers decisions.

(81 pages)

INTRODUCTION

Agriculture has been an important sector of Utah's economy for more than a century. Gross returns from farm production are currently about $200 million annually (7), while agricultural-associated industries account for nearly one-third of the personal income of the state (12).

Agriculture is a dynamic industry. Adjustments of the agricultural industry in Utah are the sum of the decisions made by farm operators in the state. Decision making in agriculture is becoming more and more complicated. With great strides in farm mechanization, the decisions of what to grow and what not to grow become highly involved in planning for specialized crop production. Costs of ownership and depreciation of expensive specialized machinery and other financial problems are vital to success in farming. Problems of labor are no longer a matter of hiring the neighbor's son but may involve such legalities as those associated with migrant labor, housing standards, and wage negotiations. These pressures and many more are brought to bear upon the farm operator in his decision-making.

This study is an analysis of adjustments made by Utah's farm sector. It is of vital importance to all concerned that trends in Utah's agriculture be discerned and causes of trends be analyzed to show the future outlook and the problems faced by Utah's farm operators.

Objectives

The objectives of this study were:

1. To ascertain what changes have taken place in the production of selected crops in Utah since World War II.

2. To show long-run production trends for those products where general tendencies are noted.

3. To identify short-run adjustments in crops and major production shifts in trends where such are evident.

4. To ascertain and analyze the factors causing these changes.

5. To indicate the direction of movement in present production in these crops in Utah.

REVIEW OF LITERATURE

Analyses of trends in production and projected future production for agriculture in specific areas have been frequently used to formulate the farm picture. Several surveys are available for different time periods for various areas. Most of these tend to summarize statistical data and discuss trends in general, but a few undertake to analyze the factors influencing decision-making processes that are involved in major changes in the industry's production.

Blanch (4) made a general appraisal of agriculture and compared its relative economic downward trend over a three year period. Costs and returns and the over-all agricultural picture were the main concerns of this article. No trend lines were calculated nor statistical analysis undertaken.

Christensen and Richards (8) presented a statistical review of the size, variety, and importance of Utah's agriculture as it compared with the eight western states over a time period from 1956 to 1968. Comparative indices were used to show general changes in production. Much of the material is a supplement to and updating of Utah Agricultural Statistics by the use of current United States Statistical Reporting Service annual reports. No attempt was made to calculate trends in production, and no analyses of causes were undertaken.

Fife completed a tabulation of agricultural production in Cache County, Utah, in 1950 (10). He studied crops and livestock production over a 40 year period from 1909 to 1949. Tables and graphs based on census data on five year intervals were used to show changes over

time in yields, acres, and total production, as well as livestock products marketed within the County. No attempts were made to establish linear trend lines in production data or to analyze factors influencing the changes in production that were noted.

Morrison and Prestwich (12) reported that the number of farmers working off the farm 100 days or more was on the increase. In 1949, 37 percent of all Utah farmers worked more than 100 days off the farm compared to 46 percent in 1954. The percent of farmers who owned their farms had decreased slightly from 70 percent in 1945 to 68 percent by 1955. But the percent of those owning part of their farm had increased from 20.7 to 25.6 percent over the same period, and tenants had decreased from 8.4 percent to 5.4 percent. Total farm production in Utah was increasing between 1948 and 1958, but by only 1 percent per year, while population growth was about 3 percent per year. The greatest production increases during this time were in beef cattle and calves and hay and grain production. Field crops, truck gardening, and fruit production were all down. Little attempt was made to explain the causes of these changes.

Reuss and Blanch (15) developed a detailed picture of Utah's land resources and the allocation of these lands to various uses. Statistics were quoted from census reports for five-year periods, both for the state as a whole and by county. Types of land and yield potential of the various types in pasture or crops were tabulated.

An over-all summary of agricultural conditions in Utah was completed by Thomas (19) and others in 1950. Land resources and allocation, size and number of farms, comparative farm and non-farm prices and income, as well as enterprise by enterprise summary of

production costs and returns are all facets of the picture. There were no attempts to specifically establish linear trends, nor were the causes of the adjustments analyzed. The effects of war on farm income were considered, and comparisons were made between the two wartime eras involved.

The changing scene of Utah agriculture, 1960, was depicted in Farm and Home Science and projected to 1980 (7). Farm output in the United States was up 25 percent, while Utah farm production was up only 8 percent from 1950 to 1960. Crop production for Utah remained constant during this period, while increases occurred in livestock production. Major problems and their effects were considered. It emphasized the problems of small fragmented farms in Utah and the increasing competition for some of the best land and water from urbanization and other public development programs. The lack of water resources has prevented the development of some three to four million acres of arable land in Utah, according to soil conservation surveys. Projected production trends given were as follows: sugar beets were expected to remain at the level of about 43,000 acres; alfalfa was expected to increase slightly; feed grains were expected to remain about stable or increase slightly at about 20 percent of all harvested crops; vegetable crops were expected to continue to decrease in importance. Corn silage was not specifically considered.

SOURCES OF DATA AND METHOD OF ANALYSIS

Yearly statistical information as to the yields, prices and harvested acres of the selected crops were obtained from the 1965 revised edition of Utah Agricultural Statistics. Periodical reports from the Statistical Reporting Service were used to update and supplement these data (22). Additional data pertaining more specifically to irrigated acres of harvested crops were gathered from the United States census reports for the years 1950, 1954, 1959, and 1964 (6).

Other pertinent information was gathered from the Agricultural Stabilization and Conservation Service records in the state office (1) and the records of the major sugar refining and vegetable canning companies. Climatological data, particularly factors that may adversely affect crop production such as periods of killing frosts, or drought indices indicating periods of extreme drought or moisture conditions were obtained from the United States Weather Bureau (9).

General information and non-empirical factors influencing farm production decisions were obtained through personal interviews with producers of farm products, company field men and agents, farm machinery dealers and distributors, and agronomists at the University. The period from 1948 to 1968 was selected for this study so as to remove abnormal periods such as World War II and the years immediately succeeding it. This included the census years of 1950, 1954, 1959, and 1964.

Four general classifications of crops grown on irrigated land were used. Under forage corps, alfalfa was studied because it was the

most popular hay crop, and corn silage was studied because it has shown the greatest expansion potential up to 1948. All major grains were studied. Winter wheat and spring wheat were analyzed separately. Oats were added to wheat and barley when a preliminary study showed a rather stable acreage of oat crops grown in recent years. Sugar beets were studied since they were the major root crop of any significance during this time, and tomatoes were selected out of all canning crops.

Average annual yields per acre were studied as a barometer of changes in the productivity of specific crops. Unless otherwise stated, acreages harvested for various crops were the criteria for determining production decisions made by farmers, and graphs were constructed on this basis for acreage and yeilds of each specific crop studied. In most cases, there was little difference between acres planted and acres harvested. However, where significant differences were noted, they were considered as possible factors for Objective Number 4.

In order to accomplish the second and third objectives, least squares trend lines were calculated and compared with the graph representing statistical data. When the trend line for the 20-year period did not appear to be the best fit, non-fitting portions were analyzed as deviaitons from the general trend, and a search was made for factors causing such deviations.

To accomplish the fourth objective, interviews were conducted with producers and handlers of the various crops analyzed. Books and periodicals dealing with specific problem areas were studied in order to obtain a more complete understanding of farm conditions in Utah. Multiple and simple regression analyses were calculated for selected crops to ascertain the relevance on farmers' planning

decisions of various independent variables. In the multiple regression analyses, the degree of influence of the independent variables was determined by R^2 values, while correlation coefficients were used to determine the influence of independent variables in simple regression analyses.

Some of the independent variables compared statistically were yields and/or product prices for the previous year, profitability features, acres grown of competing crops, and weather data pertinent to crop yields. Other factors pertaining to Utah crop production studied were: the general increase in demand for specific crops such as corn silage and feed grains, off-the-farm migration, the age of farmers and the effect of age on the attitude of farm operators toward certain crops and agronomic practices, the use of fertilizer, the increased adoption of chemicals for weed and insect control, adaptations of sprinkler irrigation, increased off-farm labor opportunities and the resulting part-time farming, the trend in tenure of farm operators, the problems of farm mechanization, and the effects of government programs.

Personal interviews were used to help understand the adjustments indicated in published statistics. About 84 farmers were interviewed in the counties of Box Elder, Cache, Davis, Weber, Salt Lake, Utah, Carbon, and Sevier. Formal questionnaires were not used but questions were asked to obtain information on crop acreage and yields, cultural practices and personal attitudes concerning specific crops. Past, present and future plans for cropping were discussed and compared. Attempts were made to ascertain reasons for adjustments that had taken place since World War II.

Nineteen fieldmen and other officials of Amalgamated, Utah and Idaho, and Holly sugar companies; grain millers and grain handlers, and agents of farm machinery retail outlets were interviewed to obtain their views pertaining to farm problems, company policies, government programs and farmers responses as they see them. Fourteen agricultural specialists from Utah State University were consulted to obtain latest improvements in agronomy pertinent to this study and their effect on farm production. Officials of government agencies, A.S.C.S., S.C.S., and Extension Services were also consulted and their views obtained concerning farm production and farmers reactions to government programs.

The information obtained from these interviews was studied in the light of statistical data to help ascertain some of the factors responsible for adjustments in crop production in Utah during the period studied.

BACKGROUND

Land Resources

About 70 percent of the 52.7 million acres in Utah is public range and park lands. Only 20 percent or 10.8 million acres was farmland in 1948, Table 1. About 3.3 percent or 1 1/2 million acres was cropland, including irrigated pasture. Of this cropland, approximately 70 percent is irrigated and 30 percent is non-irrigated, Table 2 (15, p. 4).

This study is primarily concerned with the irrigated acreage of farmland which has remained relatively stable since 1954 at slightly more than a million acres. While some of the choicest land is being lost from agriculture through urban and industrial development, other areas are being brought into production through reclamation projects and by use of underground water supplies.

Climatic Features

The growing season in Utah is relatively short. Frequent late spring and early autumn frosts cause serious uncertainty because of potential damage to crops. Summer days are hot, and plant growth is rapid only when sufficient moisture is available. Precipitation is low, especially in the summer, so that crops requiring high moisture conditions must be irrigated from storage in mountain or underground reservoirs. Most of the state has restrictions on agriculture because of limited supplies of irrigation water.

Table 1. Number of farms, land in farms, and average size of farms in Utah, census years 1945-1964

Year	No. of farms	Land in farms	Average size of farms
	Number	Acres	Acres
1945	26,322	10,309,107	391.7
1950	24,198	10,854,289	488.6
1954	22,826	12,262,222	537.2
1959*	17,811	12,688,518	712.4
1964	15,759	12,994,823	824.6
1968+	14,500	NA	NA

*The definition of farms was altered for the 1959 census eliminating approximately 1,255 small farms.
+The number of farms for 1968 is the latest estimate by the Economic Research Service.

Table 2. Irrigated farms, land irrigated and irrigated cropland per farm in Utah, census years 1945-1964

Year	Irrigated farms 1	Land irrigated 2	Irrigated cropland 3	Average irrigated cropland per farm (calculated 3 ÷ 1)
	Number	1,000 acres	1,000 acres	Acres
1945	23,543	1,124	NA	35.8*
1950	21,126	1,128	847	40.0
1954	19,406	1,073	800	43.5
1959	15,701	1,062	771	49.1
1964	13,762	1,093	770	56.0

*Estimate
NA = Not available

Weather Summary 1948-1968

Crop yields were significantly affected by severe weather conditions of both extremes. The drought index was used as a measurement scale by weather offices to represent the relative intensity of drought conditions by months. For this study monthly averages were totaled for each crop year (September to August) and used to represent the average drought level for the year (Figure 1). This and other data obtained from the office of the State Climatologist for Utah at Utah State University indicated that drought conditions began in late 1952 and increased in sererity until 1955. In August of 1958 severe drought conditions combined with high temperatures to create extremely high wilt conditions throughout much of the state. This severe drought condition continued with only brief local relief until July of 1961. During this long dry spell the run-off water decreased until stocks of irrigation water in storage dams became critical, especially in Carbon, Sevier, and Sanpete counties.

The year of 1948 was extremely wet as were the early parts of 1962 and 1964. Unseasonally heavy snow occurred on May 5, 1964, followed by cold damp weather which delayed seeding and hampered germination. On September 15 and 16, 1965, another heavy snow was followed by severe frost in the northern portions of the state and vegetable crops yet unharvested were lost. Serious losses occurred in hay and grain crops in 1968 because of mid-season rains.

Farm Structure

Utah has long been known for its predominantly small farms. Because of the high intrinsic value placed upon land-ownership and farming

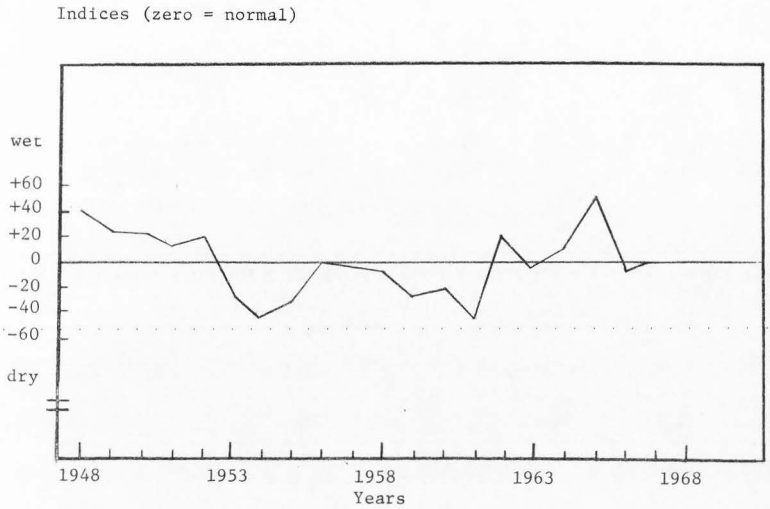

Figure 1. Moisture conditions in north central Utah as indicated by annual drought indices 1948-1967.

as an occupation, caused high land prices to prevail and encouraged the division of family farms into smaller less economical units. The resulting small farm pattern was especially pronounced along the Wasatch front. By 1945 there were 2 percent more farms in Utah than there were in 1920 (2, p. 3) indicating continuing resistance to the transition to larger farms.

Several defense oriented industries were established in Utah during and since the 1940's offering employment opportunities to many. Some major changes have occurred in individual farm programs to include this new income source. The proportion of all farm operators that worked 100 or more hours off the farm per year increased from 36 percent in 1950 to 49 percent in 1964 (Table 3). Some farmers sold or rented their land to neighbors, and the percentage of all farm land that was operated by part-time farmers increased by more than 50 percent between 1950 and 1964 (Table 4). The total number of farms declined by 38 percent between 1949 and 1968 (Table 5). In spite of these adjustments, Utah farm costs increased faster than farm returns and by 1968 the net farm income for the state had fallen $14 million below the 1948 level and net returns per farm were only 60 percent of the average for the United States as a whole (Table 5).

Table 3. Percent distribution of farm operators by off-farm employment in Utah, census years 1950-1964

Year	Percent working 100 days or more	Percent working less than 100 days	Percent not working off the farm
	Percent	Percent	Percent
1950	36.4	19.0	44.6
1954	45.4	17.6	36.0
1959	46.3	14.6	39.1
1964	49.0	12.7	38.3

Source: Census records.

Table 4. Percent distribution of farm land by tenure in Utah, census years 1950-1964

Year	Full owners	Part owners	Tenants	Managers
	Percent	Percent	Percent	Percent
1950	33.9	42.5	3.3	20.3
1954	25.8	53.4	2.9	17.9
1959	21.7	56.4	2.1	19.8
1964	18.5	69.6	2.9	8.9

Table 5. Net farm income in Utah compared to United States, 1949-1968

Year	Utah			U.S.	Utah as a comparison of U.S.
	No. of farms#	Total net farm income*	Net income per farm*	Net income per farm*	income per farm*
	Number	Million dollars	Dollars	Dollars	Percent
1949	23,250	56.4	2,426	NA	NA
1950	22,810	59.8	2,610	2,230	117
1951	22,570	79.5	3,522	2,750	128
1952	22,230	67.8	3,050	2,730	111
1953	21,890	54.2	2,476	2,750	90
1954	21,560	52.1	2,416	2,550	95
1955	20,810	52.4	2,518	2,450	103
1956	20,060	47.3	2,358	2,600	90
1957	19,310	52.4	2,714	2,500	108
1958	18,560	41.5	2,236	2,950	76
1959	17,811	44.6	2,504	2,750	91
1960	17,400	40.6	2,333	3,000	78
1961	16,990	32.4	1,907	3,300	58
1962	16,579	39.2	2,365	3,450	68
1963	16,169	30.6	1,892	3,500	54
1964	15,759	23.8	1,502	3,800	39
1965	15,445	32.3	2,091	4,150	50
1966	15,130	48.8	3,225	5,050	64
1967	14,815	44.3	2,990	4,800	61
1968	14,500	42.3	2,917	4,800	60

*Net farm income excluding inventory changes.
#1959 and 1964 figures taken directly from census records. 1950 and 1954 adjusted to 1959 farm definition. 1968 taken from ERS estimate.

PRODUCTION ANALYSIS

The irrigated cropland harvested in Utah is used in the production of three types of crops: forages, grains and intensified cash crops.

Forages and grain crops have a relatively low labor requirement and are easily adapted to most farm operations. The demand for these products in Utah comes from beef and dairy enterprises. Intensified cash crops require high labor inputs and, hopefully, provide increased cash returns per acre. Sugar beets and crops for canning have been a potential source of cash income for Utah farmers for many years. Figure 2 and Table 6 show the general allocation of irrigated acres among the main crops according to available census statistics.

Forage Crops

Forage crops account for nearly half the irrigated acreage and about two-thirds of irrigated cropland of the state. The main hay crops are: alfalfa, which represents about 32 percent of the acres irrigated; other legumes and timothy hay which is grown on about 7 percent; and grain and all other hay which accounts for about 20 percent. Corn silage is grown on about 8 percent of the irrigated acreage of Utah. At some high altitudes in the state, hay is the only crop that can be successfully grown.

Alfalfa

Alfalfa has been a basic crop in Utah's agriculture since its early introduction. It accounts for nearly 80 percent of the acreage

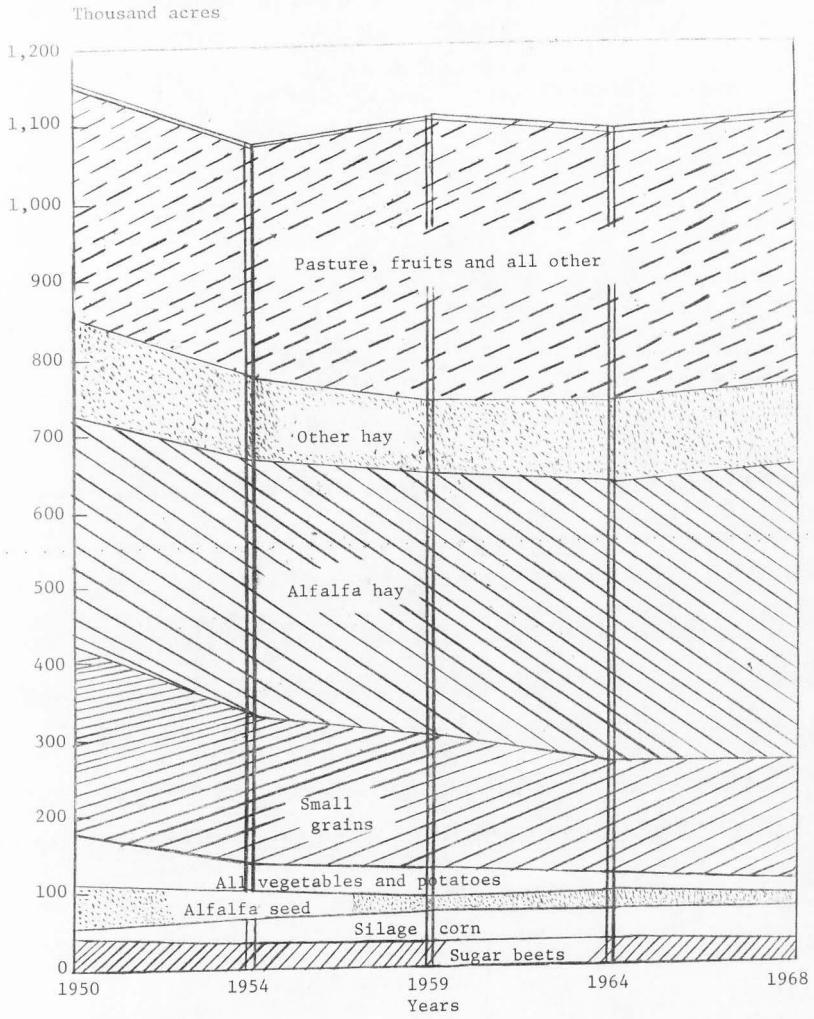

Figure 2. Use of irrigated lands in Utah, 1950-1968.

Table 6. Irrigated land by crop use in Utah, census years 1950-1964

Crop	1950	1954	1959	1964	1968[1]
	1,000 acres				
Sugar beets	38	33	31	33	29
Corn silage	21	32	39	34	44
Irrigated alfalfa seed	53	38	26	36	20
All vegetables, including potatoes	60	35	30	18	17
Winter wheat	30	15	16.5	16	22
Spring wheat	60	45	37.5	24	20
Barley	104.5	94	100.0	86	85
Oats	38.5	26	17	17.6	15
Mixed and other	17	14	8	3.2	3
All grains	251	194	179	147	145
Alfalfa hay	301	336	342	368	336
Other legumes and mixed	33	33	38	36	33
Grain hay	7	5	6	8	5
Wild and other	90	68	55	58	68
Total hay	431	441	441	470	442
Total crops harvested	854	774	746	738	697
Pasture, idle and all	313	309	316	355	383
Total irrigated acres	1,167	1,073	1,062	1,093	1,080

[1]Estimates for 1968.
Source: United States census of agriculture.

in all hay in Utah and supplied about 88 percent of the hay harvested in the state. Alfalfa is the major constituent of most crop rotations in Utah. It is a high quality feed and a valuable soil-building crop. From 1935 to 1945 about 442,200 acres of alfalfa were harvested each year. Approximately 80 percent of all alfalfa was produced under irrigation during this period. During the period immediately following World War II, approximately 80,000 acres of alfalfa were diverted to other crops such as wheat.

Trends. In 1950, there were about 361,000 acres harvested. After 1951, a shift back to alfalfa began. By 1953 there were 436,000 acres of alfalfa in Utah. This 95,000 acre increase was encouraged by a number of factors: beef cattle increased 30 percent during this period (Figure 3). Dairy cows increased 4 percent (Figure 4), and there was a 14 percent increase in the number of beef cattle on feed in Utah feedlots during this time (20, p. 3). Alfalfa hay prices exceeded $31 per ton in 1951. Expansion was over extended, however, and by 1953 prices had dipped to $20 and the increase in acreage expansion was curtailed (2, p. 68).

Utah has had a static import-export balance of hay in recent years. Northern areas of Utah have easy access to supplies of hay from southern Idaho, while southern counties of the state ship hay to California, Arizona, Nevada, and Colorado. There is usually an inventory on hand, and this coupled with the import potential, has a buffering effect on alfalfa crop expansion. Alfalfa production appears to be set at about 450,000 acres in recent years (Figure 5).

Yields. Average yields of alfalfa hay have increased slightly from 1948 through 1968 (Figure 6). Pronounced gains were made from

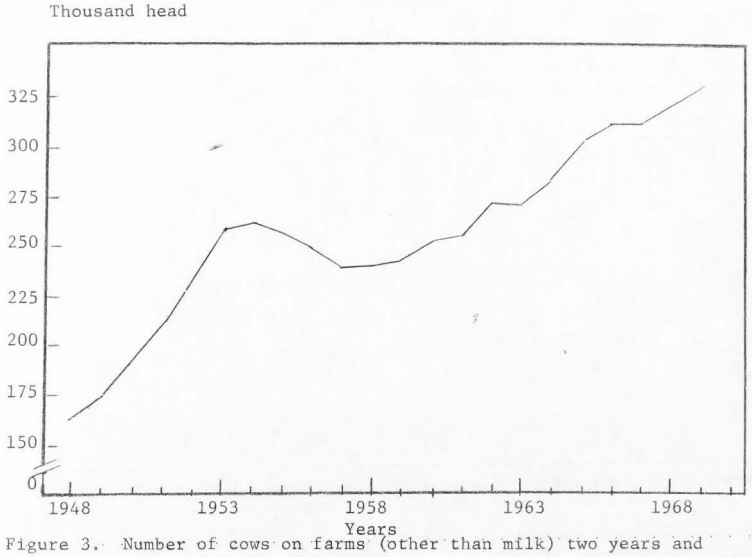

Figure 3. Number of cows on farms (other than milk) two years and older in Utah, 1948-1968.

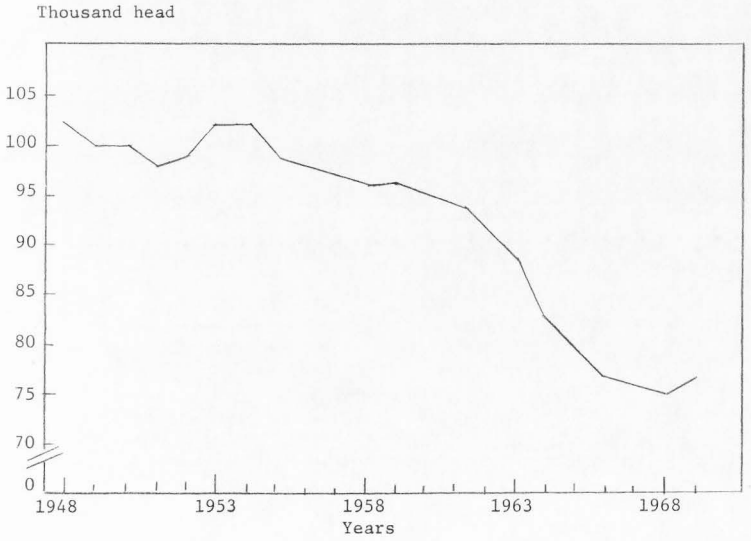

Figure 4. Number of milk cows on farms in Utah, 1948-1968.

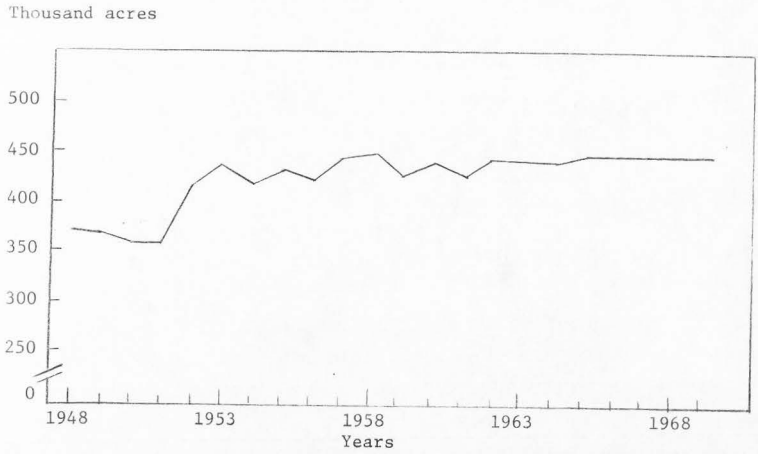

Figure 5. Harvested acreage of alfalfa hay in Utah, 1948-1968.

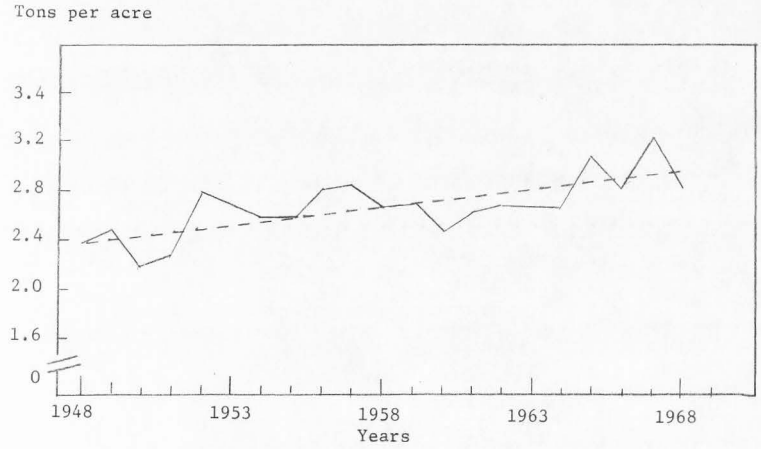

Figure 6. Average annual yields and secular trends for alfalfa hay in Utah, 1948-1968.

1948 to 1956 and from 1964 to 1968. The use of fertilizer and improved cultural practices could be expected to result in such an increase. However, from 1958 through 1964 there was a leveling off in yields. Examination of weather data for this period shows evidence of a general drought condition from 1958 through 1961 and again in 1963 (Figure 1). Such conditions could be expected to seriously retard the yields on the 20 percent of the alfalfa grown on dry land, and in some areas even affect water supplies for irrigated alfalfa.

Since alfalfa is a deep rooted crop, once the soil moisture is depleted, more than normal precipitation is needed over a sustained period of time in order to restore the moisture level to conditions adequate for normal yields. Hence, the temporary recovery of drought conditions in 1962 resulted in only slightly increased yields. The new gains in yields after 1964 were probably encouraged by the 20 months of surplus moisture conditions beginning in May 1964 and continuing through 1965. This built up sub-soil moisture in dry lands and returned them to normal production levels once again. At the same time, a marked increase in irrigation water applied to alfalfa lands took place through the use of sprinkler systems. The Porcupine Dam development area in Cache Valley is a good example of this. In a 1966 survey of Cache County, 45 percent of the farmers contacted had added sprinkler systems to their irrigation program since 1956 (2).

Corn silage

Corn silage has been grown in Utah for many years, but it was not until the introduction of field choppers and bunker silos that it became a major enterprise.

Trends. In 1932 there were 3,000 acres of corn silage grown in Utah. By 1948 there were 20,000 acres. From 1948 to 1968 the acreage more than doubled. In 1963, acres harvested dropped abruptly by 9,000 acres. The trend since 1963 has been upward again (Figure 7).

Average yields have been variable. From 1948 to 1956 the yields increased steadily. Then from 1956 to 1962 yields remained fairly stable, near 14 tons to the acre. In 1963 yields began increasing and from 1961 to 1968 the average yields continued upward (Figure 8).

Statistical analyses. A simple regression analysis, comparing acres harvested with average yields of corn silage for the preceding year in Utah from 1948 through 1968 showed a correlation coefficient of 0.9 between the two. Another factor bound to be influential was the change in the number of dairy cows. In 1954 there began a decline in dairy cow population in the state, and by 1966 the number of dairy cows in Utah had decreased by 25 percent. Since corn silage is a component in many dairy rations, the number of dairy cows fed affects the demand for corn silage. A multiple regression analysis, with acres harvested as the dependent variable and the number of dairy cows and the yields of corn silage the previous year as independent variables, failed to show significance.

Factors of influence. The most powerful influence in corn silage production over the past 20 years has been the increase in productivity relative to that of hay. The development of hybrid corn increased yield potential and shortened the required growing season of new varieties of corn silage. Studies and tests of total digestible nutrient content of corn silage emphasize the advantages of feeding corn silage to beef and dairy cattle. At the same time technological

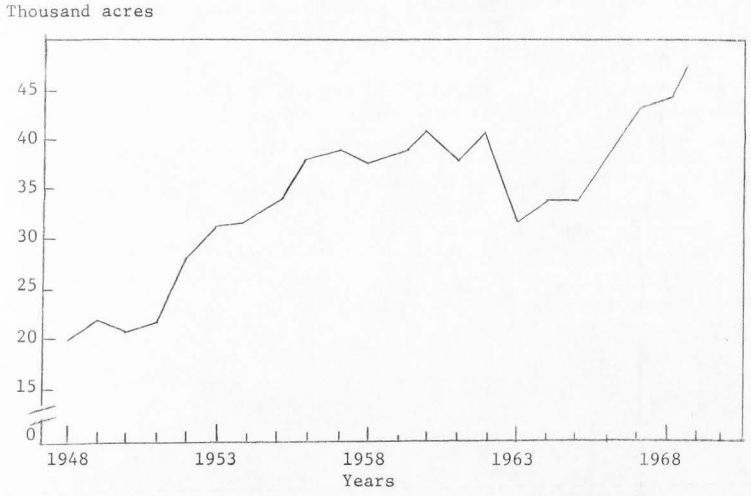

Figure 7. Harvested acreage of corn silage in Utah, 1948-1968.

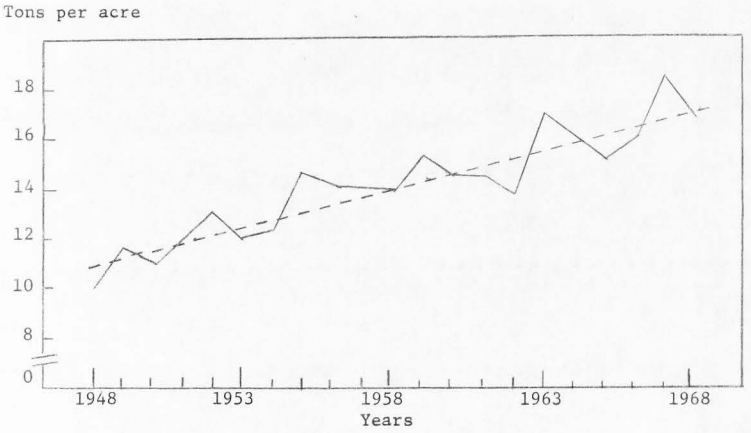

Figure 8. Average yields and secular trend in yields of corn silage in Utah, 1948-1968.

advances in harvesting and storage operations have reduced much of the labor associated with production and the increased demand for silage has made it profitable to grow corn silage under the changing farm conditions in Utah. In 1954 there was one field harvester for every 12 1/2 irrigated farms. By 1959 there was one to every seven irrigated farms, and this ratio has remained about constant through 1964 (2, p. 8). The labor requirement for corn silage production is about the same per acre as that of alfalfa hay, so it fits well into part-time farming programs. The total costs of corn silage production are about $76 per acre compared to about $50 per acre for alfalfa hay (17) but gross returns from corn silage are about double that realized for alfalfa hay. The risk involved in corn silage production is about as low as any crop harvested in Utah.

The development of chemicals for weed control has increased corn silage's use in areas infested with quack grass and other weeds. The chemical Atrazine is effective in the eradication of grasses and broad-leafed weeds, but does not seriously affect corn growth.

The most restrictive factor upon corn silage production is its excess weight. Because of the high water content of corn silage, it is not economically feasible to transport corn silage more than a few miles. Hence, the local supply must adjust to the local demand. In order to successfully produce corn silage, disposal plans must be established beforehand. Many small farmers who do not have livestock of their own to feed grow corn silage on contract for a nearby dairy. If local production of corn silage exceeds the quantity demanded locally, the resulting low prices may easily curtail plans for corn silage production for the coming year. The rapid increase in corn

silage production in the early 1950's eventually created local surplus conditions and a drop in corn silage prices resulted. The acreage planted to corn silage began leveling off in 1957 when prices dropped to $6.50 per ton.

Corn silage has long been accepted as a valuable dairy feed in Utah. The acreage planted to corn silage is influenced not only by the concentration of corn silage in the rations fed to dairy cows, but also by the number of dairy cows requiring feed. The increased ratio of corn silage to other roughages in dairy rations since 1948 was responsible for much of the increase in corn silage grown in Utah during this period. On the other hand, between 1961 and 1966 the number of milk cows in Utah decreased by 17,000 head or about 17 percent of the 1961 total. This caused a sharp decline in demand for corn silage. In 1963 corn silage acreage declined 20 percent to 32,000 acres.

The relatively low cost of corn silage compared to other roughages has encouraged the expansion of corn silage feeding in beef rations in recent years. This and the continued increase in concentration of corn silage in dairy rations more than offset the effect of decreases in dairy cows in Utah and after 1965 acreage of corn silage increased rapidly. Crop estimates for 1969 indicate corn silage acreage for Utah near 48,000 acres. The rapid growth of the beef industry in Utah has expanded this outlet for corn silage, while increased fertilizer use and improved cultural methods of production have contributed to the increased yields and the relative advantages of growing corn silage compared to other sources of livestock feed in Utah.

Two restricting factors other than the limitations of excess

weight that affect corn silage production are Utah's short growing seasons and the adoption of sprinkler irrigation. New varieties of hybrid seed have largely removed the handicap of the short season, but the problem of irrigating tall dense stands of corn with sprinkler irrigation systems remains to be solved. Many new irrigation projects are exclusively of the sprinkler pattern. In these areas corn silage production has given way to other crops for forage production, mainly alfalfa.

All Grains

Prior to the end of World War II, the acreage of all grains in Utah increased from 282,000 acres in 1924 to 611,000 acres in 1948. The greatest increase was made in barley production, from 14,000 acres in 1924 to 144,000 acres in 1948. Utah feed grain producers enjoy some price advantages because of the excess in consumption of feed grains over feed grain production. The added cost of importing feed grain becomes an added bonus to local grain producers. Since 1960 Utah farmers have produced less than a third of the feed grain fed to livestock in the state.

Between 1948 and 1964 the total acres of grain harvested in Utah decreased by about 40 percent (Figure 9). The percent of all grains grown in Utah that is irrigated has remained about the same at about 38 percent.

Government programs

The complete effect of government programs cannot be fully measured, but conditions may be described and some of the responses

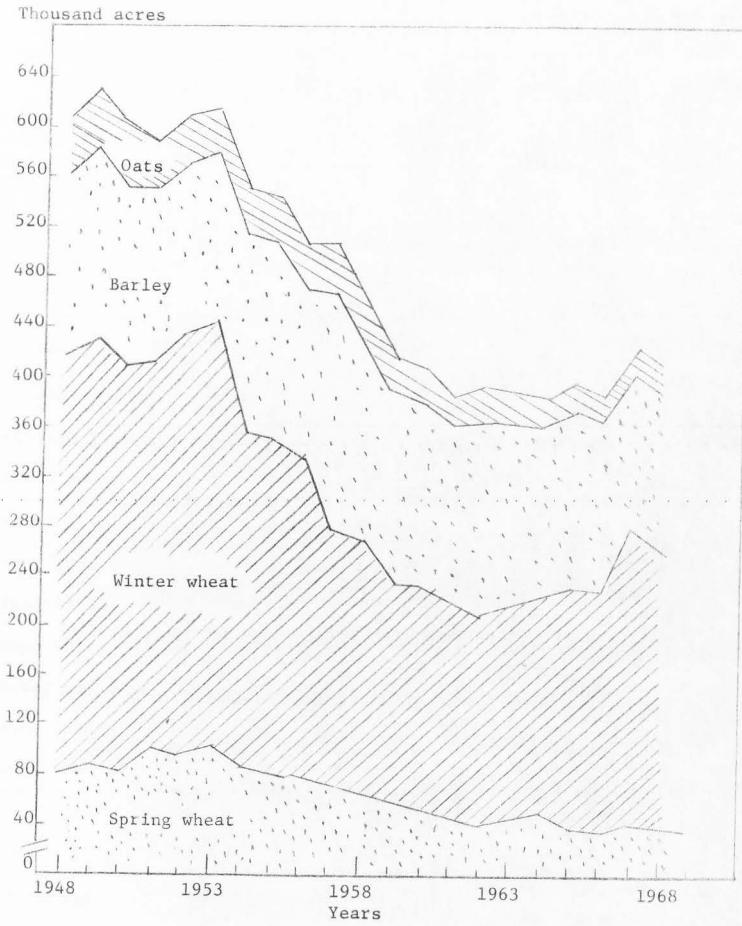

Figure 9. Acres harvested of leading grains in Utah, 1948-1968.

forecast. The major programs affecting wheat production are the soil-bank, the various wheat acreage allotments, price support programs, and the feed grain programs.

The soil-bank. The soil-bank program was a government financed plan for the orderly retirement of cropland that normally produced wheat or other surplus products. It was inaugurated late in 1956. Under this plan, farmers entered into 5 to 10 year contracts to retire land from wheat production in return for a government payment agreed upon by both parties. It was a voluntary program initiated upon the farmer's offer with payments based upon the land's productivity. If the farmer so desired, the contracts could be extended beyond the expiration date of the original contract. The soil-bank program is due to expire in 1969, and unless some provision is made to extend the contracts all acres presently retired will be released from the program (Figure 10).

The initial entry of land into the soil-bank program took marginal land of low yield out of production, thus having an increasing effect upon the average yield for the state. Furthermore, if the middle-sized or large producer participated, it served as an incentive toward more intensified use of land left in production. This also had the effect of increasing average yield for the state.

Acres released from soil-bank contracts may or may not be put back into grain or any other crop production depending upon a number of things:

1. The land's productivity may be too low to make it profitable to put it back into grain production.

2. The owner may have quit farming. If the owner was able to put all his land under contract to the government, he may have found

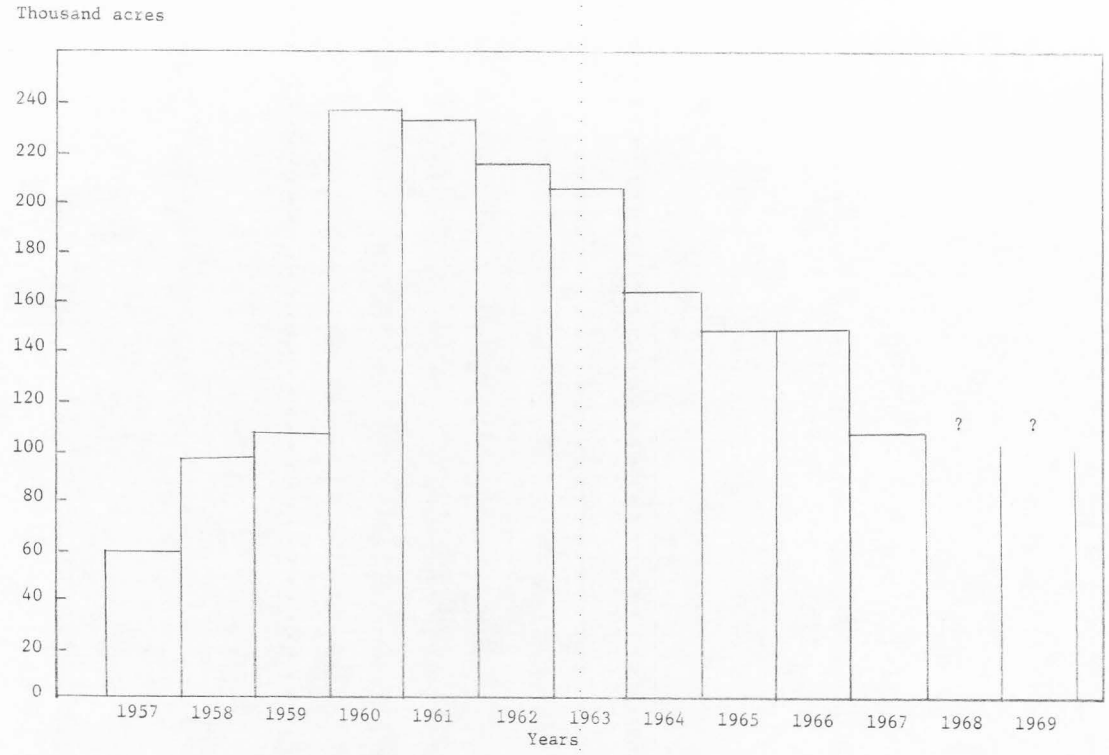

Figure 10. Crop acreage in soil-bank contracts in Utah, 1957-1968.

employment with other industries and may not be willing to return to farming. His land, under such conditions, may be sold or rented to someone else, or he may be willing to hold the land idle in the hope of making capital gains at some future date. If the owner did stay on the farm without producing grain, his machinery may be obsolete, and he may not be willing or able to rebuild the working unit for grain production.

3. The land may be more valuable for other uses. Land released from soil-bank contracts may be desirable as range land for Utah's expanding cattle industry.

Wheat acreage allotment. Wheat acreage allotments allow for voluntary participation in acreage reduction for wheat. If the farmer remained within the acreage allotted to his farm, based initially upon past acreage records, he was given wheat participation certificates or payments on about 43 percent of his allotment acreage. This 43 percent represented the portion of the wheat crop that was used for domestic use. There were several programs involved which provided the farmer with rewards for diverting additional acreage to wheat. Initially, feed grains were allowed as a diversion crop. In 1957 57,000 acres of wheat were diverted to feed grains. This caused a glut in the feed grain market. From 1958 on, feed grains were not allowed as a diversion possibility. The feed grain program, involving corn, grain sorghums, and sometimes barley, provided compensation for reducing the feed grain acreage as well. Some advantage could be gained by farmers who participated in both programs, since by doing so they were allowed certain exchange-ability between the acreages of the two crops. There was a stipulation, however, that the 43 percent of the wheat acreage

upon which he received wheat certificate payments must be in wheat that year.

Figure 11 compares annual wheat acreage allotments for Utah with the actual wheat acreage harvested. Except for the initial curtailment in 1954 and the stimulus received from the allotment increase in 1967, there appears to be little correlation between acreage allotments for the state of Utah and the total acreage planted to wheat.

Interviews with farmers have disclosed that there are three responses to the acreage allotment program.

1. Small farmers who, in order to participate in the wheat allotment program, must restrict their acreage to an uneconomically-sized unit may quit growing wheat altogether. This has a positive effect upon acreage reduction.

2. Some farmers would normally drop out of wheat production when prices were extremely low, but because of a minimum acreage requirement, they must keep up a specified level of production in order to retain their wheat allotment. In fact, some farm leases included a stipulation that a minimum acreage be planted to wheat each year in order to preserve the allotment quota for future use. This has an adverse effect upon acreage reduction.

3. Large farms, consisting partially of leased land, may not have allotments on all the land they farm. Yet they must restrict their production to their effective acreage allotment in order to comply with the wheat program. This is not good management so they frequently abandon the program completely and raise all the wheat they can on all the land available. Thus, by maximizing total production, they hope to overcome the economic disadvantage incurred from the loss

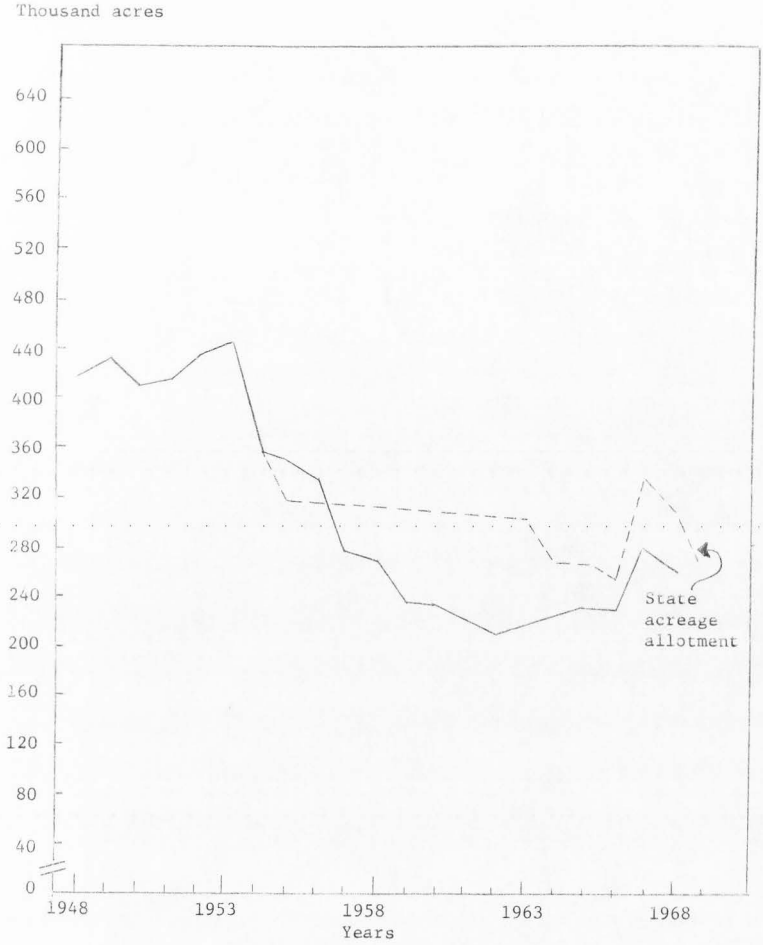

Figure 11. Acres harvested of all wheat in Utah compared to wheat allotments for Utah, 1948-1968.

of the government payment on the 43 percent of the allotted acreage. To these operators the wheat acreage allotment program is meaningless.

Several other government programs were designed to bolster the prices received for grain. The details of these programs have been adjusted and changed from year to year. Sometimes barley was included in the feed grain program; sometimes it was not. Various programs have been included to influence farmers to comply with the acreage restrictions on a voluntary basis. Price incentives have in general increased grain production in Utah while the acreage restrictions have had a decreasing effect on dryland at least. Total production of irrigated grain does not seem to be seriously curtailed by the total program.

Winter wheat

By far the most common grain grown in Utah is winter wheat. Large acreages of Utah's arable land have no irrigation water available. Such land, if carefully farmed in a wheat-fallow rotation so as to enable maximum utilization of the moisture recieved, may produce a profitable winter wheat crop every other year. Basically, the dry-land winter wheat grown in Utah is of the hard red varieties that are used for milling purposes. The price has been slightly higher for milling quality wheat than for feed wheat. Winter wheat is planted in the late summer or early fall thus reducing the spring labor requirements. While this factor relieves the labor pressure in the springtime, it also creates some problems, especially on irrigated farms. When planning a crop rotation it is extremely difficult, if not impossible, to follow late maturing crops such as sugar beets with winter wheat on irrigated land.

Acreage adjustments. Prior to 1950, winter wheat acreage had increased rapidly as additional dryland was brought under cultivation. From 1948 through 1953 there were approximately 335,000 acres of winter wheat harvested in Utah (Figure 12). In 1954, the pressure of government sponsored wheat acreage restriction programs decreased the total wheat acreage in Utah to 356,000 acres, exactly equal to the allotted acreage for wheat in Utah that year. Winter wheat production dropped 20 percent to about 270,000 acres (Figure 12). The government incentive program of 1957 paid farmers to divert acres from wheat production to other non-surplus crops. Wheat acreage declined by 57,000 acres; 51,000 for winter wheat and 6,000 for spring wheat. However, farmers simply sowed additional acres to feed grains in Utah; 52,000 additional acres of barley and 5,000 added acres of oats. The final total gave the same acreage of the four grains as was planted the year before (Figure 9).

The new soil-bank program began to take effect in 1958. Weather conditions were dry and the payment for letting land lay idle began to look very attractive for dryland farmers. A large acreage of marginal land was taken out of production through soil-bank participation from 1957 through 1960 (Figure 10). Winter wheat plantings dropped to 177,000 acres in 1959 and remained about at that level until 1965 (Figure 12). Winter wheat acreage has increased since 1965.

Yield analysis. Yields have played an important part in farmers' decisions to plant winter wheat in recent years. During the drought periods of the late 1950's the trend toward increased use of fertilizer on dryland crops was temporarily suppressed. Yields were low on dryland wheat. Since about 90 percent of all winter wheat is dryland, this reduced yield had a depressing effect on the over-all winter wheat

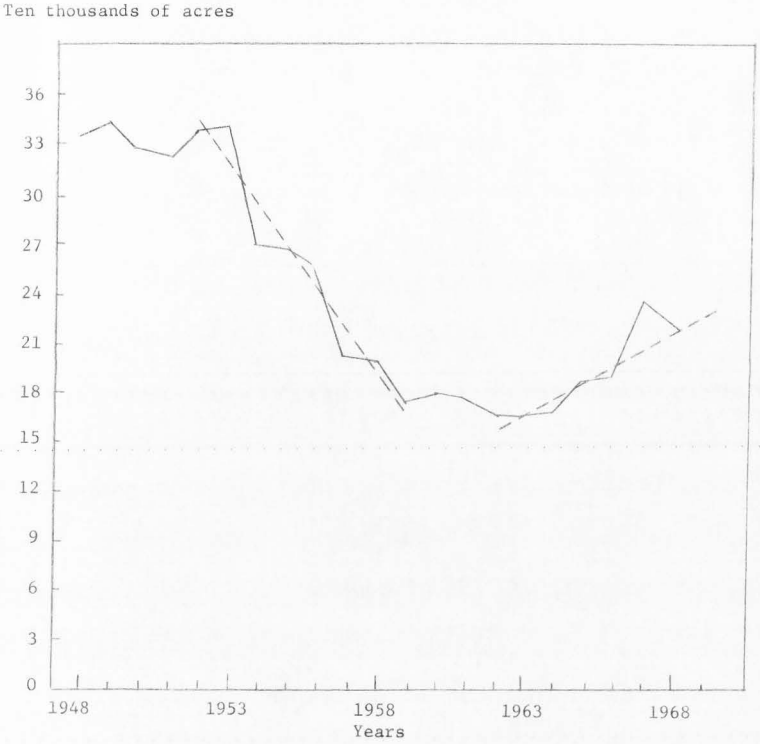

Figure 12. Harvested acreage and trend lines indicating reversal of trends in winter wheat acreage in Utah, 1948-1968.

average yields (Figure 13). In 1962 the drought was broken and yields of dryland wheat began to increase. As moisture became more plentiful, the use of commercial fertilizer, long an accepted practice on irrigated crops in Utah, began to extend to dryland crops as well.

Yields of irrigated winter wheat received a boost from another source. For years heavy yields of irrigated winter wheat had suffered severe problems with lodging. Then "Gaines" wheat was developed. Gaines is a soft white feed quality winter wheat, which under irrigated conditions will yield 100 bushels per acre or more without lodging. This new variety allowed maximum applications of fertilizer on irrigated winter wheat. Yields have subsequently been raised considerably by this development. Results of these developments are evident in the increased average yields shown since 1962 in Figure 13.

Interviews with farmers and grain handlers indicate that since 1964 the acreage of irrigated winter wheat has increased more rapidly than that of non-irrigated. There are several reasons for this shift. One is the increased use of sprinkler irrigation in Utah. With sprinkler irrigation, lands formerly impossible to irrigate can now be irrigated from nearby water supplies too low for use by flood irrigation. This practice has increased the irrigated winter wheat acreage as it reduced the dryland wheat acreage.

The price of wheat has shifted in recent years. In 1963 the average price received for winter wheat (milling wheat) was $3.50 a hundredweight while the price of feed wheat was only $2.00 a hundred. In 1968 and 1969 milling wheat and feed wheat sold for about $2.00 a hundred. Either one was mixed readily with barley in feed rations. Since Utah produces only about a third of the feed grain that is fed

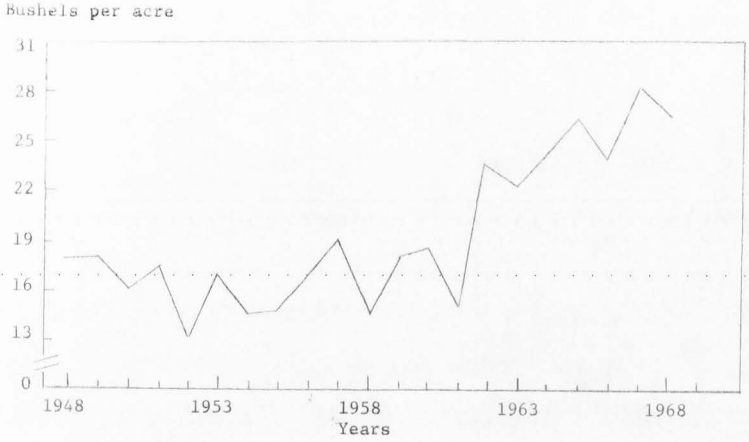

Figure 13. Average yields in winter wheat in Utah, 1948-1968.

in Utah and since the livestock industry has made such rapid gains in the west, there is a strong market for feed wheat. This price adjustment has encouraged the production of irrigated Gaines wheat in competition to barley and other crops on irrigated land.

Statistical analyses. Simple regression analysis was made plotting acres of winter wheat against various independant variables with the following results:

Against drought index . . . . . r = .8

Against yields in year previous . . . r = .53

Against yields not staggered . . . . r = .88

Against price received for wheat . . . r = .55

Against participation in wheat program . r = .4

Against state wheat allotments . . . . r = .8

(since 1954)

These analyses would likely have been more significant if the acreage of dryland wheat could have been separated from that of irrigated wheat, but detailed records of this division were not available. However, these results may indicate that some factors are significant. Drought certainly affects the planned plantings of winter wheat on dryland and furthermore, an extremely dry fall would cause low germination and light stands. This would encourage more wheat acreage abandonment in the spring which would in turn cut harvested acreage.

It may be that last year's yield of winter wheat would have less effect upon next year's harvestings than the prospects for a good yield next year would. Thus, the staggered yield comparison was of little significance while the direct comparison was more meaningful. The participation in government programs did have some effect upon those who were

under the program. An example of this was the encouragement and increased acreage allotment in 1967. A definite rise and fall followed the allotment changes in that period.

In analyzing wheat acreage plotted against acreage of barley, a correlation coefficient of -.73 indicates only a slight negative relationship. Many confounding variables, for which empirical data are not available, may tend to conceal what otherwise may have shown a much higher correlation.

Spring wheat

The varieties of spring wheat grown in Utah are all soft white wheat. These wheats can be used for livestock feed or for pastry flour or some may be mixed with hard red milling wheat and used for all-purpose flour.

Acreage trends. In 1948 there were 80,000 acres of spring wheat grown in Utah. About 73 percent of this was grown on irrigated land. The total acres harvested in Utah increased about 4 percent per year from 1948 through 1953 (Figure 14). A decline of 18,000 acres occurred in 1954 due to government acreage allotment restrictions. This downward trend continued at the rate of about 6.7 percent per year until 1962 when the downward trend was temporarily broken. Since 1962 acreage has been up and down but generally has leveled off at about 37,000 acres (Figure 14).

Yields. There appears to be no noticeable trend in yield during the period, as indicated in Figure 15. These data include both irrigated and dryland spring wheat. The relative ratio of each has changed over the period. In 1948, 73 percent was irrigated. By 1954 only 54 percent was irrigated. In 1959 irrigation accounted for 65 percent and

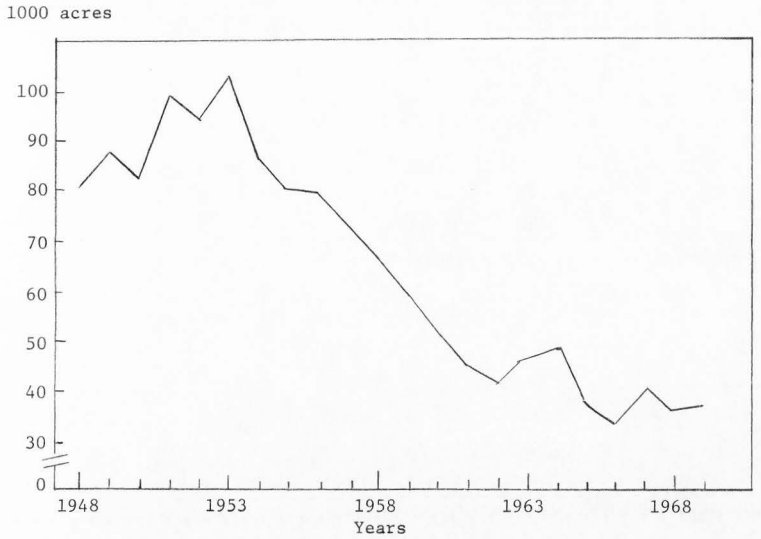

Figure 14. Harvested acreage of spring wheat in Utah, 1948-1968.

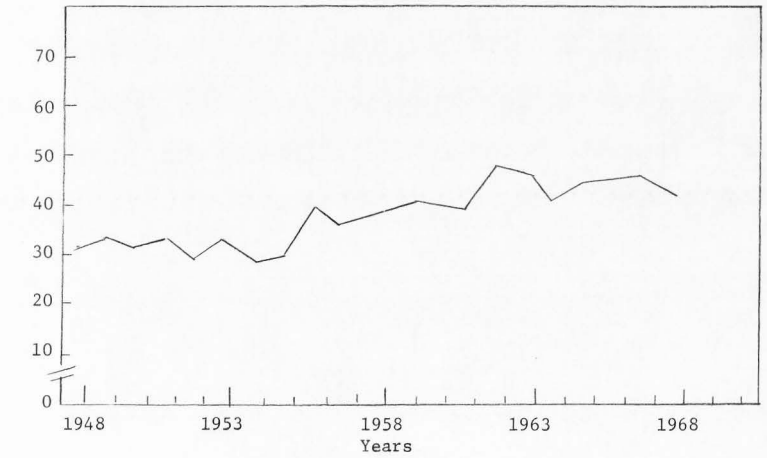

Figure 15. Average yields of spring wheat in Utah, 1948-1968.

by 1964, it had fallen to 51 percent. One thing is noticeable. The average yield has increased over the period.

Average yields of irrigated spring wheat are much lower than the average yields obtained from Gaines winter wheat. Hence, if there were any competition between the two, the Gaines wheat would prove most profitable. No significant breakthroughs have been made in the development of new varieties of spring wheat. Hence any increases in yields that are realized must be gained through improved cultural practices such as weed control and fertilizer use.

Analysis. A simple regression analysis was conducted with acres planted to spring wheat from 1948 to 1968 as the dependent variable and price per bushel received by farmers for the previous years as the independent variable. No correlation was found between 1948 and 1953, but from 1953 to 1968 the correlation coefficient between the two was found to be 71 percent. Other tests were made comparing acres planted with yields, also with one year lag; with government acreage allotment, and with acreages of barley and oats. No significant correlation was found in any of these tests because of confounding influences. There is some interchangeability between spring wheat and barley, since both are spring grown and are also used as a livestock feed. Until recent years profitability among irrigated crops was higher for spring wheat than it was for either barley or winter wheat. However, recently, winter wheat profitability increased due to increased yields and winter wheat seems to be replacing both barley and spring wheat in planted acreage.

Spring wheat is frequently planted upon land originally sown to winter wheat or other crops that have suffered damage from poor

germination or winter kill. Also, spring wheat, when sown only one bushel per acre, is equally acceptable with oats as a nurse crop in establishing alfalfa stands. Both of these factors are independent of price of grains or of government programs.

Barley

Barley has been a popular feed grain for many years. It is used in dairy feeds, in beef, hog, and lamb fattening rations and in poultry feeds. The strongest competition for these markets in Utah comes from imported milo, corn and home grown feed wheat.

Barley has one practical advantage over wheat. Since barley has the shortest growing season of all the grain crops, it is valuable as a replacement crop, for crops that must be abandoned in the late spring. Winter wheat crops may be lost because of low germination in the fall or through winter kill. Early seeded crops such as sugar beets suffer when cold spring weather slows germination or prevents timely seeding. Barley is an ideal crop to replace these losses.

Trends. Harvested acreage of barley in Utah has varied widely from year to year with a peak acreage in 1957, when government programs created incentive to shift 50,000 acres to wheat land to barley (see discussion in section on government programs). Since 1957, although year to year variability is not quite so pronounced, the acreage trend in barley has been downward (Figure 16).

Figure 17 shows that average yields since 1952 have varied widely from year to year. The mean yield from 1948 through the drought years of 1958-1961 remained relatively stable at about 45 bushels per acre. From 1962 through 1968, the variability from year to year continued

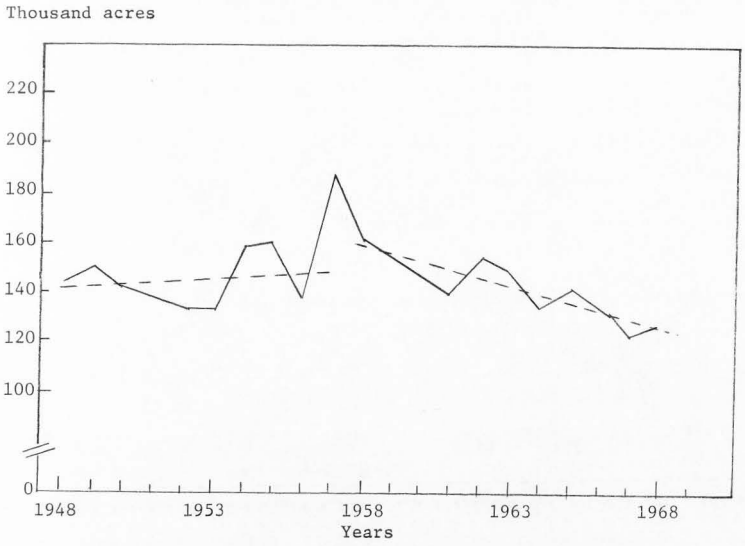

Figure 16. Harvested acreage and trend lines indicating reversal in trend of barley acreage in Utah, 1948-1968.

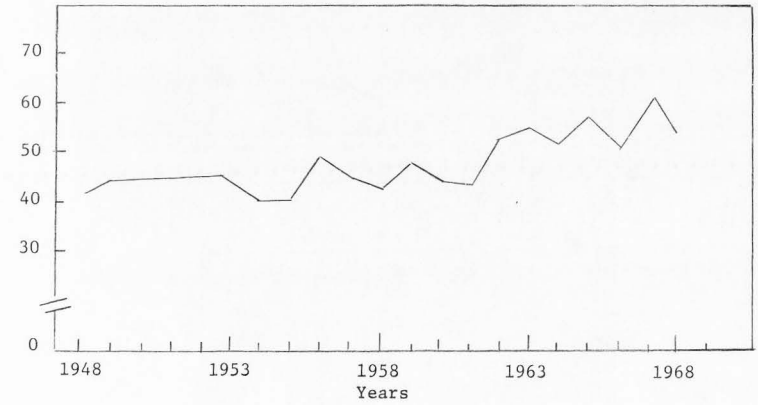

Figure 17. Average yields of barley in Utah, 1948-1968.

but the trend in yields turned slightly upward. In 1967 average yields of barley reached a peak of 60 bushels per acre. The higher yields of the last 6 years may be attributed to improved agricultural methods, increased use of fertilizer and the expanded use of 6-row barley varieties in irrigated crops. The sudden jump in yields shown in Figure 17 for the years 1961 and 1962 and after may be explained by the adverse moisture conditions of 1958 through 1961 as explained in the winter wheat yield adjustments of the same period.

Analysis. Regression analyses were run with acres of barley harvested as the dependent variable and independent variables with results (taken one at a time) as follows:

Price of barley the previous year . . . not significant

Prices of wheat the previous year . . . not significant

Yields of barley the previous year . . . not significant

Acres sown to spring wheat the same year . not significant

Acres sown to winter wheat the same year . coefficient of correlation of -.73.

Three circumstances of substitution partially explain this negative relationship between barley and winter wheat acreages. First the substitution of barley for acres of wheat abandoned because of winter kill. Second, the competition, especially in recent years, between barley and feed wheat for the livestock feed market. Third, the substitution of barley for wheat or vice versa as influenced by government grain programs. As Gaines wheat takes over more and more of the livestock feed market, these latter relationships may become more significant.

Oats

Oat production is a minor grain enterprise in Utah. Although 73 percent of all oats harvested comes from irrigated land, average yields show that irrigated oats yield only one bushel per acre above those of all oats. This indicates that irrigated oats are being planted on poorer quality land or are used as a nurse crop for hay seeding. If this were not so, the relative unprofitability of oats compared with barley and wheat would eliminate it as a crop altogether. Therefore, oats must be considered as an independent crop, non-competitive with other grains. Besides human consumption, oats are used for horse feed and calf ration. Each of these affect the demand for oats in the state.

Trend. The general trend of oats harvested in Utah since 1948 has been downward. From the peak of 51,000 acres in 1950, the acres of oats harvested dropped 13,000 acres by 1951. Another major drop took place from the high peak in 1957 of 39,000 acres to 23,000 in 1959. Since that time oat production has leveled off at about 21,000 acres (Figure 18).

Analysis. A multiple regression analysis was run with acres of oats as a dependent variable and the horse population of Utah (Figure 19), and the numbers of milk cows on farms in Utah (Figure 4) as the two independent variables. The results of this test showed the multiple coefficient of determination R^2 to be .84, indicating a significant relationship involved. Simple regression analysis was done between acres of oats and number of horses in Utah. The coefficient of correlation between these two was found to be +.72, indicating a positive relationship between the two. In making these analyses, the year 1957 was omitted. In 1957, wheat acres were diverted to oats and barley

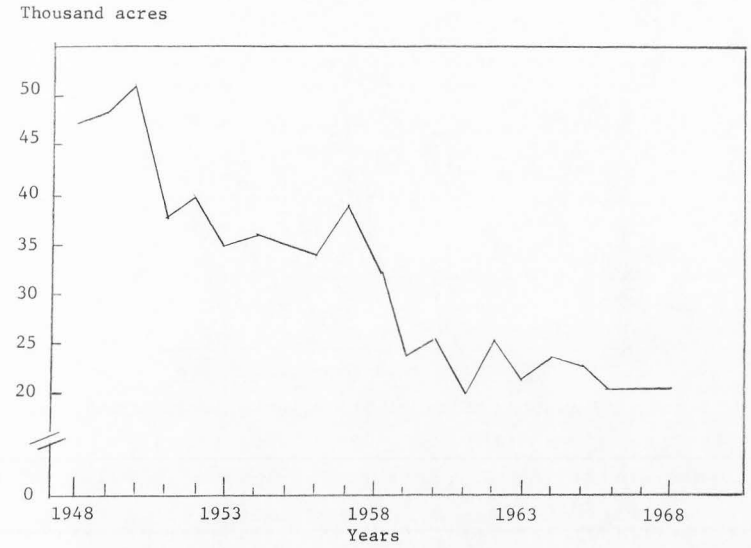

Figure 18. Harvested acreages of oats in Utah, 1948-1968.

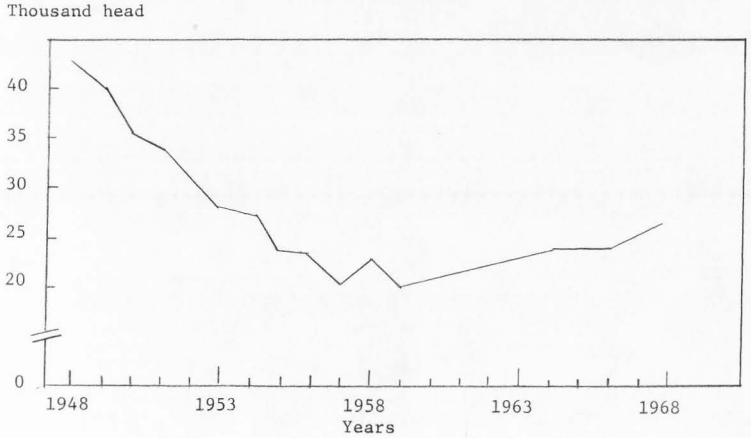

Figure 19. Population of horses and mules in Utah, 1948-1968.

under the government Crop Diversion Plan, and the acres of oats jumped to 5,000 but by 1958 the acreage was reduced to the previous level.

"Oats for the horse," tells some of the story of oat production in Utah. Forty years ago there was an average of about five horses and mules per farm in Utah. By 1948 this rate had decreased to three horses per farm. Oats were still in demand as the primary feed concentrate for farm horses. However, as farm mechanization progressed, the draft horse almost vanished from the scene. By 1957 the horse population had dwindled to about 20,000, or an average of one horse per farm. As draft horses were disappearing, a greater interest was developing in riding stock. Horseback riding became a hobby of young and old. Many urban families also acquired a horse for pleasure. Since 1959 horse numbers in Utah have been steadily increasing at the rate of nearly a thousand horses a year (Figure 19).

Dairy cattle numbers have been decreasing since 1959, which has in turn caused a decrease in the demand for calf feed. Thus, the two opposite influences have resulted in an almost stable demand for oats since 1959 as is indicated by the leveling off of the decline in oat acreage since that time.

Interviews with farmers who grow oats have indicated that on higher quality land oats are grown in small patches and only enough to supply the farm with needed oats for feed.

Intensified Cash Crops

The production of root crops, canning crops and fresh vegetables requires the intensive application of labor and capital to land resources, with the objective of increasing cash returns per acre.

Utah's small irrigated farms with their large supplies of family labor presented ideal conditions for the establishment of root crops, vegetable and fruit enterprises. A reasonable cash return might be expected per acre under these conditions.

Then other irrigated areas with longer growing seasons began to expand production of these crops through the increased use of commercial fertilizer and modern technology. Modern methods of specialized transportation increased the threat to Utah producers. The industrial development accompanying defense oriented industries that were established in Utah during and following the second World War increased the opportunities for labor in industry and the surplus farm labor was soon syphoned off to more lucrative employment. All these developments spelled problems for Utah producers of labor intensive crops.

Sugar beets

Historically, sugar beet production has offered an attractive cash income for farmers. Sugar beets were originally introduced into Utah because they were a profitable crop due to the high price of imported sugar. The first successful attempt at establishing the sugar beet industry in Utah was at Lehi in 1890.

Plantings of sugar beets in Utah reached a peak in 1920 of 113,000 acres. At that time, nineteen sugar processing plants were operating in the area (3). Prior to 1920, Utah supplied about 1/5 of the nation's beet sugar (1). Then, while other areas in the United States continued to expand production of sugar beets, Utah's production began a long decline. By 1949 there were 29,000 acres of beets grown in Utah (21).

Trends. Sugar beet acreage in Utah has remained relatively constant at about 30,000 acres from 1948 through 1968 (Figure 20). This contrasts to the upward trend of total sugar beet acreage for all of the United States (Figure 21). The average size of sugar beet enterprises in Utah has gradually increased from 10 acres in 1948 to 33 acres per enterprise in 1968 (Figure 22). From 1948 to 1968, the average annual yield of sugar beets in Utah has shown a general improvement from a high in 1949 of 16.6 tons in the beginning of the period, to a peak of 19 tons in 1968 (Figure 23).

Yield variation. During the period from 1948 through 1968, adverse weather conditions caused five abnormally low average crop yields in sugar beets. In 1948, 1952, and 1964, cold wet spring weather delayed seeding and caused poor germination, late crops, and severe weed encroachment in most sugar beet fields. In 1958 extremely high temperatures and drought conditions prevailed. Leaf hoppers from the desert areas spread curley top disease across beet and tomato fields causing severe losses and abandonment. Drought conditions continued through 1959 and 1960, and by 1961 the supply of storage water in many central Utah irrigation storage dams was drastically reduced. Sugar beet acreage was severely cut in these areas, but even then the water supply was insufficient to provide adequate irrigation for the remaining acres and major losses resulted.

The following table indicates the crop abandonment due to the critical conditions of these five low yield years:

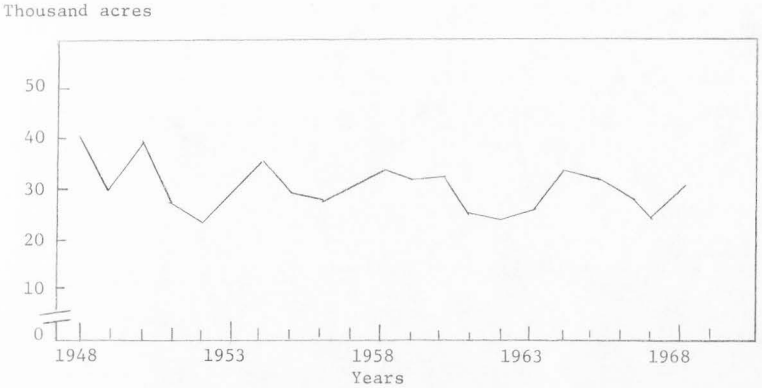

Figure 20. Planted acreage of sugar beets in Utah, 1948-1968.

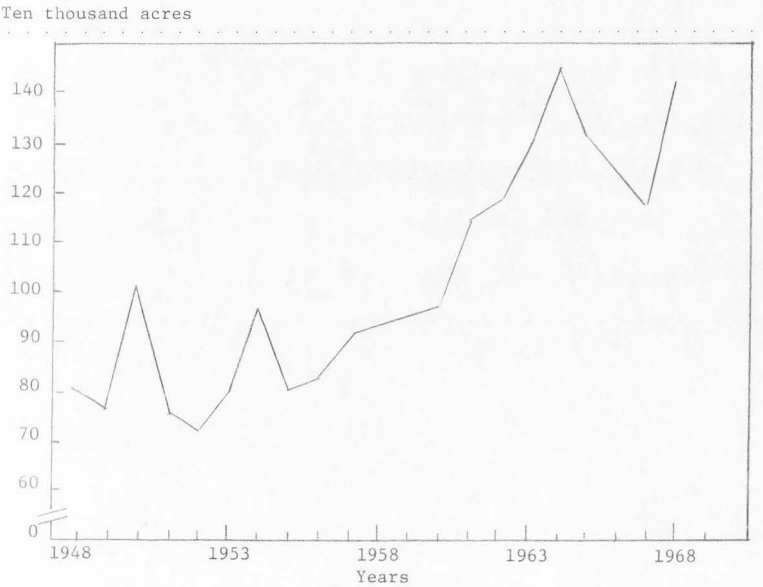

Figure 21. Planted acreage of sugar beets in U.S.A., 1948-1968.

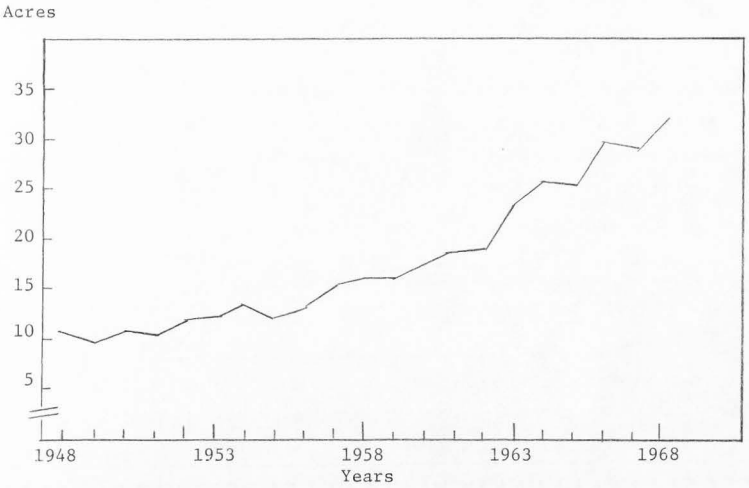

Figure 22. Average acreage per sugar beet enterprise in Utah, 1948-1968.

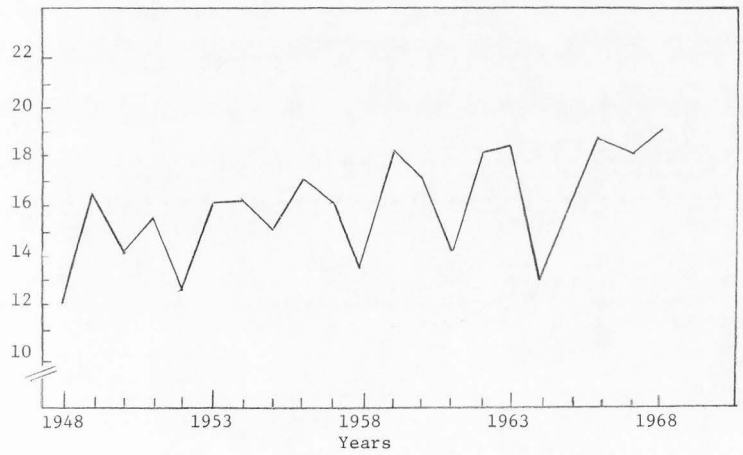

Figure 23. Average yields of sugar beets in Utah, 1948-1968.

Table 7. Total sugar beet abandonment in major loss years and average of all years from 1948 to 1968 in Utah

Acres	1948	1952	1958	1961	1964	Average for the other 16 years
Acres planted	40,000	23,000	34,200	25,130	33,750	
Acres harvested	35,000	20,400	31,500	22,700	32,000	
Acres abandoned	5,000	3,000	2,700	2,470	1,750	350
% of crop abandoned	12.25	13	8	10	5.2	.12

Source: Agricultural Stabilization and Conservation Service records.

Analyses. Total acreage planted to sugar beets in Utah has not changed over the period studied. However, there has been a constant adjustment within the industry and only the total acres has remained unchanged. Older sugar producing areas that have been in production for a half century decreased in acreage, while newly developed lands have come into sugar beet production.

Several factors have influenced this change. Wherever sugar beets have been grown over long periods of time, nematode infestation has usually occurred. Since complete irradication of the pest is not possible, the older sugar beet areas in Utah must learn to live with it, either by rotating beets with other crops or applying expensive fumigation to the soil every year. The use of crop rotations effectively reduces the sugar beet acreage available each year. This emphasizes the handicap, already facing sugar beet expansion, caused

by Utah's small farm ownership patterns and small field irrigation layouts. Large fields and large enterprises are essential to the successful adoption of efficient technological improvements so necessary to profitable sugar beet production today.

Table 8 lists several factors influencing sugar beet production and shows the comparative changes that have taken place in these areas in the seven sugar beet producing counties. Box Elder and Utah Counties have made substantial net gains over the period studied while all other counties have lost acreage in sugar beet production.

Box Elder, Davis, Salt Lake, Weber, and Utah Counties are the most productive counties in the state with sugar beet yields averaging 18 tons or better per acre over the period studied. Because of the shorter growing season and greater frost uncertainty, Cache and Sevier Counties averaged about 2 to 3 tons per acre less than the above five counties. This partially explains the reduction in sugar beet planting in the latter areas in the past 20 years.

Decreases in the number of potential sugar beet acres is a limiting factor on the total acres of sugar beets planted. While irrigated acreage does not always reflect the sugar beet acreage potential in the five most productive counties, it does become a significant factor. Total irrigated acreage is the result of two opposite influences, the loss of irrigated land to urbanization on the one hand, and the addition of new agricultural areas through reclamation irrigation projects on the other. Davis, Weber, and Salt Lake Counties and the Wasatch Front part of Utah County have lost sugar beet potential acreage as industrialization and housing developments push into choice agricultural areas. This is evidenced by the increase in population in these areas partially

Table 8. Factors affecting sugar beet production in seven counties and the state of Utah

	Unit	Box Elder	Cache	Davis	Salt Lake	Sevier	Utah	Weber	State
Change in sugar beets planted, 1965-68 average over 1948-51 average	Percent	+25	-19	-12	- 24	-74	+12	-19	- 9
Change in total irrigated acres in 1964 over 1949	Percent	+29	+ 5	0	- 49	- 8	+ 2	-37	- 5
Change in population between 1950 and 1960	1000's	+ 5.3	+ 2.3	+34	+108	- 5	+25	+27	+202
Average irrigated acreage on irrigated farms, 1964	Acres	90	66	51	50	82	47	44	77
Average size of sugar beet enterprise, 1948-51	Acres	14	7.2	10.6	10.8	13.2	7.6	7.6	10.4
Average size of sugar beet enterprise, 1964-68	Acres	37	17.5	14	33	23	28.7	23.5	28.5
Average age of farm operators, 1965	Years	50.2	51.7	52.2	51.9	52.4	51.3	51.1	51.0
Percent of operators over 54 years of age, 1964	Percent	37.4	43.7	43.6	40.8	47	41	37	40.6
Average yield for census years and 1968	Tons per acre	17.5	14.5	17.4	17.5	14.5	16.6	17.6	17

Source: A.S.C.S. yearly reports, Census records.

shown in Table 8.

In Davis, Box Elder, and Utah Counties, reclamation projects have tended to offset losses of irrigated land to other uses, but both Salt Lake and Weber Counties have had a net loss of irrigated acreage. Portions of Utah County southwest of Utah Lake and west of the Jordan River have a major advantage because of the newly irrigated acreage there. These areas have fewer restrictions of nematode infestation, farm size, and irrigation patterns and are usually operated by younger men with the result that large sugar beet enterprises have been organized so that modern machine methods can be used efficiently. For example in 1968, seven sugar beet producers in the Goshen area averaged 265 acres of sugar beets per farm on new cropland by sprinkler irrigation, while the average size of enterprises for the rest of Utah County was 21.4 acres (6). If these new lands were subtracted from the Utah County statistics, sugar beet acreages for Utah County would likely have shown a decrease somewhat comparable to Salt Lake County over the past 20 years.

Box Elder has the highest accumulation of positive factors influencing sugar beet production. It had an increase of 29 percent in total acres irrigated in 1964 over 1949. The average size of irrigated farms in Box Elder County is 90 acres, the highest average of any county in the state. The average percentage of farm operators over 54 years of age is only 37 percent, compared to an average of 40.6 percent for the state. In the period noted, Box Elder had the least increase in population of all the heavy sugar beet producing counties, indicating the pressure of urbanization has been less severe in this area (Table 8). These positive factors influencing production

tend to explain the planting of 10,913 acres of sugar beets in Box Elder County in 1968 making the 1965-1968 average an increase of about 25 percent over the 1948-1951 average (Table 8).

Statistical tests. Correlation tests were made using acres planted to sugar beets in 1948-1968 as the dependent variable with the following independent variables: the price of sugar beets, the acres of sugar beets abandoned, and the yield of sugar beets, all with one year lag; and against corn silage acreage and acres of sugar beets planted in the United States as a whole the same year. Neither simple regression nor multiple regression analyses showed significant correlation in any of these combinations. In analyzing average yields, a simple regression analysis was run plotting tons of sugar beets per acre against the drought index drawn up by the Utah State Weather Bureau (9). No significant correlation was found.

Sugar beet acreage allotments. From 1948 to 1959, acreages planted to sugar beets in the state followed closely the government proportional allotments allowed. In 1960 government allotments were increased about 10 percent, but Utah producers failed to plant all the acres allowed. The allotment program was discontinued in 1961 due to the cutback in the sugar supply following the Cuban crisis. Farmers in other areas of the United States increased production by more than 50 percent in the following four years. Utah farmers, on the other hand, reacted quite the opposite. As long as the allotment was in effect, it was desirable to preserve it by planting sugar beets, but once the allotment was dropped, Utah producers responded to other pressures and reduced acreage by 28 percent to about 23,000 acres and remained at about that level for three years. The re-instating of the

proportional allotment in 1965 and 1966 seemingly had little effect upon sugar beet plantings in Utah.

Government allotment programs may have prevented some of the normal adjustments in sugar beet plantings, but the drop in acreage which occurred in 1961 cannot be fully attributed to the reaction of farmers to the removal of government allotment restrictions. In 1960 acreage allotments were increased, but producers failed to respond by increasing sugar beet plantings. The major sugar beet producing counties, including Box Elder, Cache, Davis, Salt Lake, Utah, and Weber, increased acreage slightly in 1960 over 1959 as would normally be expected. But in other counties, such as Carbon, Millard, Sanpete, and Sevier Counties, where water was a limiting factor, producers were forced to reduce sugar beet acreage due to the drought conditions which existed from 1958 through 1961.

Canning tomatoes

The tomato canning industry grew steadily from 1920 to 1942 when a peak of 8,800 acres were grown. Because of adverse weather and a short growing season in Utah, other areas, principally California, have a comparative advantage over Utah producers. The abundance of family labor and the small irrigated farm pattern in Utah combined to make tomato production attractive to Utah farmers prior to 1948. In 1948, there were 6,400 acres of tomatoes grown in Utah.

Trend. The general trend for tomato acreage from 1948 to 1968 was downward. Major decreases have occurred from 1958 to 1960 and from 1962 to 1966 (Figure 24).

The trend in yield of tomato crops has been upward from 10.8 tons

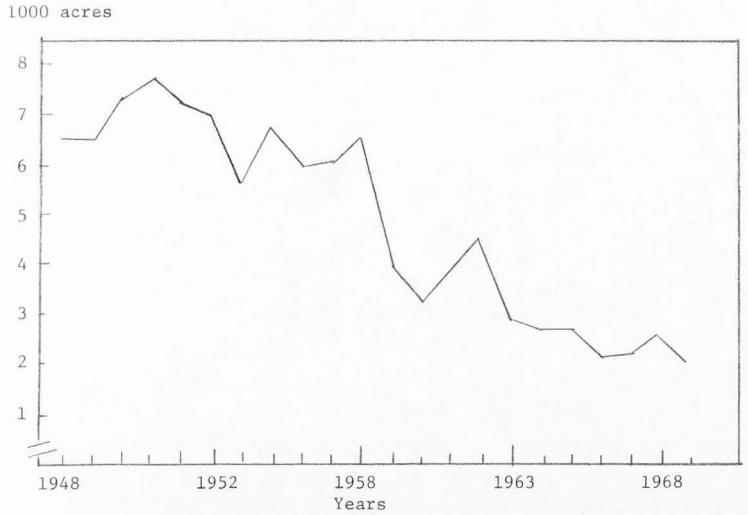

Figure 24. Acres planted of canning tomatoes in Utah, 1948-1968.

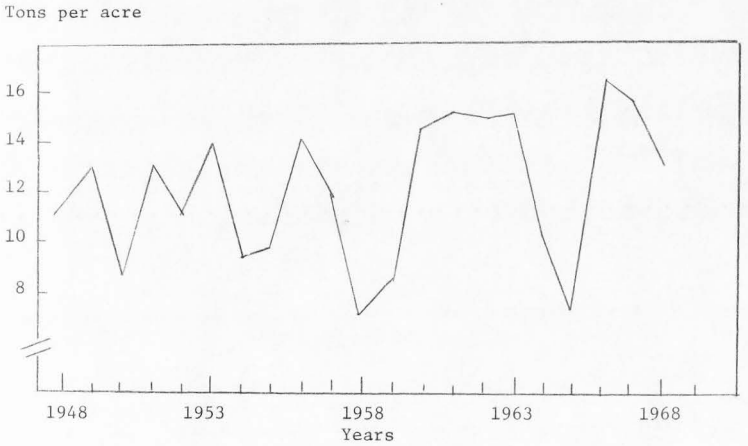

Figure 25. Average yields of canning tomatoes in Utah, 1948-1968.

per acre average at the beginning of the period to 13.4 tons per acre average for the last of the period. However, average yields are highly variable from year to year. For example, in 1955 the state average yield was only 7 tons per acre but in 1966 the average yield was 16.6 tons per acre.

Analysis. In five years, 1950, 1954, 1958, 1959, and 1965, the average yields were drastically reduced (Figure 25). Several factors contributed to these low yields. In 1965 and 1959, spring plantings were delayed by damp weather. Harvests were also late and in each case were cut off abruptly by severe frost in several areas. In 1965, a shortage of harvest labor aggrevated the harvesting problem.

The year 1958 was a disastrous year for tomato producers in Utah (11). In the summer of 1957 and the following winter, weather conditions allowed a major build-up of leaf-hoppers in the Utah desert lands. The hot dry summer of 1958 created the ideal environmental conditions for these pests to migrate to crop lands adjacent to desert areas. These leaf-hoppers carried the virus responsible for "curly-top" in tomatoes, and before harvest time most of the tomato crop was destroyed. That year, 4,500 out of the 6,500 acres planted to tomatoes were abandoned. The remaining crop averaged only 7 tons per acre. Gross returns per acre on the harvested portion of the crop averaged only $167 per acre, about $90 per acre short of paying the costs of production of an average crop (16).

In 1959, the total acreage of tomatoes planted was down $2,400 acres from 1958. Then as a result of low yields in 1959, farmers again reduced the acreage in 1960 by 1,200 acres to 3,300 acres. An attempt was made by canning companies to encourage farmers to stay

in tomato production by waiving the interest on outstanding debts owed to the company for seedlings in 1958 for those farmers who stayed in tomato production. This may have contributed to the increased plantings of 1961 and 1962, but the downward trend continued after 1962 at an increased rate.

Statistical analyses. Simple regression analyses were used to test acres planted to tomatoes as the dependent variable with the following as independent variables: yield of tomatoes, profitability of tomatoes, profitability of sugar beets, profitability of corn silage (all with one year lag), acres planted to corn silage, and acres planted to sugar beets. No significant correlation was found in any of these combinations.

Factors of influence. Personal interviews with tomato producers and field men indicated that decisions to grow tomatoes in Utah were influenced by: the age of farmers, the size of fields and farms, uncertainty caused by adverse weather conditions, and various problems pertaining to the hiring and housing of transient labor. There is also a growing reluctance among farmers with a dependable income from off-farm employment to risk heavy investments in tomato or vegetable crops that have high uncertainty factors.

The greatest problem in tomato production is the competition from California growers who have natural comparative advantages over Utah in these four general areas.

1. Planting. Because of the short season in Utah, tomato plants must be imported and transplanted into the fields. This operation costs about $90 per acre. California growers plant to stand in the fields and avoid much of this cost.

2. Harvesting manpower. Tomato harvest has always been a labor intensive operation. This requirement initially gave Utah producers a relative advantage because of the family labor available. With the increase in off-the-farm employment opportunities, however, this source of labor disappeared and migrant workers had to be hired to do the job. As government regulations regarding housing and wages of migrant labor became more rigid, labor costs spriralled. This, plus the cancellation of the Bracero Program which had allowed importation of Mexican labor, placed additional pressure on growers to mechanize. The development and subsequent adoption of the mechanical picker and tomato varieties to go with it, only widened the gap between Utah production costs and those of California. The mechanical tomato harvester requires 16 to 18 workers to ride on the machine constantly sorting the tomatoes as it picks. Such bulky equipment operates most efficiently on long rows in fields of 20 or more acres. Utah's average tomato enterprise is only about ten acres. Some mechanical harvesting was experimented with in Utah in 1968.

3. Maturing. It is difficult to adapt Utah tomato production to mechanical harvesting methods. The short season and the risk of early fall frost makes it necessary to begin harvesting before the crop is totally ripe so that mechanical harvesting must begin while part of the crop is yet green. These green tomatoes must be discarded which decreases the yield and increases the harvesting costs. The use of Ethro or other growth regulators on tomato crops delays the ripening process until all the crop ripens together, but in Utah this delay increases the danger of frost damage to the entire crop.

4. Contract control. All canning crops are grown by contract. Tomato contracts are determined according to the supply situation in California. For example, the surplus of canning tomatoes that accumulated from the bumper crop in 1968 caused a cutback in contracts in Utah of about 20 percent in 1969 from the 1968 acreage. This allotment appears to be adequate to allow all growers who wish to grow tomatoes to obtain a contract.

SUMMARY

This study was undertaken to indicate and analyze some specific trends in Utah's Agriculture between 1948 and 1968 and to ascertain some of the factors affecting farmers' decisions concerning crop production on irrigated lands in Utah.

Individual studies were made of 8 selected crops: alfalfa hay, corn silage, winter wheat, spring wheat, barley, oats, sugar beets, and tomatoes. Annual crop report data from the Statistical Reporting Service and U. S. Government Census reports were used for the basis of graphs depicting annual harvesting acreages and average yields of these crops for the state from 1948 through 1968.

Acreages harvested of the various crops were considered indicative of the accumulative decisions of farmers concerning cropping plans. Where wide discrepancies were noted between planted acres and harvested acres more detailed study was directed at the possible causes of the acreage losses. Crop yields and possible factors influencing major changes in yields over time were studied to lend greater understanding of farmers' planting decisions.

Trend lines were calculated by least squares methods. Wherever the use of trend lines contributed to the understanding of relative movement in production of crops, dashed lines were added to the graphs to represent the long run trends. These secular trend lines were inserted in Figure 6, average yields of alfalfa hay, and in Figure 8, average yields of corn silage for a comparison tool between the trends in yields of these two competing fodder crops.

Where a definite trend was established early in the period of study which was reversed later on, two trend lines were calculated and entered on the graph to indicate the change and the relative slopes of the two trend lines. Such reversals in trends were entered in Figure 12, harvested acreages of winter wheat, and Figure 16, harvested acreages of barley. Trend reversals in these major crops were subjects for further study to ascertain the causes of these adjustments.

Simple regression analyses were done on all crops studied. Acreage harvested was plotted against such independent variables as price of product, annual yields of crop, yield and returns from competing crops, statistics of moisture conditions over the period and the numbers of livestock in the state that consume the product studied. Both concurrent data and data staggered one year were used. Multiple regression analyses were used where more than one independent variable appeared to be affecting the production.

Non-empirical information was gathered from interviews with farmers, field men, and men involved in the selling or processing of the product, government officials, and specialists of the agricultural department of Utah State University. Books and periodicals were also searched for information pertinent to the study. As other influencing factors were suggested through these interviews, a more thorough search was made of the statistical trends of these factors to ascertain the effect they had upon the various crops. Industrial growth and the accompanying demand for labor, age of farmers, part-time farming, size of farms, new land development, sprinkler irrigation, and irrigation patterns are some of the factors studied more deeply. Since data desired on some of these factors was not available on a year by

year basis, the census figures of counties in Utah were studied to find indications of conditions influencing the production of various crops by county.

Much more concentrated research could be done in these areas to more accurately ascertain their effects upon farm production in Utah.

CONCLUSION

The results of this study indicate the following adjustments in Utah's agriculture during the period 1948-1968.

General

Average farm size increased but net farm income per farm did not. Part time farming increased. Total irrigated acreage remained relatively constant through 1964. Acreage lost in some areas to urbanization was offset by newly developed irrigation projects.

Crops

Alfalfa hay acreage remained relatively constant at 450,000 acres while corn silage acreage increased from 20,000 to 40,000 acres. Statistical tests indicated yield was an important factor in this acreage increase. The relative profitability of corn silage increased compared to alfalfa hay. Corn silage production was also influenced by local demand much more than was alfalfa. Both crops fit well into part-time farming practices.

Winter wheat acreage decreased until 1963, but since then it has increased. Statistical tests showed a negative relationship between winter wheat and barley acreage. Barley acreage increased through 1957, then decreased. The greatest real gains in irrigated winter wheat occurred in the past 10 years through the adoption of the high yielding Gaines feed wheat. This advantage will likely continue to increase winter wheat on irrigated lands.

Irrigated spring grains have some advantages over Gaines winter

wheat in specialized uses. Spring wheat, barley, and oats are used as late spring reseeding crops after crop abandonment; spring wheat and oats as nurse crops for alfalfa seeding; oats as a horse and calf feed. After 1964 spring wheat acreages leveled off and may remain at about 34 to 38,000 acres. Oats also leveled off at about 21,000 acres and is likely to remain at this level.

Barley has declined since 1957 and will continue to decline as long as Gaines wheat is grown in open competition for the feed grain market. There will likely be a leveling off in barley acres, however, when the acreage is reached where Gaines wheat is no longer an alternative crop because of different growing conditions.

Sugar beet acreage remained about constant in Utah over the period studied. Acreage was lost in marginal areas of Cache and Sevier and Sanpete Counties and in the older established areas of the Wasatch front, but sugar beet acreage increased in Box Elder County, and in areas of Utah County in newly irrigated lands south and west of Utah Lake.

Negative factors influencing sugar beet production were: small size of farms, older age of farm operators, part-time farming practices, nematode infested land, labor shortage, loss of irrigated land to urbanization and other alternate uses, and the high risk factor due to adverse weather conditions.

The increase in sugar beet acreage depends upon the development of low cost fumigants, improvement of low-labor beet-growing techniques, new land development and the break-up of small-farm patterns of the older established areas.

Acreages in canning tomatoes have decreased over the 20-year

period. Nearly all the negative factors discouraging sugar beet growing in Utah also affect tomato production. In addition, competition from warmer areas enjoying relative advantages because of longer growing seasons is a serious problem and will become more critical as transportation facilities continue to improve. Utah tomato production will likely continue to decline.

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