AN ABSTRACT OF THE THESIS OF

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Title: OREGON'S MID-WILLAMETTE VALLEY WETLANDS: AGRICULTURAL USES, ALTERNATIVE USES, PROBLEMS AND TRENDS

Redacted for privacy

Abstract approved: Richard M. Highsmith, Jr.

The wetlands are distinguished from other lands of the Mid-Willamette Valley by excessive soil moisture. The wetlands, as defined for this study, consist of 20 soil series (in 22 soil mapping units) which are classified by the Soil Conservation Service as having excessive wetness as the major factor limiting their uses.

The five counties considered in this study, Benton, Linn, Marion, Polk, and Yamhill, have been and continue to be important to the agricultural production of Oregon. In 1977, this region produced 28.4% of the state's value of sales from agricultural products. In the same year, this five-county area also produced 100% of the nation's ryegrass, crimson clover, and red fescue seeds, and large quantities of other important seeds.

Personal interviews were conducted with 141 wetland farmers during the period January through March, 1979. The land farmed by the interviewed farmers amounted to 63,748 acres, which represented 9.8% of the 652,000 acres of wetlands in the Mid-Willamette Valley.

Farmer responses obtained from the interviews provided the data base for much of this study. Information pertaining to farm types and crops were cross tabulated with other variables using the Statistical Package for the Social Sciences at Oregon State University. The resulting statistics were evaluated for patterns of distributions and emerging trends in agricultural land uses.

Of the surveyed farmers, 73% were full-time operators; the remainder were part-time, semi-retired, or hobby farmers. There were wide variability in farm sizes, 15 to 5,400 acres for full-time farmers, and 5 to 424 acres for part-time farmers. Farms producing grass seeds, row crops, and grain were generally large in size, while farms producing tree fruits, nuts, berries, nursery products, and other specialty crops were generally small.

Although the Mid-Willamette Valley wetlands form a valuable part of Oregon's agricultural land base, the production capacity of much of the wetlands can be further upgraded by installation of drainage and irrigation systems. However, the current high costs for these resource converting systems, and the elimination of Federal cost-sharing for farm drainage projects, may make installation of these systems economically infeasible for many farmers. In early 1979, costs for installation of new drainage systems were $300 to $400 per acre. Irrigation systems cost $225 to $450 per acre, with the actual cost depending on the type of irrigation system selected.

Farmers' perceptions of factors considered to have adverse effects on their farming operations were examined for two periods: the past five years, 1974 through 1978, and the current agricultural year, 1979. For the five-year period, 64% of the farmers stated that they had experienced what they considered to be serious problems. The two primary groups of problems were those related to reduction of the farmers' net income and farm production. The third group of problems pertained to policy limitations, particularly the acreage limitations to open field burning, and government regulations, restrictions, and interference.

During the period 1977 to 1978, 10.6% of the interviewed farmers had made land use changes. The 15 farmers made 19 changes involving 773 acres. There were large net gains in acreage for legumes, and smaller net gains for row crops, peppermint, and strawberries. The largest net acreage loss was for grain. Smaller net losses occurred for grass seed and silage.

Farmers who had made land use changes rated 12 of the 19 changes as satisfactory, 3 as unsatisfactory, and 4 as not possible to evaluate until crop is harvested.

Most of the wetlands are currently limited to the production of grass seed due to the severe physical limitations. Therefore, open field burning will continue to be an important issue on Oregon's Mid-Willamette Valley wetlands.

Oregon's Mid-Willamette Valley Wetlands:
Agricultural Uses, Alternative Uses,
Problems and Trends

by

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CHAPTER I

INTRODUCTION

Introduction to the Problem

The Mid-Willamette Valley of Oregon is a major agricultural region for the state and the nation. Its agricultural land base consists of more than 1 million acres; 839,900 acres of cropland, 175,300 acres of woodland pastured, and 166,400 acres in other agricultural uses. This study concentrates on the cropland. The primary crops grown on the cropland are small grains, grass seed, pasture and hay. Other crops which are economically important, although occupying less acreages than the primary crops, are fruits, vegetables, and other specialty crops (U.S. Census of Agriculture, 1974, Vol 1, Part 37).

Agriculture in the Mid-Willamette Valley has played an important role in maintaining the economic health of the state since the early days of settlement.

However, a number of persistent problems have contributed to reducing the agricultural output below the full potential. A major limiting physical characteristic of these agricultural lands is the excessive wetness of about 650,000 acres. This physical limitation to land use has been one of the major factors in the development of the grass seed industry on the Mid-Willamette Valley wetlands. The grasses are, as a group, one of the few crops which can be grown on the wetlands. Without artificial drainage, the wetlands are unsuitable for most other crops because of wetland characteristics such as shallow rooting depths, cooler soils, and seasonal inundation.

In addition to the physical land use limitations, the farmers of this region also face a number of policy limitations in the form of new governmental restrictions. At the state level, an atmosphere of uncertainty has been created for the wetland farmers by frequent revisions on acreages allowed for field burning. Growers of grass for seed and cereal crops were the most seriously affected. The initial legislation drastically reduced the acreages allowed for field burning. Subsequent legislation generally increased the acreage limitations (Oregon Laws, 1971, 1973, 1975, 1977, and Senate Bill 472, 1979). The specifics of these laws are discussed in more detail in Chapter III.

The grass seed farmers, who make up a large portion of the farm population in the Mid-Willamette Valley, have consistently contended that field burning is necessary to control disease. Other benefits of field burning were said to be: inexpensive residue removal, weed control, stimulation of seed yield, insect and rodent control, reduced pesticide requirements, quicker return of minerals to the soil, easier crop establishment, increased fertilizer efficiency and reduced fire hazard (Oregon Agricultural Experiment Station, Special Report 476, 1977, p. 10).

Even with the uncertainty of field burning, the farmers also contended that they were unable to place their land into more profitable uses such as converting farmland to residential uses. With the passage of the Land Use Acts in 1973, state policy has been to retain prime agricultural lands in agricultural uses. Most of the wetlands fall into the state's description of prime agricultural lands. Therefore, proposals by farmers to convert their cropland to residential uses are opposed by the county planning staffs and county commissioners. The exceptions are usually for farmland which adjoins existing residential areas, are within designated urban growth boundaries, or are in areas favored for growth by the counties.

In addition to policy limitations, physical limitations also make much of the wetlands unsuitable for conversion to higher level uses. Seasonal inundation and soils unsuitable for septic systems effectively prevent changes to residential use.

Problem Statement

The study was designed to contribute to the understanding of the agricultural land uses of the Mid-Willamette Valley wetlands. This research provides information on some aspects of agricultural geography of the study area, particularly on the current agricultural land uses, alternative uses, problems encountered in current uses, problems anticipated in alternative land uses, and the developing land use trends.

Research Objectives

The objectives of this research were to:

1) determine the principal agricultural uses of the Mid-Willamette Valley wetlands;

2) identify patterns of distribution of these agricultural land uses;

3) identify and evaluate the effects of the physical and policy limitations to agricultural land uses of the wetlands;

4) locate and assess alternative agricultural land uses of the wetlands;

5) determine the reasons for success or failure of alternative agricultural land uses;

6) project futures for wetland use based on the information obtained.

Study Area

The term "Mid-Willamette Valley" as used in this study refers to that portion of the Middle Willamette River Basin contained within the five principal counties, Benton, Linn, Marion, Polk, and Yamhill (Figure 1). Portions of the basin within Clackamas, Lane, Lincoln, Tillamook, and Washington are excluded from this study. The specific study area, the wetlands of the Mid-Willamette Valley, is on the main valley floor and on the level surfaces beside the major tributaries of the Willamette River (Figure 2).

Literature Review

A number of studies have been conducted in recent years on selected aspects of the Willamette Valley. Two excellent studies completed in the 1960's focused on the

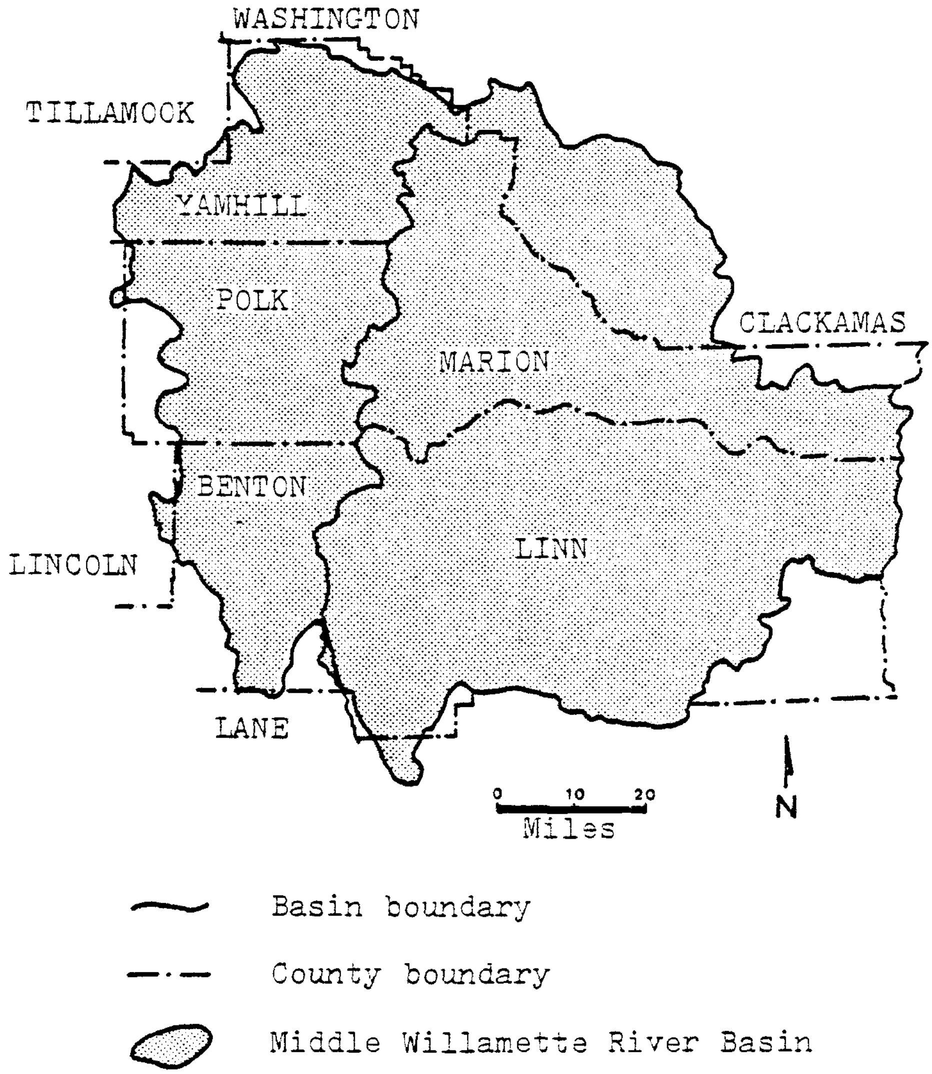


Figure 1. Middle Willamette River Basin in relation to county boundaries.
Modified after Oregon State Water Resources Board, <u>Oregon's Long Range Requirements for Water</u>, Appendix 1-2, 1969, Figure 4.

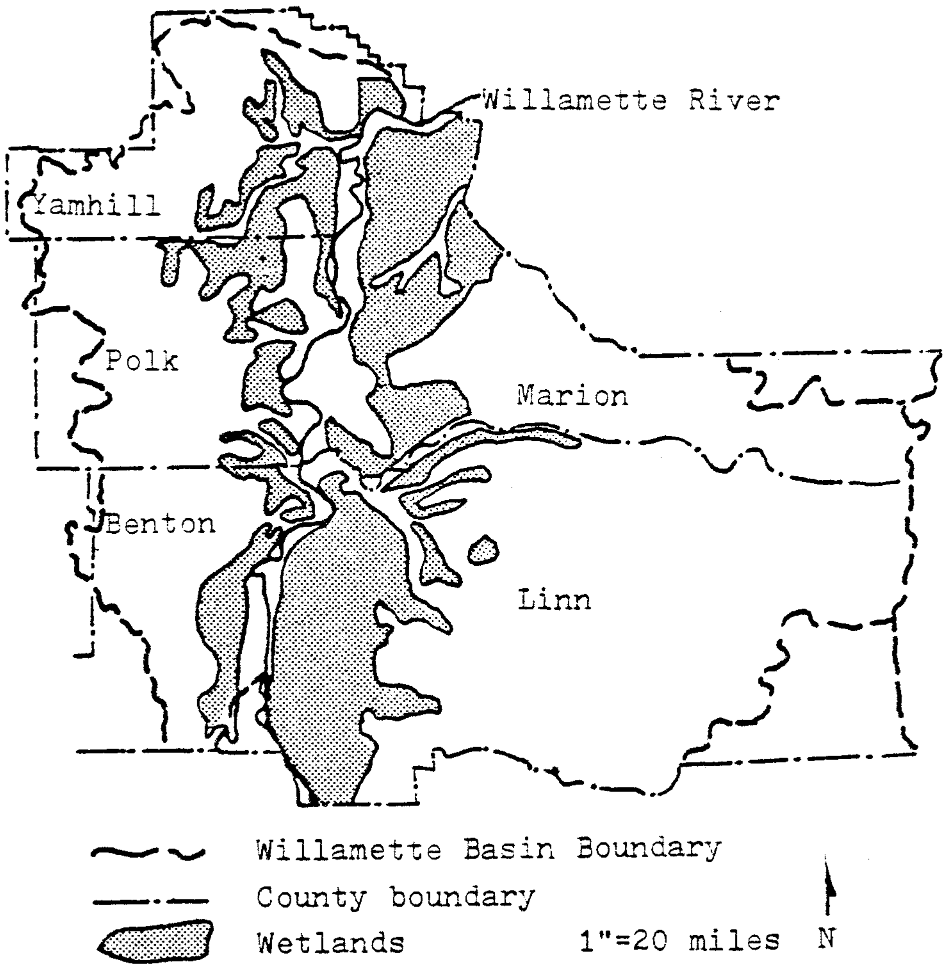


Figure 2. Wetlands of the five-county area, Mid-Willamette Valley, Oregon. Greatly simplified after Willamette Basin Task Force of the Pacific Northwest River Basins Commission, Map II-1, Soil Associations, 1967.

water resources of Oregon. The 1962 publication USDA Report on Water and Related Land Resources, Middle Willamette River, Oregon, by the Oregon State Water Resources Board and USDA provided information on water resources pertinent primarily to agriculture and to other problems as erosion, flood prevention, and drainage (USDA, 1962).

In 1969 the State Water Resources Board followed with the publication Oregon's Long-Range Requirements for Water: General Soil Map Report with Irrigable Areas Willamette Drainage Basin. This publication provided information on soil properties, qualities and interpretations. It was a forerunner to the more detailed soil surveys by counties, some which have been published and others still in the developmental stages (Oregon State Water Resources Board, 1969, Appendix 1-2, Willamette Drainage Basin).

During the past five years three studies having somewhat similar interests to this study were completed. All three studies focused on various aspects of agriculture in the Willamette Valley. The specific areas of research and the boundaries of the study area are not duplicated in this study, however.

Jack H. Blok, in his 1973 doctoral dissertation "Evolution of Agricultural Resource Use Strategies in the Willamette Valley" used the historical approach in his research and presentation. His main interest was in the development of the strategies by farmers as technology, public policy, and demands for farm goods changed from 1840 to 1973 (Blok, 1973).

George Van Otten looked at how farm sizes changed over time and how they were organized in spatial extent as holdings were increased or reduced. His doctoral dissertation "Spatial Expressions of Farm Size Changes in Polk and Linn Counties of Oregon" was presented in July, 1977 (Van Otten, 1977).

The third study used the economic approach to identify and describe a specific agricultural activity. Conklin and Fisher produced for the Agricultural Experiment Station, Circular of Information 643, Economic Characteristics of Farms Producing Grass Seed in Oregon's Willamette Valley. The chief objective of this study was to examine the factors which influenced profitability (Conklin and Fisher, 1973).

Many other studies have been conducted on various aspects of the Willamette Valley and the activities which occur within the valley. Most are unrelated or only remotely related to the research described in this paper. Some of these published material are listed in the bibliography.

This study differs from existing studies in the following ways:

1) the study area is based on soils possessing similar characteristics and limitations to uses;

2) the focus is on agricultural land uses of these wetlands;

3) the study synthesizes existing information with new information gathered by field survey;

4) the objectives of this study are to gain new information on, and the understanding of, current land uses, alternative uses, problems, and trends.

Research Design

Published Material

The main sources of information for the background and comparative purposes were government documents, publications and reports. Primary sources included publications and reports from the Bureau of the Census, USDA, The State of Oregon, Oregon State University (OSU) Agricultural Experiment Station, OSU Extension Service, OSU Cooperative Extension Service, OSU Air Resources Center, and OSU Water Resources Center.

Identification of Wetlands

For the purpose of this study, the twenty-two soil

TABLE I. SOIL MAPPING UNITS DESIGNATED AS WETLANDS.

Mapping Unit	Symbol	:	Mapping Unit	Symbol
Aloha	Al	:	Dayton, Gravel Subsoil	Ds
Amity	Am	:	Dayton, Thick Subsoil	Dt
Awbrey	Ay	:	Grande Ronde	Gr
Brenner	Bn	:	Holcomb	Ho
Chitwood	Cw	:	McAlpin	Mp
Clackamas	Cl	:	McBee	Ma
Coburg	Cb	:	Nestucca	Ns
Concord	Co	:	Semiahmoo-Labish	Se
Conser	Cs	:	Waldo	Wa
Courtney	Ct	:	Wapato	Wp
Dayton	Da	:	Woodburn	Wo

Source: Oregon State Water Resources Board, 1969, pp. 31-35.

mapping units shown in Table I were designated as wetlands.

Sampling Methods

The data collection was based on point type sampling frame using the section-center sampling technique. The study area was first divided into sections of one square mile each, based on the U. S. Land Survey System. Then the sections having more than 50% of the area consisting of the twenty-two soil mapping units listed above were designated as "wetland sections". Sections with more than 50% of the wetlands in urban, wildlife refuge or airport uses were deleted from the sampling population. The remaining wetland sections were numbered on a map overlay for identification purposes.

The numbering system began with number one as the westernmost section of the northernmost row of sections, and ended with the easternmost section of the southernmost row as the last section. The other sections were numbered sequentially from west to east, beginning with the northernmost row.

Determination of Sample Size

A preliminary sampling consisting of thirty-one randomly selected sample sections was conducted to obtain the values used in the equation below. This equation was used to determine the minimum number of samples required in the final sample size.

$N = ((Zs)/E)^2$, where the factors are:

"n, the sample size

Z, the indicator of confidence, the probability level

s, the measure of dispersion in the original population

E, is the maximum amount of difference allowable between point estimate and the true value" (Ingram, 1973, p. 150).

Substituting the values obtained from the preliminary sampling, and using a confidence level of 95% and an allowable error of 100, the final sample size required was:

$$n = ((Zs)/E)^2$$
$$= (((1.31)(770))/100)^2$$
$$= 102$$

During the initial sampling it was noted that interviews were obtainable from only about 60% of the selected sample sections. The reasons for failure to obtain interviews included farmers vacationing out-of-state, no farms or farmers at home within one mile from the center of the sample section, or refusal by farmers to participate in the survey.

To allow for the nearly 40% no-response rate, and to insure that the final sample size would be greater than 102, 250 sample sections were selected randomly from the population of 812 wetland sections. This was expected to provide about 150 samples, and 148 were actually obtained. From the 148 completed questionnaires, 7 were deleted. Six of these were outside the one-mile radius from the section centers, and one was not within the designated wetlands. Thus, the final sample size used for this study was 141.

Questionnaire

The questionnaire used in this study is found at Appendix I.

Data Processing

The questionnaire used to obtain the information was specifically designed to facilitate computer processing of farmer responses. The responses were reduced to fifty-three variables. The data for these variables were key-punched to computer cards and processed with the Statistical Package for the Social Sciences (SPSS) at the Oregon State University Computer Center. Some of the variables were grouped and re-coded during data processing to obtain cross-tabulations with other variables. Much of this study, with Chapters IV through VII in particular, are dependent on the statistics derived from farmer responses to the questionnaire.

Administering the Questionnaire

The questionnaire was administered to the farmers living closest to the center of the sample sections. The interviewer read the questions to the respondent while the respondent looked at a copy of the questionnaire. Answers were noted on the interviewer's copy of the questionnaire.

The following rules applied:

1) the interviewee must be a farmer, or if a part-time farmer, must have received part of his income from his farming operations;

2) the interviewee must have conducted his farming operations within the study area;

3) only information from that portion of the farm within the study area would be considered;

4) the location of the farm will be marked on the Oregon Department of Transportation General Highway Map, for mapping purposes only;

5) if the occupant of the farm closest to the center of the sample section is not a farmer or is not willing to participate in the survey, a notation will be made on the top right-hand corner of the questionnaire;

6) if 5 above is true or if there is no farm

within the sample section, the next closest farmer on wetlands will be interviewed. The nearest neighbor rule will follow until a sample is obtained;

7) if the closest neighbor is outside a one-mile radius from the sample section center, the sample will be rejected.

Organization

Chapter II sets the background for the subsequent chapters. The discussion centers around the factors which influence the quality of the land for agricultural production. Physical characteristics which influence the agricultural utility of the land are also considered.

Policy limitations to agricultural land uses also influence the farmers' decisions on crops to be planted. The two major policy limitations, on field burning and land uses, are described in Chapter III.

The farmers' decisions are partly seen in their current uses of farmland. These uses are examined in Chapter IV. The discussion in Chapter V focuses on the use of irrigation and drainage as resource converting techniques to upgrade the land use capabilities of the wetlands.

In Chapter VI, the farmers' perceptions of past and anticipated problems are classified and cross tabulated with variables such as farm types and county. The farmers' views of how factors affect their operations may influence their land use decisions. This idea is pursued by considering the recent land use changes, in Chapter VII.

Finally, in Chapter VIII, the entire study is summarized and the conclusions are presented.

CHAPTER II

THE LAND RESOURCE BASE

Climatic factors, soils, surface relief, and drainage stand out in distinguishing the wetlands as a land resource base from other Mid-Willamette Valley lands. These physical attributes combine to create conditions favorable to agricultural production, as well as conditions severely limiting agricultural use. These shortcomings and favorable qualities are generally shared by the twenty-two soil mapping units designated as the wetlands.

Climatic Factors

The wetlands have a maritime climate which is moderated by the Coast Range. Winters are usually mild and wet, and summers are warm and relatively dry. This mild climate provides ideal growing conditions for many plants. The temperature regime is generally comparable throughout the wetlands due to the similarity in elevation. The wetlands are in the elevational range of 100 to 350 feet above mean sea level (Table II).

TABLE II. STATION DATA.

Station	Latitude North	Longitude West	Elevation in feet	Years of Record Precip	Years of Record Temp
McMinnville	44 14	123 11	148	79	84
Salem	44 55	123 01	195	84	85
Corvallis	44 38	123 12	225	85	87

Source: NOAA, Climatological Data, Annual Summary, Oregon; 1977 (Vol. 83, No. 13).

Annual precipitation varies somewhat according to the site location in respect to the Coast Range and its rain shadow effect. However, the average annual precipitation over most of the valley is more than 35 inches (Table IIa). Salem, for example, receives 41 inches of precipitation, eighty percent (32.93 inches) of which fall in the six-month period, October through March, and twenty percent (8.15 inches) in the other six-month period, April through September (Figure 3).

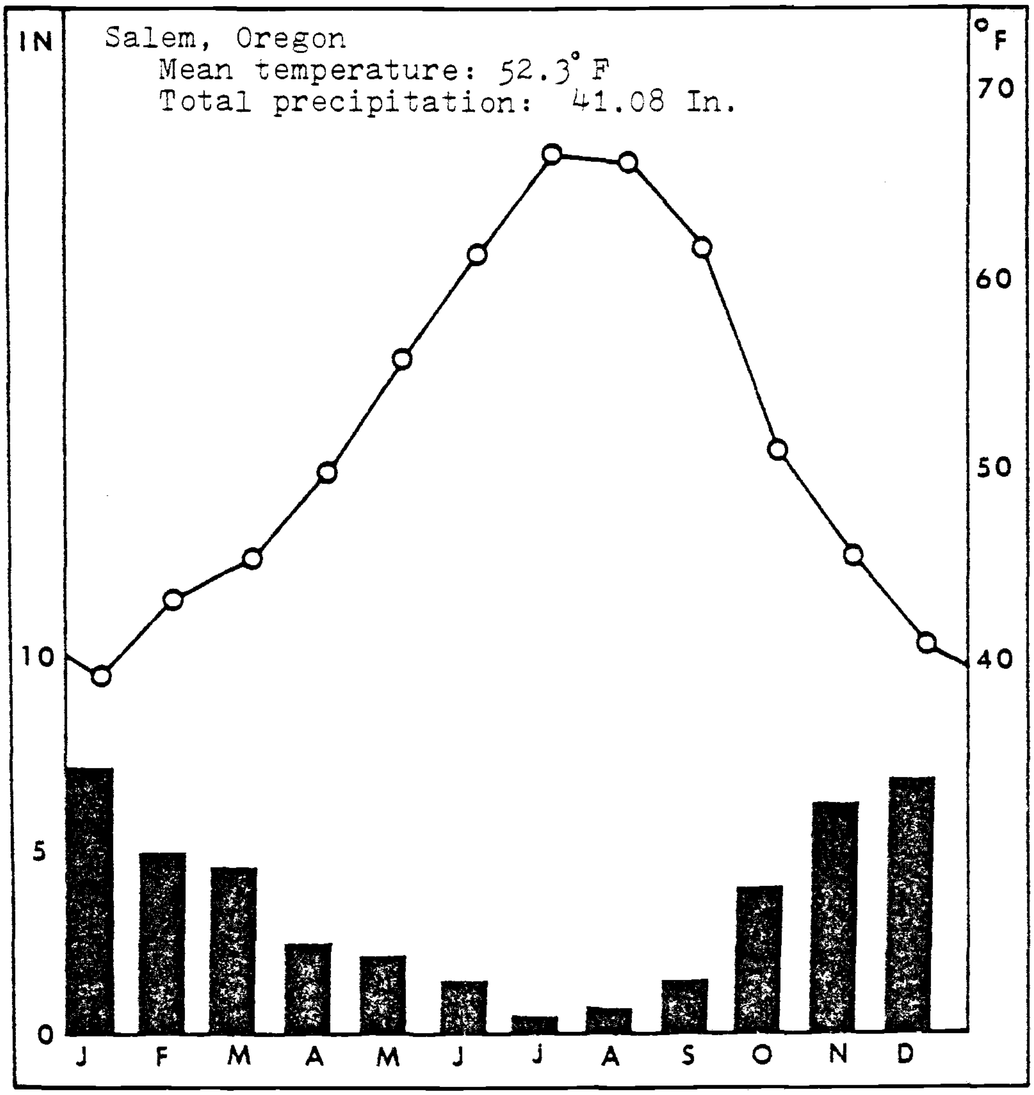
Most of the precipitation fall in the form of low-intensity rain. Only about two percent of the precipitation fall as snow. During the summer months, the precipitation is usually associated with light rainstorms and thunderstorms.

The average frost-free period is about 200 days. This long growing season, in combination with mild winters, permit the cultivation of many different crops.

TABLE IIa. AVERAGE MONTHLY TEMPERATURES AND PRECIPITATION FOR MID-WILLAMETTE VALLEY STATIONS

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
McMinnville	Deg F	38.4	42.8	45.3	49.9	55.6	60.6	65.2	64.9	61.0	52.6	45.1	40.8	51.9
	In.	7.33	5.17	4.63	2.37	1.86	1.17	0.41	0.64	1.58	4.11	6.83	7.45	43.55
Corvallis	Deg F	38.8	43.1	45.4	50.1	55.7	61.0	65.9	65.8	62.0	53.2	42.9	41.0	52.3
	In.	7.06	4.63	4.20	2.05	1.77	1.11	0.33	0.55	1.31	3.78	6.04	6.83	39.70
Salem	Deg F	38.8	42.9	45.2	49.8	55.7	61.2	66.7	66.1	61.9	51.0	45.2	40.9	52.3
	In.	6.90	4.79	4.33	2.29	2.09	1.39	0.35	0.57	1.46	3.98	6.08	6.85	41.08

Data from NOAA, Climatological Data, Annual Summary, Oregon; 1977 (Vol. 83, No. 13). Values calculated from 1977 climatic data and variations from normals which were listed in the annual summary. Years of record used for precipitation and temperature normals were: McMinnville, 79 and 84; Salem, 84 and 85; and Corvallis, 85 and 87.



Station Elevation: 195 ft.

Years of Record: temperature - 84
Precipitation - 85

Figure 3. Climograph of Salem Oregon.
Data from NOAA, Climatological Data, Annual Summary, Oregon, 1977.

Unfortunately, the growing season coincides with the dry season. The inverse relationship of high temperatures with high rainfall in seen in Figure 3.

Wetland Soils

Soil, the site expression of an environmental system, is the product of interactions of biological and physical factor. The formation and development of soils are influenced by climate, living organisms, the nature of parent material, topography of the area, and time. Given similar combinations of these factors, similar soils can be expected to form in different areas.

Climatic Influences

Climate is generally thought to be the most important factor influencing soil formation. It affects both physical and biological soil forming processes.

Precipitation.

Of the climatic factors, precipitation may be considered the most important factor influencing development of vegetative types and plant growth. It is the primary source of soil moisture and influences the relative humidity of the air, and thereby, the consumptive rates of water by plants. Precipitation also influences the development of acid, neutral, or alkaline soils

(Brady, 1974).

On the wetlands, most of the precipitation fall when it is not needed for plant growth. During the growing season when moisture is needed, there is generally little precipitation. When low rainfall and poor water storage capacity of soils are combined, the number of crops which can be grown is severely reduced.

The relatively high amounts of annual precipitation favors the development of acid soils on the wetlands, generally of pH lower than 6.5. The pH of the A horizon of the three principal soils range from 5.6 to 6.0. Amity silt loam has a pH of 6.0 in the Ap, A1, and A2 horizons. Dayton silt loams are slightly more acid with pH of 5.6 in the Ap horizon and 5.8 in the A1 horizon. Woodburn silt loams are less acid than the Dayton silt loams, with pH of 5.9 in the Ap horizon, and 6.2 in the A1 horizon (USDA, 1972, pp. 83, 89, 114).

A pH range of about 6.0 to 7.0 is considered to be ideal for microbial activity and plant nutrient availability. This pH range also reduces the availability of aluminum, iron, and manganese below toxic levels. When the pH is low, excessive amounts of these minerals go into soluble forms and become available for absorption by plant roots (Brady, 1974, p.233).

Temperature.

Temperature has a profound effect on the rate of chemical reaction. For every ten degree Centigrade rise in temperature, the reaction rate doubles. Temperature also affects the rates at which biochemical changes occur. Therefore, soil characteristics such as organic matter content, soil structure, and nutrient availability are also indirectly affected by temperature (Brady, 1974, pp. 127, 226).

Combined Effects of Climatic Factors.

The combined effects of precipitation, temperature and light are extremely important for plant growth. Plants generally have four growth periods: 1) germination; 2) elongation; 3) budding and flowering; and 4) fruit formation and hardening. Each growth period requires certain conditions for which there are optimums, and extremes beyond which the growth processes cease.

Living Organisms

Living organisms, especially plants, play a major role in the rate of organic matter accumulation, profile mixing, nutrient cycling, and structural stability of the soil. As vegetative cover, the living organisms protect the soil surface from erosive forces and reduce the rates of soil removal. Micro-organisms provide nitrogen to the soil either by themselves or in symbiotic relation with plants (Brady, 1974, pp. 132-163).

On the wetlands, vegetation plays the dominant role in providing organic substance to the soil. Depending on the type of native or cultivated vegetation growing at the site, up to about one-third of the vegetative material may be in the soil as roots. Unless the plants are cultivated as root crops, which would not be common in the study area, the roots would remain in the soil after harvesting operations. These roots, along with the other unused plant parts which are left on the soil surface or turned under, provide the food source for other organisms.

The organisms and organic matter influence the development of soil horizons, provide soluble nutrients and secondary minerals in the decomposition process, increase water and nutrient holding capacity, and stabilize soil structure. On the wetlands, the excessive moisture often interferes with some of the organic processes. When the soil is saturated with water, the oxygen supply is not available. Aerobic bacterial activity ceases, thereby causing a reduction in the supply of nutrients such as Nitrogen and Sulfur (Brady, 1974, p. 233).

Nature of Parent Material

The wetlands occur primarily on alluvial deposits derived from basalt and sedimentary rocks, and secondarily on colluvial deposits (Figure 4). Silt loam and silty clay loams comprise the dominant surface soil textural classes.

The nature of the parent material influence the texture and structure of the soil, which in turn strongly influence the permeability of the soil. The parent material also influences the chemical and minerological composition of the soil, and the type of clay minerals which may be present in the soil profile (Brady, 1974, pp. 306, 309).

Clay minerals significantly affect the utility of the wetlands when they form impermeable layers near the surface. In Dayton soils, these clay layers reduce the effective rooting depth to 12 to 24 inches. In comparison, the other two principal soils, Amity and Woodburn, have effective rooting depths of more than 60 inches (Oregon State Water Resources Board, 1969, pp. 52-58).

The clay layers also severely reduce the moisture retention capability of some soils. In Dayton soils only 3 to 6 inches of water can be stored above the clay subsoil. Unless irrigated, the type crops which

Dominantly very deep and deep soils on alluvial floodplains and terraces

Dominantly moderately deep to very deep colluvial/residual soils associated with basic igneous bedrock

Dominantly moderately deep to deep soils formed in loess

Dominantly moderately deep colluvial/residual soils associated with sedimentary bedrock

Dominantly shallow to deep stony and cobbly colluvial/residual soils associated with various kinds of parent materials

Figure 4. Soil parent materials. After Pacific Northwest River Basins Commission, Willamette Basin Comprehensive Study, App. G, 1969, Map II-2.

can be successfully grown are limited to cereal grains, grass for seed, and pasture. The soils with deeper rooting depths also have increased moisture retention capacity. Amity silt loams can store 9 to 12 inches of water and Woodburn silt loams can hold 11 to 13 inches (USDA, 1972, pp. 83, 90).

Topographic Influences

Topography has had a major influence on the formation and development of wetland soils. The basic structure of the Willamette Valley is a north-south oriented broad synclinal trough which dips to the north. Sediments from the Cascade and Coast ranges slowly filled the trough to eventually form a broad alluvial plain (Figure 5).

Geomorphic Surfaces.

The composition of the sediments, the sequence in which these sediments were deposited, and the final topographic form, are important factors in forming the characteristics of the wetlands. These aspects of soil formation are related to the time and sequence in which the landscapes were formed. A detailed account of these relationships in the Willamette Valley are described in a publication of the Oregon State University Agricultural Experiment Station (Balster and Parsons, 1968).

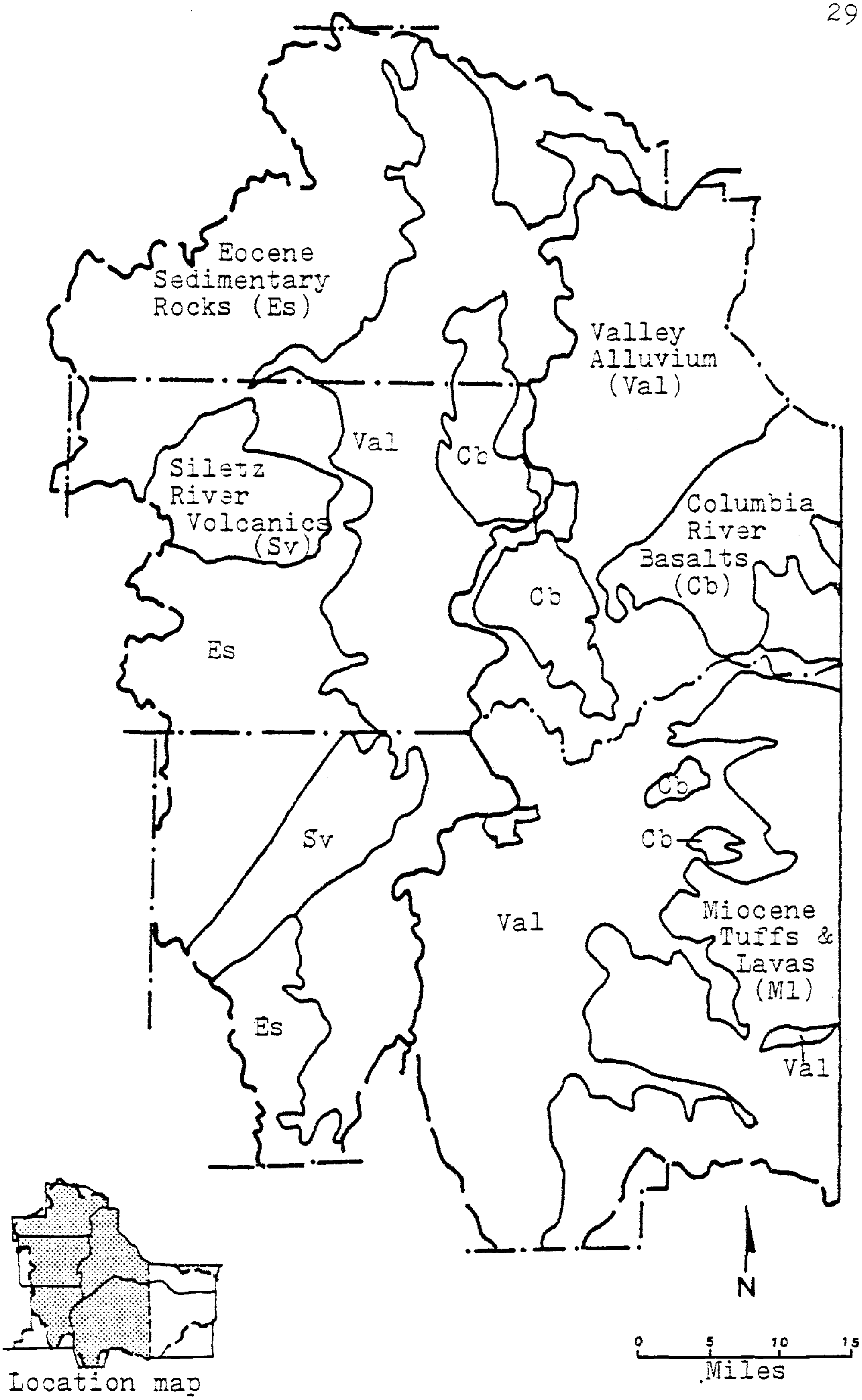


Figure 5. Generalized geologic map.
After USDA, 1962, Figure 2.

Of the twelve geomorphic surfaces discussed by Balster and Parsons, only seven are related to the wetland soils. These pertinent geomorphic surfaces, Quad, Calapooyia, Senecal, Champoeg, Winkle, Luckiamute, and Ingram are of relatively recent geologic age, ranging from late Pleistocene to about 555 years before present (Table III).[1]

The Looney unit, shown offset to the right, extends over a longer time span, and the Luckiamute unit, also offset to the right, brackets the Ingram and Horseshoe units. Mass Movement, while not a geomorphic surface, is included because of its common occurrence and large total surface area in the Willamette Valley. However, it is not common on the wetlands.

A cross-sectional profile of the Willamette Valley south of Corvallis shows the typical relationship of the geomorphic surfaces in the south central portion of the Willamette Valley (Figure 6). Six of the major geomorphic surfaces are present, including three which contain wetland soils, Calapooyia, Senecal, and Ingram.

Relationship of Geomorphic Units to Wetland Soil Series.

The geomorphic surfaces are generally separated

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[1]Pleistocene - the first epoch of the Quaternary Period in the Cenozoic Era, roughly 1,000,000 years to 10,000 years before present.

TABLE III. GEOMORPHIC SURFACES

Surface		Age
Eola (Eo)		Oldest, early, late Pleistocene
Dolph (Do)		
[1]Quad (Qu)		Late Pleistocene
[1]Calapooyia (Ca)	Looney (Lo)	
[1]Senecal (Se)	Mass Movement (M)	
[1]Champoeg (Ch)		
[1]Winkle (Wi)		
[1]Ingram (In)	[1]Luckiamute (Lu)	
Horseshoe		Youngest; 555-3,290 ±100-120 years before present

[1]Surfaces on which wetland soils occur.

Modified after Balster and Parsons, Geomorphology and Soils, Willamette Valley, Oregon; 1968, p.5.

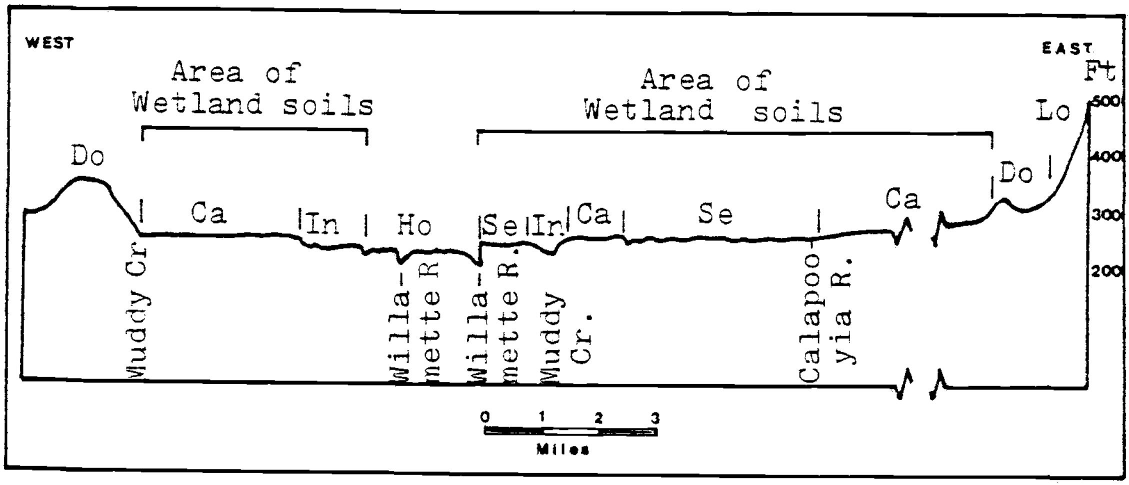


Figure 6. Cross-valley profile along latitude 44° 30' N (near Corvallis airport).
Modified after Balster and Parsons, Geomorphology and Soils, Willamette Valley, Oregon, 1968, p. 5.

by enough relief to represent different ages and duration of evolutionary processes. These differences may be associated with different parent materials, sediment particle size, characteristics of depositional layers, depth of deposits, and time for soil forming factors to act on the soil.

Quad Unit.

The Quad unit is a minor unit in surface extent. It is flat, having only a few feet in relief except along its margins. It is a unit associated with the valley floor and contains Woodburn and Amity soils (Balster and Parsons, 1968, p. 6). Most of the Woodburn soils are found along streams in gently undulating terrain. The surface consists of silty loam lying over moderately fine textured subsoils. Woodburn soils are moderately well drained, while Amity soils have poorer drainage due to finer texture (Oregon State Water Resources Board, 1969, pp. 64, 124, 125).

Calapooyia Unit.

This unit is widespread over the southern part of the study area. It is flat with a slope of only five feet per mile. Surface drainage is unorganized and poor (Balster and Parsons, 1968, pp. 6, 7). On the Calapooyia unit, the Dayton soils occur in large areas in Linn and Benton counties. In the flat areas it is usually associated with Amity soils and in more undulating terrain, with swales. Dayton soils are silty in the surface horizons with impermeable clay subsoils. Concord soils have thinner clay layers than Dayton soils. The clay layer is also more permeable. Concord soils are often found intermixed with Dayton soils (Oregon State Water Resources Board, 1969, pp. 76, 77, 79).

Senecal Unit.

The Senecal unit is a modification of the Calapooyia surface. The surface has minor drainage incisions which create a drainage network more organized than that of the Calapooyia surface. Slopes in the southern portion of the valley are about five feet per mile (Balster and Parsons, 1968, p. 7). Woodburn and Aloha are the common soils on this surface. Aloha soils are found in the northern portion of the wetlands. These soils have medium texture and imperfect drainage. Where moderate downcutting has occurred, Amity and Concord soils are common in large units (Oregon State Water Resources Board, 1969, pp. 60, 61, 76, 77, 124, 125).

Champoeg Unit.

This unit is a more severely dissected form of the Calapooyia and Senecal surfaces. Relief on this unit varies from site to site and can be as much as 70 feet. The wetland soils contained in this unit are Amity, Woodburn, and Aloha (Balster and Parsons, 1968, p. 8). Amity soils are found on the convex slopes. On the concave slopes or level areas, Concord soils are common. Woodburn and Aloha soils occur in areas similar to those described for the Senecal unit.

Winkle Unit.

This is another widespread unit. Its origin is old streambeds and their floodplains. In some areas such as Lake Labish, the old lakebeds have been filled with organic deposits. Soil series such as Labish, Coburg, Awbrey, Clackamas, and Courtney are found on the Winkle surface (Balster and Parsons, 1968, p. 8, 9). Labish soils formed from mineral and organic matter mixed on former shallow lake bottoms. They have slopes of less than 1% and are poorly drained. Labish soils are associated with Semiahmoo soils and are found in Marion county. Coburg soils were formed in mixed alluvium and are found on the broad terraces of the Willamette River. These soils are deep and moderately well drained. Awbrey soils were formed of water deposited material. They are found in nearly level to slightly concave swales on broad streamcut terraces in the southern portion of the study area.

The surface layers consist of silt loam and the subsoils are of very firm silty clay of slow permeability. Clackamas and Courtney soils occur primarily on the eastern side of the Willamette Valley. They were formed of gravelly water deposited materials on nearly level to gently sloping stream terraces. In Clackamas soils the surface layers of gravelly loam is underlain by material consisting of more than 35% gravel and cobbles. This sublayer restricts rooting depth to less than three feet. Courtney soils have silty clay loam surface layers with silty clay subsoils and a lower layer of more than 50% gravel and cobbles (Oregon State Water Resources Board, 1969, pp. 63-78).

Ingram Unit.

The Ingram unit occurs as a low river terrace of the Willamette River. The surface is generally undulating due to frequent flooding and relocation of channels. Maximum relief on the Ingram surface is about eight feet. McBee and Wapato are the soils on this geomorphic surface (Balster and Parsons, 1968, p. 9). Both soils are formed of recent water-deposited materials. McBee soils formed on floodplains and are found beside major streams and bottomlands of smaller streams. Silty clay loam forms both surface soil and subsoil. Wapato soils occur in low areas of floodplains. Slopes are less than one percent. Most areas are subject to occasional flooding. Silty clay loam comprise both the surface soils and subsoils of the Wapato soil series (Oregon State Water Resources Board, 1969, pp. 99. 120. 121).

Luckiamute Unit.

This unit consists of the floodplains of drainages from the Eola, Dolph, and Looney units. The Luckiamute surface has little or no relief. Wetland soil series found on this geomorphic surface include McBee, Wapato, Waldo, Chitwood, and Nestucca (Balster and Parsons, 1968, p. 9, 10). McBee and Wapato soils are found in areas similar to those in the Ingram unit. Waldo soils occur in slightly concave positions on the floodplains of small streams. The surface layer is silty clay loam and the subsoil, silty clay or clay. Soils of the Chitwood and Nestucca series are found on stream terraces of smaller valleys. Silt loam makes up the surface layer and silty clay loam forms the subsoil (Oregon State Water Resources Board, 1969, pp. 73, 74, 99, 103, 120, 121).

Time

The alluvial soils of the wetlands are generally younger than the residual soils of the surrounding uplands. Soils of the recent sediments are found on the bottomlands of streams and rivers while the soils of the old sediments fill the main valley floor. These older alluvial soils occur on the Quad geomorphic unit and are thought to be of late Pleistocene age (Balster and Parsons, 1968, p. 6).

The younger soils are found on the recent sediments such as those of the Ingram geomorphic surface. The age of the Ingram unit correlates to the upper level of the Luckiamute unit, which has been given ages ranging from 555 ± 100 years to 3,290 ± 120 years by radiocarbon dating (Balster and Parsons, 1968, p. 9).

Surface Relief

The major effect of topography on the wetland is to limit the agricultural use by creating inadequate surface drainage. By definition, the wetlands of this study included only soils with excessive wetness and with slopes ranging from zero to three percent. This flatness of terrain is the major contributing factor to the problem of excessive wetness, primarily through inadequate drainage outlets.

On the positive side, the level surfaces permit use of large, modern, labor-saving mechanical equipment on the commercial farms. Growers of grain, grass for seed, and row crops are the principal beneficiaries of this type of mechanization. The flatness of the farmland also promotes the improvement on the natural precipitation and drainage conditions. Irrigation and drainage systems can be installed without great difficulty on level or evenly sloping land.

Drainage

The precipitation regime, soil characteristics, and topography combine to form the conditions of poor drainage and inadequate drainage outlets. Fortunately, most of the adverse effects of poor drainage occur during the non-growing season. These conditions do, however, generally limit the use of these wetlands to annual crops and crops which can tolerate wetness, such as the grasses.

Soils most seriously affected by lack of or inadequate drainage outlets are shown in Table IV.

Because of the may adverse effects of excessive soil moisture, the soils which make up the wetlands are used primarily for cereal grains, grass for seed, and pasture. When drained, however, most of these soils are suitable for most of the crops commonly grown in the Willamette Valley.

The three principal soils, Amity, Dayton, and Woodburn, collectively make up about two-thirds of the wetlands. When improved, these soils, as well as many of the other wetland soils, can support a variety of crops. Amity soils, when drained and irrigated, can

TABLE IV. SOILS WITH INADEQUATE OUTLETS.

A. Soils with Severe Problems Caused by Lack of Adequate Outlets.

Concord

Courtney

Dayton

Holcomb

Waldo

Wapato

B. Soils with Moderate Drainage Problems and Less Restrictions Due to Better Outlets, and Soils Easily Drained Where Outlets are Available. Requires Drainage only for Intensive Cropping.

Aloha

Amity

Clackamas

Woodburn

Source: Pacific Northwest River Basins Commission, Willamette Basin Comprehensive Study, App. G, 1969; pp. II-51, II-52.

be used for most of the crops grown in the Willamette Valley. Dayton soils, when drained, can be used for corn, and winter and spring small grains. However, even when drained, Dayton soils are still unsuitable for deep-rooted crops and many perennials. Woodburn soils, even when unimproved, can support orchards, caneberries, and row crops. Still, these soils have a perched water table which make them unsuitable for crops which cannot tolerate excessive moisture (USDA, 1972, pp. 82, 83, 89, 90, 114, 115).

In areas of inadequate drainage and poor soil permeability, relatively small amounts of rainfall are sufficient to cause ponding. Figure 7 shows the result of such conditions on a field in southern Linn County.

Excessive soil moisture is accompanied by numerous adverse effects to agriculture. The reduction of soil oxygen, biotic activity, effective rooting depths, and oxidation of iron and manganese have already been discussed. Additional adverse effects to agricultural uses are soil heaving and cooler soils.

Soil moisture is the most important factor in changing the capability of soils to warm quickly in the spring. For example, the dry weight specific heat of mineral soils is about 0.20. If water was added to constitute 20% of the soil, the specific heat would increase to 0.33. Poorly drained soils can be expected

Figure 7. Ponding caused by inadequate drainage outlets, Linn county, February 17, 1979.

to have temperatures as much as 6 to 12 degrees Fahrenheit lower in the surface layer than in comparable soils which are well drained (Brady, 1974, pp. 270, 275).

Such reduction in temperatures may limit the types of crops which may be grown successfully. Each type of seed has its own optimum temperature for germination, and temperature extremes beyond which germination will not take place. Cooler soil temperatures may, in effect, reduce the growing season by increasing the germination time. Furthermore, the delayed germination may increase the loss of seed due to seed rot.

Excessive soil moisture also leads to soil heaving from frost-thaw processes. Crops such as wheat, alfalfa and clover are especially susceptible to damage by the tearing action on the root systems. Evidence of such damage was visible during the field survey phase of this study during January and February, 1979. In Linn County, several thousands of acres were damages and required replanting. Particularly hard hit were the late fall and early winter planting of wheat and ryegrasses. Earlier plantings were well-rooted and suffered only minor damage.

Soil Classification

The soil classification system currently used in the United States is the Comprehensive Soil Survey System which is the officially adopted version of the seventh approximation by the Soil Survey Staff, U.S. Department of Agriculture. The soils are classified by quantitatively measurable soil properties. The nomenclature is designed with Latin or Greek root words to provide for broader categories, and for easier comprehension of the soil nomenclature. Diagnostic horizons are the primary criteria used to differentiate the higher levels of classification. Six categories of classification are used. They are, from the broadest category to the most specific, order, suborder, great group, subgroup, family, and series (Soil Survey Staff, 1960).

Classification of the wetland soils by subgroup, family, and series is included at Appendix II. The subgroup nomenclature automatically identifies the order, suborder, and great group to which it belongs.

For this study, the category of soil classification used to identify the wetlands is that which is most specific, the series. The wetland soil series identified as having wetness problem as the major limiting factor total about 652,000 acres (Table V).

TABLE V. ACREAGES (IN THOUSANDS) OF WETLAND SOIL SERIES, BY COUNTY.

Soil Series	Symbol	County					Row Total
		Marion	Yamhill	Polk	Benton	Linn	
Aloha	Al	0	6.0	0	0	0	6.0
Amity	Am	47.0	13.6	16.7	12.5	51.7	141.5
Awbrey	Ay	0	0	0	2.2	4.5	6.7
Brenner	Bn	0	0	0	2.5	0	2.5
Chitwood	Cw	0	0	0	1.3	0	1.3
Clackamas	Cl	10.9	1.1	1.0	0	14.4	27.4
Coburg	Cb	0	0	1.0	3.2	7.2	11.4
Concord	Co	16.5	0.5	0.5	0	4.6	22.1
Conser	Cs	0	0	0	0	7.2	7.2
Courtney	Ct	4.8	0	0	0	8.8	13.6
Dayton	Da	11.5	5.5	8.1	11.0	42.1	78.2
Dayton, Gravel Substratum	Ds	0	0	0	0	4.4	4.4

Data from Oregon State Water Resources Board, Oregon's Long-Range Requirements for Water, Appendix 1-2, 1969.

		County					Row
Soil Series	Symbol	Marion	Yamhill	Polk	Benton	Linn	Total
Dayton, Thick Subsoil	Dt	0	0	0	2.2	16.6	18.8
Grande Ronde	Gr	0	1.4	1.3	0	0	2.7
Holcomb	Ho	2.6	0.1	0	0.7	20.1	23.5
McAlpin	Mp	8.5	0	0	2.0	1.7	12.2
McBee	Ma	3.6	0.7	8.5	3.4	10.2	26.4
Nestucca	Ns	0	0.1	0.9	1.0	0	2.0
Semiahmoo-Labish	Se	2.3	0.2	0	0	0	2.5
Waldo	Wa	3.4	5.4	3.0	2.6	3.7	18.1
Wapato	Wp	11.0	11.5	8.5	10.4	22.4	63.8
Woodburn	Wo	71.4	34.2	17.9	14.9	21.3	159.7
Column Totals		193.5	80.3	67.4	69.9	240.9	652.0

Data from Oregon State Water Resources Board, <u>Oregon's Long-Range Requirements for Water</u>, Appendix 1-2, 1969.

Soil Capability Classes

The Soil Conservation Service has developed a soil capability grouping system which shows in a general way the suitability of soils for most field crops. The system consists of grouping soils at three levels, the capability class, subclass, and unit.

Capability Classes

This is the broadest group. Roman numerals are used to designate these from I through VIII. Class I has the least limitations to uses, and the limitations increase to the most severely limited group, Class VIII. Only soils of Classes II through IV are found on the wetlands. The soils of these classes have limitations as follows:

Class II - Moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III- Severe limitations that reduce the choice of plants, require very special conservation practice, or both.

Class IV - Severe limitations that reduce choice of plants, require very careful management, or both.

Capability Subclass

The second level of grouping indicates the main limitation to use of the soil. This limitation is shown by adding a small letter, e, w, s, or c to the class numeral. Thus, IIw would indicate a Class II soil with wetness as the main limitation. All soils of the wetlands have this designation. The other letters represent: e, erosion; s, shallow, droughty, or stony; and c, climate too cold or dry. None of the wetland soils have these designations (USDA, 1975, p. 46).

Capability Units

The last level of grouping specifies the capability unit within each subclass. An Arabic numeral is added to the subclass symbol. This numeral groups soils suited to the same crops and require similar management practices (USDA, 1975, p. 46).

In Marion County the three principal soils are classified as follows:

Amity	IIw-2
Dayton	IVw-1
Woodburn	IIw-1

Soil capability units of various soil series may vary slightly from county to county.

Soil Association

New detailed soil surveys have been completed and published for four of the five counties. Linn county does not yet have a published new soil survey. These soil surveys contain detailed maps of soil series by different phases (slope groups) overprinted on aerial photographs at a scale of 1:20,000.

Most of the farms surveyed in this study extended over three to five different soil series. If this number of soil series were to be compared with up to seven types of crops and acreages, three types of irrigated crops and acreages, four types of crops on drained lands and acreages, and a number of other variables, handling the mass of data would have been prohibitive in time needed for data collection and handling, and in processing expenses. Furthermore, the mass of data would have been difficult to analyze. Therefore, a different scale of soil identification was needed.

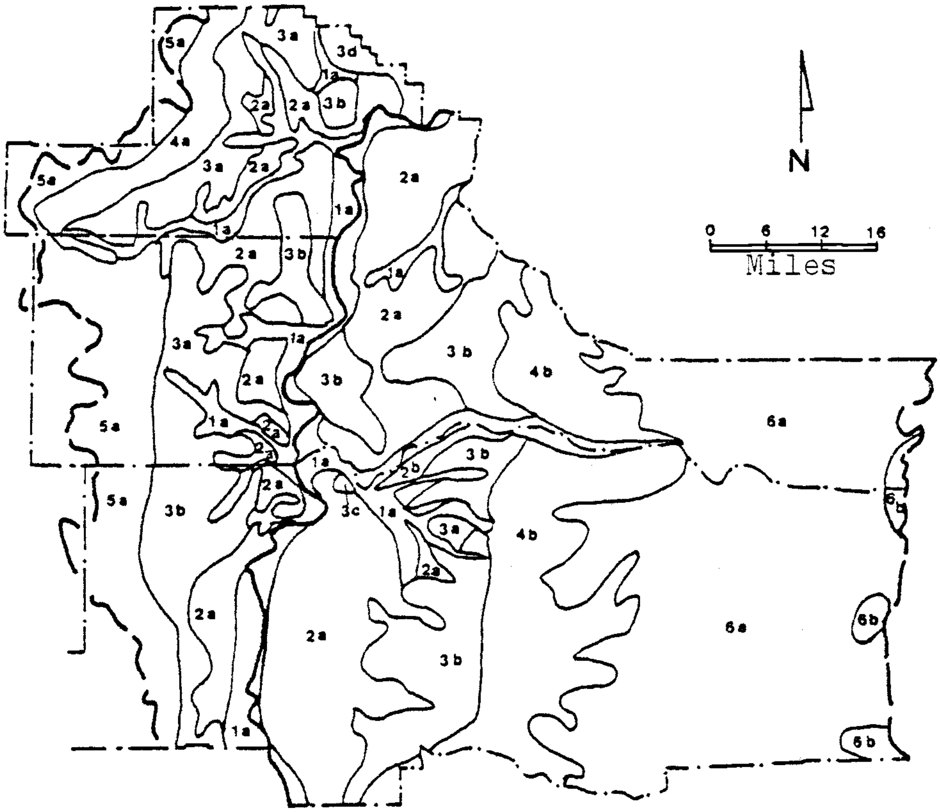
Use of soil associations provided the desired results. The soil association maps are based on two or more geographically associated soil series. For example, a Dayton-Amity mapping unit would consist of Dayton soils with about 30 percent Amity soils and some inclusions of Concord and Woodburn soils. Using the association eliminated the requirement for identifying the exact boundaries of each crop within each farm on the large scale 1:20,000 map. Instead, smaller scale maps of scale 1:158,400 were used. These maps were available in Oregon State Water Resources Board publication, Oregon's Long-Range Requirements for Water, 1969.

A smaller scale soil association map with a scale of about 1 inch to 20 miles is used to show the very generalized soil associations within the five-county area. The wetlands are contained on the Woodburn-Amity (2a) and Salem-Clackamas (2b) soil associations (Figure 8).

Soil Suitability for Cropland

Interpretations can be made of soil suitability for cropland use by evaluation of the characteristics and qualities of the land. These interpretations for the general study area clearly show the close correlation of the wetlands with the areas generally highly suitable for cropland use and areas generally suitable for cropland use but with moderate soil problems (Figure 9. Compare with Figure 2).

When comparing the two figures, a feature which stands out is the non-correlation of the areas bordering the major drainages. These areas are the low river terraces on the Horseshoe geomorphic surface. Although



1a Chehalis-Newberg
1b Sauvie-Cloquato

2a Woodburn-Amity
2b Salem-Clackamas

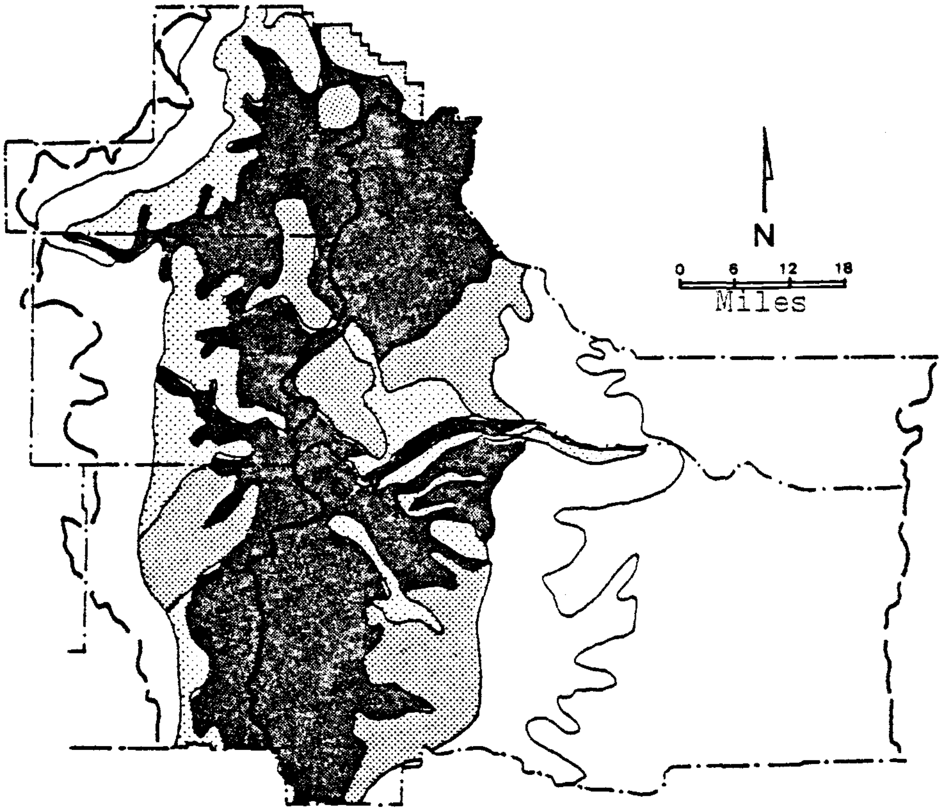
3a Willakenzie-Peavine
3b Jory-Nekia
3c Cazadero-Bornstedt
3d Cascade-Laurelwood

4a Olyic-Melby
4b McCully-Kinny
4c Peavine-Klickitat

5a Astoria-Hembre
5b Aschoff-Bull Run
5c Honeygrove-Bohannan

6a Whetstone-Henline
6b Timberline-Rockland

Figure 8. Soil associations. Modified after Pacific Northwest River Basins Commission, Willamette Basin Comprehensive Study, Appendix G, 1969, Map II-1.



Generally highly suitable

Generally suitable, moderate soil problems

Generally suitable, severe soil problems

Generally unsuitable or major restricting soil problems

Figure 9. Soil suitability for cropland. Modified after Pacific Northwest River Basins Commission, Willamette Basin Comprehensive Study, Appendix G, 1969, Map II-5.

they are generally highly suitable for cropland use, these soils possess a different major limiting factor, flooding. Therefore, the physical and chemical characteristics are different from those of the wetland soil series.

The Wetlands as a Land Resource Base

The combination of a mild climate, level surfaces, and soils highly suitable for cropland, establishes the wetlands as a valuable land resource base. There are, however, a number of factors which currently limit agricultural uses and reduce volumes of production. Poorly drained soils combine with heavy winter precipitation and inadequate drainage outlets to create ponding on some soils during the winter and early spring. Furthermore, of the 40 inches of annual precipitation, only about twenty percent fall during the months when it can be used by most crops.

There are, fortunately, technology and equipment available today which may reduce or eliminate the effects of the factors harmful to agriculture. With modern drainage and irrigation techniques, the value of the wetlands as a land resource base should increase.

CHAPTER III

POLICY LIMITATIONS TO AGRICULTURAL LAND USES

Although the wetlands make significant contributions to Oregon's economy, use of these land resources are limited by government policy, as well as by the physical restrictions described in Chapter II. Two such limitations which impact most seriously on the wetland farmers are imposed at the state level. These are the restrictions on open field burning and land use regulations.

Background

Economic Importance of the Five-County Area

Agriculturally, the five-counties of this study make large contributions to the economy of Oregon. In 1977, the value of sales of all crops, livestock, and livestock products of these five-counties was more than 293 million dollars, 28.4% of the total value of sales of Oregon for these products.

Marion County contributed the greatest sales value in the state with product sales value of more than 122 million dollars, product sales value equivalent to 11.8% of Oregon and 41.6% of the five-county area. The value of sales in millions of dollars, for these agricultural products for the other four counties were: Linn, 66.2; Yamhill, 44.8; Polk, 32.1; and Benton, 28.2 (Oregon State University, Extension Economic Information Office, commodity Office, Commodity Data Sheets, 1978).

Economic Importance of the Grass Seed Industry

The grass seed industry is of economic importance to the state and as a grass seed source to the nation. In 1978, the value of sales of selected seeds from the five-county area was more than 45 million dollars.[2] This was 90% of Oregon's value of sales of selected seeds. Linn County was the largest producer with 25.4 million dollars of sales value.

In 1977, Linn, Polk, Benton, Marion, and Yamhill counties collectively produced 100% (248.8 million pounds)

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[2]Selected seeds include bentgrass, Merion Kentucky bluegrass, chewings fescue, red fescue, all ryegrasses, other Kentucky bluegrasses, and orchard grass.

of the nation's ryegrass seed, 100% (4.1 million pounds) of crimson clover seed, 100% (6.2 million pounds) of red fescue seed, 60% (5.1 million pounds) of hairy vetch seed, and 61.2% (420,000 pounds) of Merion Kentucky bluegrass seed. Other important grass seeds were also grown but made up small percentages of the national production.

The five-county area also produced 83.2% of Oregon's perennial grass seeds, with Linn County again the largest contributor with production of 76.5% of the state total.

Open Field Burning

Open field burning has been used for many years on the agricultural lands of the Willamette Valley. For the farmers, it is an economical method of disposing the straw residue left on the fields of cereal grains and grass seed after completion of harvesting operations.

Field burning on grass seed crops became standard practice in the mid-1940's. During that period, blind seed fungus (Gloetinia temulenta) had become widespread in the Willamette Valley perennial ryegrass fields. With up to 90% of these crops infested, the ryegrass industry was in danger of collapse (Oregon State University, Air Resources Center, 1970, p.3). In 1948, John R. Hardison, USDA research plant pathologist at Oregon State University, proposed field burning to control blind seed disease (Oregon State University, Agricultural Experiment

Station, 1973, p. 1).

In addition to destroying the inoculum of the blind seed disease, open field burning successfully controlled ergot, silver top, grass seed nematode, and other diseases in the perennial grasses. Some control was acquired over 125 grass rusts, 140 grass smuts, and 400 leaf and stem diseases of Oregon (Oregon State University, Air Resources Center, 1970, p. 4).

With the burning of the straw residue, weed control was improved by destroying weed seeds and reducing amounts of herbicides needed (Oregon State University, Agricultural Experiment Station, 1973, p. 1). Other benefits such as insect and rodent control, are cited by the farmers and some scientists, but these benefits are disputed by some entomologists (Oregon State University, Air Resources Center, 1970, p. 4).

Legislation Limiting Field Burning

Legislation

With the enactment of the Clean Air Acts, strict provisions were placed on the amounts of particulates allowed in the air. Due to the configuration of the Willamette Valley, and the occurrence of atmospheric stagnation and air temperature inversion during the late summer and early autumn, smoke from field burning operations is frequently retained within the valley with a resultant increase in the air pollution levels (Oregon State University, Department of Atmospheric Sciences, 1976, p. 1).

Under pressure of the National Environmental Protection Agency, the Oregon Legislature passed measures aimed at reducing the smoke problem by targeting on one of the major contributors to air pollution, field burning. Field burning is a highly visible air polluter which is capable of generating huge clouds of smoke (Figure 10).

In 1971, the Legislature passed, and the Governor signed into law, a schedule for reduction in field burning acreages. This law also called for an end to all field burning of cereal crops after January 1, 1975 (Chapter 563, Oregon Laws, 1971).

Two years later another bill related to field burning, House Bill 2205, was passed. This bill created a fund to be used for the development of mobile field incineration, and established fees to be paid by the farmers (Chapter 578, Oregon Laws, 1973). The experimental field sanitizer was to provide the benefits of burning while reducing the amounts of particulates released to the atmosphere (Figure 11). House Bill 2205, therefore, increased the production costs to the farmer, but provided no additional benefits. The development of mobile field incinerators progressed slowly and turned into an expensive project.

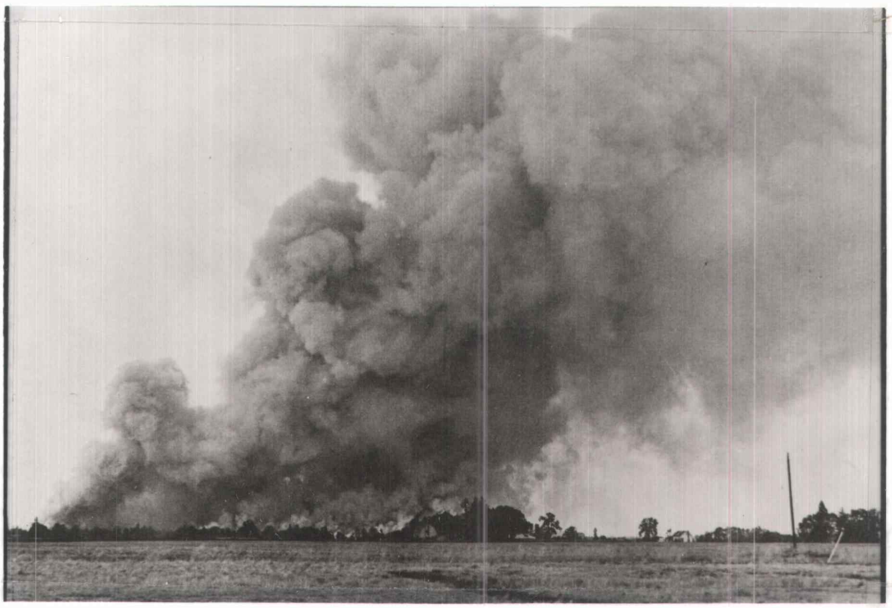

Figure 10. Open field burning. OSU, Agricultural Experiment Station photo.

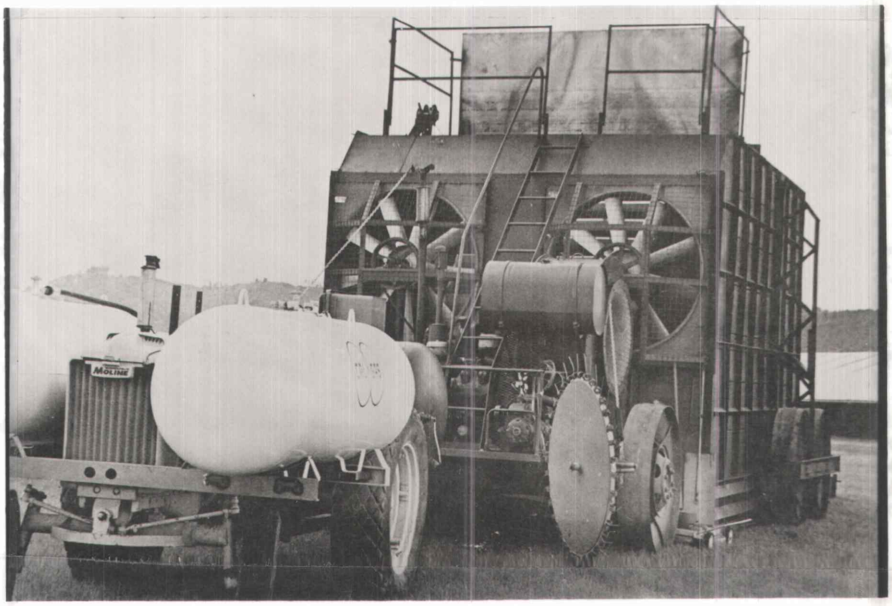

Figure 11. Mobile field sanitizer. OSU, Agricultural Experiment Station photo.

To accomodate both the farmers, who protested against the ineffectiveness of the new equipment, and the clean air advocates, the legislature looked for a middle position. In 1975, the date of abolition of field burning was rescinded. Senate Bill 311 established a phasedown schedule to not more than 95,000 acres in 1975, and to 50,000 acres after 1977 (Chapter 559, Oregon Laws, 1975).

The next legislative session in 1977 generated three more bills relating to field burning limitations. Senate Bill 535 set the annual maximum total registered acreage to be burned at 235,000 acres. This bill was passed by the Senate and House, vetoed by the Governor, and finally laid on the table with the veto message (Oregon Senate and House Journal, 1977).

Senate Bill 419 deleted the then current annual limitations on the maximum total registered acreage allowed. The new acreage limitations were 195,000 in 1977, 180,000 in 1978, 165,000 in 1979, and 150,000 in 1980. This bill was still in committee when the Legislature adjourned.

The third bill, House Bill 2196, also increased the total maximum acreage allowed for field burning. This bill was passed and established new limits effective July 22, 1977. The maximum open field burning acreages were set at 195,000 in 1977, and 180,000 in 1978 (Chapter 650, Oregon Laws, 1977).

In 1979, a new measure was passed which again raised the field burning limit, this time to 250,000 acres. The actual acreage to be burned, however, is to be based on weather conditions and the smoke management program of the State Department of Environmental Quality (Oregon Senate Bill 472).

Research in Straw Residue Removal

A study in 1973 identified four areas of research needed to find alternatives to field burning: 1) reduction of air pollution emissions (mobile field sanitizer); 2) disease, agronomic, and climatological studies; 3) grass residue utilization; and 4) economic considerations (Oregon State University, Agricultural Experiment Station, Circular of Information, 1973, p. 2, 3). To provide the technical information, several studies were completed. Oregon State University Air Resources Center published a progress report, Air Pollution Meteorology and Chemistry Research, January, 1973. Another climatological study was published by Oregon State University Department of Atmospheric Sciences in 1976, The Field Burning Climatology of the Willamette Valley. On the economic side, Conklin and Fisher produced Economic Characteristics of Farms Producing Grass Seed in Oregon's Willamette Valley, for Oregon State University Agricultural Experiment Station, in 1973. Also from the Agricultural Experiment

Station, Circular of Information 638, March, 1973, dealt with grass residue utilization in the publication Technical and Economic Considerations in Shipping Grass Seed Residue to Japan.

By passing Senate Bill 472, the Oregon Legislature appears to have concluded that the grass seed industry is indeed important to the state's economy and that no effective and economical alternatives to field burning has been developed.

Land Use Limitations

Senate Bill 100 (Chapter 80, Oregon Laws, 1973) and Senate Bill 101 (Chapter 503, Oregon Laws, 1973) presented farmers with a dichotomy of public policy; protection of agricultural lands on one hand, and limitations to land uses on the other. These statutes were responses to the growing public interest in preservation of the state's agricultural land base. The statutes were enacted during a period of rapid population growth in the state, particularly in the Willamette Valley. This rapid population growth created a high demand for new housing, and with that, the associated needs for commercial, recreational, service, and transportation land uses. These uses intensified the competition for agricultural lands, for the desired land characteristics were similar. Stable soils, level surface, and good drainage were some of the physical attributes considered desirable for all of these land uses.

Senate Bill 100

Senate Bill 100, commonly referred to as the 1973 Land Use Act, was designed to correct the conditions of uncoordinated use of lands by promoting "coordinated administration of land uses consistent with comprehensive plans adopted throughout the state." A Land Conservation and Development Commission (LCDC) consisting of seven members was created within the Department of Land Conservation and Development. This Commission was directed to develop and adopt state-wide planning goals and guidelines for use by state agencies and local government bodies (Chapter 80, Oregon Laws, 1973). This task was completed after a series of public meetings conducted throughout the state in 1974.

Goal 3, Agricultural Lands

Of the nineteen statewide goals, Goal 3 refers directly to retention of agricultural lands in farm use. The stated goal is "to preserve and maintain agricultural lands." However, recognition is also given to requirements for conversion of some farmland to other uses such as urbanized land.

In Western Oregon, agricultural land is identified as lands designated as Classes I through IV by the Soil Conservation Service Soil Capability Classification System. Using this classification system, all of the wetlands of this study are designated as agricultural lands, and are subject to preservation.

Senate Bill 101

Senate Bill 101 was passed in 1973 after more than 20 years of inequities in tax relief and inadequate protection of farmland. The idea of providing tax relief and special considerations to zoning had been in existence in Oregon since 1961. During the following years, however, the Legislature continued to change the laws in an effort to develop the best program possible.

In 1971, new legislation awarded two major benefits to the farmers through the adoption of exclusive farm use zones. Farms were assessed at farm values, which were lower than the true market values, and were exempt from any tax liability when the farmlands were converted to housing developments. The second benefit consisted of exemption of farms from zoning regulations. This exemption permitted subdivisions to be developed on farmland and roads inadequate for general traffic to be constructed in areas designated exclusive farm use zones.

For farmers outside the exclusive farm use zones, changing to non-farm use required payment of five years of deferred taxes. It was this inequity, and the undesired results of subdivisions and roads inadequate to handle the increased traffic, which prompted the passage of Senate Bill 101 (Chapter 503, Oregon Laws, 1973).

Senate Bill 101 was written to provide incentives to the farmers to keep their farmlands in agriculture, and to penalize those who took advantage of special assessments only to convert the land to other uses when they so desired. This bill reinforced the idea of preservation of agricultural land and acknowledged the serious loss of land to non-agricultural uses. It limited the uses of rural land, and at the same time provided incentives to farmers to retain their farmlands in exclusive farm use zones.

Two types of agricultural lands were designated, those within the exclusive farm use zones and those not within these zones. A number of important benefits accrued to the farms within the exclusive farm use zones. Most significant was the tax assessments based on the farm use value. Also, if the farm passed on to heirs, inheritance tax was based on farm valuation. These two benefits provided powerful fiscal incentives to keep the farms in these specially created zones. Other benefits were obtained through exemptions from levies and assessments of water and sanitary districts.

The portion of Senate Bill 101 which controlled conversion of farmland to non-agricultural uses was the requirement that the county governing body review and approve any proposed division of land which created parcels less than ten acres. If the governing body disapproved such partition, the landowner was unable to sell the land in these smaller parcels.

When farmland was converted to other uses with the approval of the county governing body, or when the assessor discovered land had been converted without the assessor being notified, a "rollback" tax was imposed on the farmer. This penalty was equal to the number of years, up to ten, that the land had been in an exclusive farm use zone, times the difference between the farm value and market value assessments (Chapter 503, Oregon Laws, 1973).

Legislation thus limited the traditional farm practice of field burning, and also restricted the use of land suitable for agricultural use.

Effects of Limitations on Wetland Farmers

During the field survey phase, this researcher sensed some indignation by farmers over what they felt were undue government interference and excessive regulations. Some farmers complained of the sense of uncertainty created by the constantly changing regulations, particularly on the acreage limitations to field burning. These farmers desired stable conditions in order to plan their farming operations.

Policy limitations, which included government rules, regulations, and interference, made up 15% of the major problems perceived by the surveyed farmers. Some of the comparisons of farmers voicing such complaints with other variables will be examined in detail in Chapter VI.

CHAPTER IV

CURRENT AGRICULTURAL LAND USES

The current agricultural land uses are the result of all inputs to the farmers' decision-making processes. These land uses reflect the farmers' perceptions of the importance of each of the many factors affecting their farming operations. In this chapter, the current agricultural land uses will be examined and compared to variables such as farm sizes and soils.

Questionnaire Design

The questionnaire (Appendix I) consisted of four parts: farm and farmer information; changes in land uses; perceived problems; and irrigation and drainage. This chapter deals with the information obtained from the first part of the questionnaire, farm and farmer information. Information from the other three parts of the questionnaire are covered in Chapters V through VII.

After all of the questionnaires were completed through personal interviews, the farm types were grouped into nine categories. The first category, diversified farms, consisted of farms where two or more enterprises occurred. All single-enterprise farms were categorized into one of the following eight farm types: grass for seed, grain, berry, livestock, row crop, tree fruit, nut, dairy, and all others. Grass for seed included all grasses grown for seed, but excluded the legumes (alfalfa, clover, and vetch) for seed; grain included all small grains such as wheat, barley, and oats; berry included caneberries and strawberries; and livestock included cattle, sheep, hogs, and horses. Row crops included the perishable vegetables and cannery type crops such as sweet corn, beans, and peas; tree fruit included apples, pears, peaches, plums, and cherries; and nuts included filberts and walnuts. The last two categories were dairy and all others.

Questions 5, 6, and 7 pertaining to 1978 as a representative agricultural year, and to the types of crop rotation, if any, were used to differentiate normal crop rotation from other land use changes.

Questions 8 through 14 addressed the land use changes which did not result from normal crop rotation. The questions in this section, and in the following section dealing with problems, were left open-ended. Open spaces were left for responses instead of providing lists of reasons for changes, reasons for satisfaction or dissatisfaction, and problems. This was done to avoid leading or prompting responses. The remainder of the questionnaire was straightforward, requiring only Yes-No, or crop and acreage information.

Distribution of Sample Farms by Counties

One hundred and forty-one useable samples were obtained from the wetlands of the five-county area. Figure 12 shows the locations of these sample farms in relation to the wetlands and the five-county area. Table VI shows the distribution of the sample farms by counties. In both Figure 12 and Table VI the high number of samples in Linn and Marion Counties is apparant. Linn and Marion Counties collectively account for 81.6% of the sample farms.

This apparent over-representation by Linn and Marion Counties is moderated when the relative frequency of samples are compared to the proportion of the 812 wetland sections contained in each county. The relative frequency of samples and the proportion of wetland sections for the counties are: Benton, 4.3% and 9.4%; Linn, 37.6% and 36.6%; Marion, 44.0% and 31.2%; Polk, 7.8% and 9.0%; and Yamhill, 6.4% and 15.1%.

This comparison still leaves Marion County over-represented, and Benton and Yamhill Counties under-

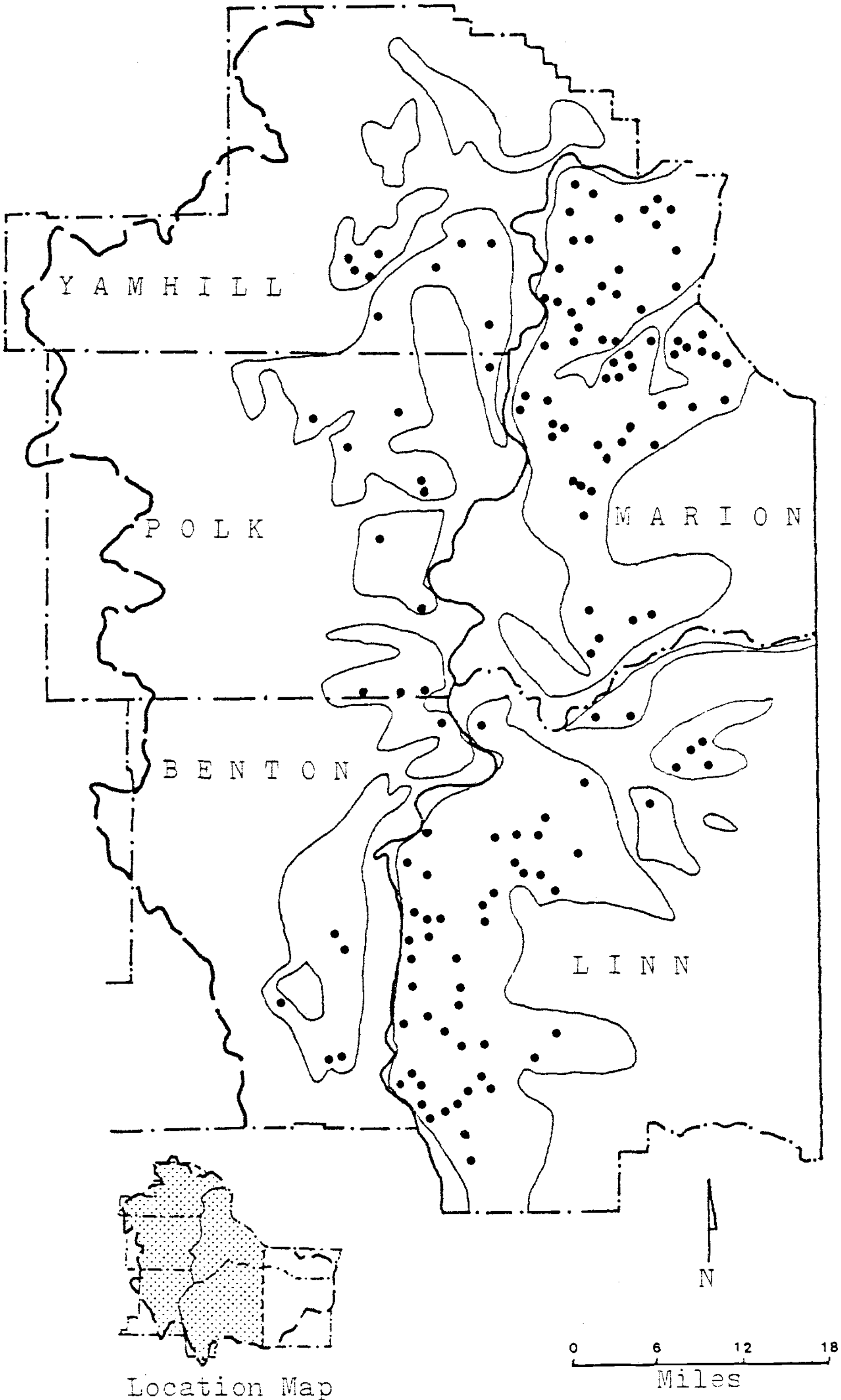

Figure 12. Location of sample farms.

TABLE VI. NUMBER OF SAMPLE FARMS BY COUNTIES.

County	Number Farms	Relative Frequency (%)
Benton	6	4.3
Linn	53	37.6
Marion	62	44.0
Polk	11	7.8
Yamhill	9	6.4
Total	141	100.0

represented. These conditions may be attributable to the contiguous nature of the wetlands of Marion County and the discontiguous nature of the wetlands of Benton and Yamhill Counties. Considerable portions of the wetlands of the latter two counties occur as narrow strips along minor drainages and are not shown on the generalized maps. In many sections these narrow bands of wetlands and small isolated areas of wetland soils amounted to less than the minimum of 50% needed for designation as wetland sections.

Full-time and Part-time Farmers

Of the 141 farmers comprising the sample size, 103 (73.0%) were full-time farmers, and 38 (27%) were part-time farmers (Table VII). The full-time farmers derived all of their income from their farming operations, whereas part-time farmers earned part of their income from off-farm work.

Some of the part-time farmers engaged in full-time, off-farm occupations and operated the farms as hobby farms. Other part-time farmers were semi-retired or held seasonal off-farm jobs. Most of the part-time farmers lived on farms situated near the urban centers of Salem and Albany.

Farm types of the full-time farmers are shown in Table VIII. Diversified farms consisting of two or more

TABLE VII. FULL-TIME AND PART-TIME FARMERS BY COUNTIES.

County	Full-Time (%)		Part-Time (%)		Row Total (%)	
Benton	4	(66.7)	2	(33.3)	6	(4.3)
Linn	39	(73.6)	14	(26.4)	53	(37.6)
Marion	42	(67.7)	20	(32.3)	62	(44.0)
Polk	10	(90.9)	1	(9.1)	11	(7.8)
Yamhill	8	(88.9)	1	(11.1)	9	(6.4)
Column Total	103	(73.0)	38	(27.0)	141	(100.0)

TABLE VIII. FARM TYPES OF FULL-TIME FARMERS BY COUNTIES.

Farm Type	Benton	Linn	County Marion	Polk	Yamhill	Row Total	(%)
Diversified	2	22	29	9	7	69	(67.0)
Grass for Seed	1	13	-	-	-	14	(13.6)
Grain	-	-	-	1	-	1	(1.0)
Berry	-	-	3	-	-	3	(2.9)
Livestock	-	-	1	-	-	1	(1.0)
Row Crops	-	-	4	-	-	4	(3.9)
Dairy	1	4	3	-	1	9	(8.7)
Other	-	-	2	-	-	2	(1.9)
Column Total (%)	4 (3.9)	39 (37.9)	42 (40.8)	10 (9.7)	8 (7.8)	103 (100.0)[a]	(100.0)

[a]May not add up to 100.0 due to rounding.

enterprises were the most important farm type category, making up 67% of the sample farms. The greatest representation of diversified farms were in Linn and Marion counties with 22 and 29 farms respectively.

Table IX shows the farm types of the part-time farmers. Diversified and livestock farms made up the largest categories with 17 and 10 farms, respectively.

Part-time farmers who were semi-retired or had seasonal jobs were mainly in diversified farming operations, while those with full-time off-farm jobs tended to be in livestock, berry, and tree fruit operations. This division appears to have developed primarily as a result of the equipment requirements and amount of time needed to conduct the farming operations. Farmers raising grass seed, grain, and row crops need special equipment for planting, fertilizing, and harvesting. In general, the farmers who operated these types of farms as part-time operations were those who have had larger full-time farms, and had reduced the farm size for partial retirement, health, or other reasons.

The part-time farmers with full-time, off-farm jobs usually had smaller operations requiring less specialized equipment. Tasks requiring special equipment, such as spraying, were often hired out. Harvesting was often done by hired temporary labor, or on the U-pick basis.

TABLE IX. FARM TYPES OF PART-TIME FARMERS BY COUNTIES.

Farm Type	Benton	Linn	County Marion	Polk	Yamhill	Row Total	(%)
Diversified	-	6	10	1	-	17	(44.7)
Grain	-	-	1	-	1	2	(5.3)
Berry	-	-	4	-	-	4	(10.5)
Livestock	2	7	1	-	-	10	(26.3)
Tree Fruit	-	-	3	-	-	3	(7.9)
Other	-	1	1	-	-	2	(5.3)
Column Total (%)	2 (5.3)	14 (35.8)	20 (52.6)	1 (2.6)	1 (2.6)	38 (100.0)[a]	(100.0)

[a]May not add up to 100.0 due to rounding.

Table X is a compilation of Tables VIII and IX. It shows the numbers of full-time and part-time farmers, by farm types.

Diversified Farms

Diversified farms made up the largest farm type, accounting for 61% of the sample farms (Table XI). Diversification consisted of two to seven types of enterprises occurring on a farm. Other farm types shown in Table XI are single crop, specialized farms. Collectively, specialized farms represented only 39% of the sample farms.

A better picture of actual land use can be realized by separating the diversified farm types based on land use and crops grown. These diversification types are shown in Table XII. Highly diversified farms consisted of farms with three or more crops or land uses. Many of these farm types were organized for the production of row crops, grain, and grass for seed. With this in mind, the importance of grain and grass seed becomes clearer, particularly when considered together with the next five diversified types, where grain and grass seed are in the two-crop diversification types.

TABLE X. FARM TYPES.

Farm Type	Number Farms	Relative Frequency (%)
Diversified	86	61.0
Grass for Seed	14	9.9
Grain	3	2.1
Berry	7	5.0
Livestock	11	7.8
Row Crops	4	2.8
Tree Fruit	3	2.1
Dairy	9	6.4
Other	4	2.8
Total	141	100.0

TABLE XI. FARM TYPES BY COUNTIES.

Farm Types	County					Row Total	(%)
	Benton	Linn	Marion	Polk	Yamhill		
Diversified	2	28	39	10	7	86	(61.0)
Grass for Seed	1	13	-	-	-	14	(9.9)
Grain	-	-	1	1	1	3	(2.1)
Berry	-	-	7	-	-	7	(5.0)
Livestock	2	7	2	-	-	11	(7.8)
Row Crops	-	-	4	-	-	4	(2.8)
Tree Fruit	-	-	3	-	-	3	(2.1)
Dairy	-	4	3	-	1	9	(6.4)
All Other	-	1	3	-	-	4	(2.8)
Column Total	6	53	62	11	9	141	(100.0)
(%)	(4.3)	(37.6)	(44.0)	(7.8)	(6.4)		(100.0)[a]

[a]May not add up to 100.0 due to rounding.

TABLE XII. TYPES OF DIVERSIFICATION.

Type Diversification	Number of Farms
Highly Diversified[1]	53
Grain - Grass for Seed	14
Grain - Pasture	7
Grain - Tree Fruit	1
Grass for Seed - Pasture	5
Grass for Seed - Legume for Seed	1
Row Crop - Berries	2
Tree Fruit - Pasture	1
Berry - Pasture	1
Livestock - Hay	1
Total	86

[1]Three or more enterprises.

Acreage of Surveyed Farms

The 141 surveyed farms contained 63,748 acres of land. Linn County had the largest acreage with 30,645 (48.1% of sampled acreage), followed by Marion County with 13,521 acres (21.2%), Polk County with 10,340 acres (16.2%), Benton County with 4,957 acres (7.8%), and Yamhill County with 4,285 acres (6.7%). The acreages by farm types within each county are shown in Table XIII.

Two farm types which stand out because of the high acreages are diversified, and grass for seed. For Linn, Polk, and Benton counties, much of the land in farms classified as diversified are in grain-grass for seed type diversification. Therefore, actual grass for seed and grain acreages would be much higher than shown in Table XIII.

In Marion County, where 11,351 acres are in diversified farms, the degree of diversification is generally higher. Row crops, grain, berries, tree fruits, legumes for seed, and hay and pasture are the common crops and land uses.

TABLE XIII. ACREAGE OF SURVEYED FARMS BY FARM TYPES AND COUNTIES.

Farm Type	Benton	Linn	County Marion	Polk	Yamhill	Row Total
Diversified	1,800	10,123	11,351	9,790	4,203	37,267
Grass for Seed	3,000	20,002	-	-	-	23,002
Grain	-	-	20	550	12	582
Berry	-	-	151	-	-	151
Livestock	115	172	133	-	-	420
Row Crops	-	-	1,465	-	-	1,465
Tree Fruit	-	-	41	-	-	41
Dairy	42	328	241	-	70	681
All Other	-	20	119	-	-	139
Column Total	4,957	30,645	13,521	10,340	4,285	63,748

Mean Farm Sizes

The mean farm size for all surveyed farms was 452.8 acres with a standard deviation of 702.6 (Table XIV). The large standard deviation is caused by the extremely wide range of farm sizes, from 5 to 5,400 acres. The 95% confidence interval of 334.1 to 570.1 indicates a distribution curve skewed to the left, and tailing off gradually to the right.

In Table XIV, the mean farm sizes of the various farm types are shown for each of the five counties. Discounting the single sample for grass seed in Benton County, grass seed farms have the largest mean size, with 1,538.6 acres. The large standard deviation again indicates a wide variability in sizes, in this case, from 150 to 2,750 acres.

Division of farms by full-time and part-time operators do not fully explain the wide ranges. Some part-time farms are larger than some full-time farms. The farm size may be influenced by the type crops grown. Grain and grass for seed require large farms, and berries and tree fruits, much smaller farms. Conversely, the farm size may influence the crops grown. The operator of a large farm relies upon mechanization. The ability to mechanize may be one of the major factors in his crop selection.

There are wide variations in farm sizes within the

TABLE XIV. MEAN FARM SIZE BY COUNTIES AND FARM TYPES.

County and Farm Type	Number Farms	Mean Acres	Standard Deviation
Benton			
Diversified	2	900.0	848.5
Grass for Seed	1	3,000.0	0
Livestock	2	57.5	31.8
Dairy	1	42.0	0
Linn			
Diversified	28	361.5	641.6
Grass for Seed	13	1,538.6	2,343.5
Livestock	7	24.6	12.5
Dairy	4	82.0	36.2
All Other	1	20.0	0
Marion			
Diversified	39	391.1	377.6
Grain	1	20.0	0
Berry	7	21.6	13.2
Livestock	2	66.5	75.7
Row Crops	4	366.3	314.8
Tree Fruit	3	13.7	7.5
Dairy	3	80.3	34.9
All Other	3	39.7	17.6
Polk			
Diversified	10	979.0	1,645.9
Grain	1	550.0	0
Yamhill			
Diversified	7	600.0	690.9
Grain	1	12.0	0
Dairy	1	70.0	0
Total	141	452.8	

Standard deviation for ungrouped data: 708.6
95% confidence interval for mean of ungrouped data: 334.1 to 570.1

full-time and part-time farm groups. For the full-time farmers, farm sizes ranged from 15 to 5,400 acres. For the part-time farmers, the range extended from 5 to 424 acres.

Land Uses by Soil Categories

Tables XV, XVI, and XVII show the relationship of soil categories to number of farms, number of land uses, and the mean farm sizes.[3] The mean acreages by soil categories are shown in Table XV. Farms on Dayton soils have a mean of 903.3 acres, which is about twice the size of the mean (452.8 acres) for farms on all soils. The reason for such a high mean can be seen be referring to Table XVI, which cross tabulates soil categories with land uses. Grass for seed, and grain are the most common land uses, with 18 and 8 recurrences respectively, which account for 63.4% of the total land uses on Dayton soils. That grass for seed and grain are farmed in

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[3]Land uses are the uses by crops, such as grass for seed, grain, etc., and non-crop uses, such as pasture, fallow, or nursery. A single farm may have one, to as many as seven land uses. Therefore, in Tables with headings labeled "Land Uses", in cases involving all samples, the total land uses will be greater than 141. In other cases, the total number of land uses may equal or exceed the number of sample farms considered.

TABLE XV. MEAN ACRES BY SOIL CATEGORIES.

Soil Category	Number Farms	Mean Acres	Standard Deviation
Amity	23	598.7	747.4
Dayton	23	903.2	1,202.9
Woodburn	72	346.5	482.2
All Others	23	189.3	333.5
Total	141	452.8	

Standard deviation for ungrouped data: 710.3
95% confidence interval for mean of ungrouped data: 334.5 to 571.1

TABLE XVI. NUMBER OF LAND USES BY SOIL CATEGORIES.[1]

Land Use	Soil Category Amity	Dayton	Woodburn	Others	Row Total
Grass for Seed	11	18	22	5	56
Grain	14	8	46	8	76
Berry	1	1	18	2	22
Fallow	3	2	13	1	19
Row Crops	3	1	15	3	22
Tree Fruits	1	-	10	-	11
Nuts	-	1	2	-	3
Pasture	13	8	37	18	76
Legume for Seed	4	1	14	2	21
Sugar Beets for Seed	1	-	2	-	3
Nursery	-	-	2	-	2
All Others	4	1	16	4	25
Column Total	55	41	197	43	336

[1]Based on 336 land uses reported by 141 farmers.

TABLE XVII. MEAN FARM SIZE BY COUNTIES AND SOIL CATEGORIES.

County and Soil Categories	Number Farms	Mean Acres	Standard Deviation
Benton			
Amity	1	42.0	0
Dayton	1	3,000.0	0
Woodburn	0	-	-
All Other	4	478.8	690.6
Linn			
Amity	9	1,072.7	935.6
Dayton	18	563.1	441.3
Woodburn	16	603.6	605.5
All Other	9	66.2	59.2
Marion			
Amity	11	353.1	367.9
Dayton	1	1,820.0	0
Woodburn	42	150.5	210.8
All Other	8	187.3	270.1
Polk			
Amity	1	19.0	0
Dayton	2	2,753.0	3,743.4
Woodburn	6	754.0	583.4
All Other	2	172.5	74.2
Yamhill			
Amity	1	70.0	0
Dayton	1	313.0	0
Woodburn	7	557.4	720.5
All Other	0	-	-
Total	141	452.8	

Standard deviation for ungrouped data: 708.6
95% confidence interval for mean of ungrouped data: 334.1 to 570.1

large acreages has been demonstrated earlier. Therefore, the mean of 903.2 acres appears to be a good indicator of the true value of the mean acreage on all Dayton soils.

Farms on Woodburn soils have a mean size of 346.5 acres, considerably smaller than the mean size of farms on Dayton soils. The smaller mean farm size on Woodburn soils may be a reflection of the greater number of land uses which require small acreages. There were 32 uses for berries, tree fruits, nuts, and nurseries. Pastures and fallow land, which also were generally smaller in size than grass for seed or grain, were common on Woodburn soils. There were 50 such uses. Grass seed and grain land uses accounted for 35.5% of the total land uses, considerably less than for Dayton soils.

Amity soils have a high percentage (45.5%) of grass seed and grain uses, but this factor appears to be moderated by the large percentage (23.6%) of pastures, which are generally smaller in size than grass seed or grain uses.

Pastures also make up a large proportion (41.9%) of the land uses on the soils classified as "other", and may be responsible for the small mean size of 189.3 acres.

Table XVII shows the mean farm sizes of the four soil categories for each county. Two figures stand out in this table. The first is the mean acreage of 3,000 for Dayton soils in Benton County. This figure is a poor indicator of the true population mean because it was a single observation. The second striking figure is the mean of 2,753 acres for Dayton soils in Polk County. Here again, the mean is a poor indicator of the true population mean. Only two samples were obtained for this combination of variables and for one of the samples the farm size was 5,400 acres. This sample, coincidentally, was the largest farm in this study.

CHAPTER V

UPGRADING THE LAND USE CAPABILITY

Land Drainage

Problems Associated with Wetlands

Excessive soil wetness caused by poor drainage and inadequate drainage outlets is the major factor limiting agricultural uses of the wetlands. High soil moisture causes a number of adverse effects, among them, high water tables, manganese toxicity, and reduced yields.

High Water Tables

High water tables limit agricultural use of the wetlands to crops which can tolerate excessive soil moisture, and to pastureland. The moisture tolerant crops are primarily grasses, and in the better drained areas, cereal grains. By lowering the water tables through installation of drain tiles and by improving drainage outlets, the wetlands can support higher value crops.

Manganese Toxicity

Without drainage, the high water table increases the toxicity of manganese. In an experiment program conducted by Oregon State University, high concentrations of exchangeable and water-soluble manganese oxide resulted from the high water tables in Dayton soils. Bush beans planted on these wet soils began with vigorous growth, then died in the seedling stage. The failure of the bean plants to progress through the seedling stage was attributed to the level of manganese toxicity (Oregon State University, Agricultural Experiment Station, 1968, p. 31).

The level of available manganese can be controlled by providing adequate drainage. Experiments were conducted at the Jackson Farm using various drainage systems to evaluate their effectiveness in lowering the water table. On Dayton soils, the best drainage was provided by tiles spaced 45 feet apart and 20 inches below the soil surface, and with vertical channels filled with sawdust. These channels were spaced six feet apart and ran from tile to tile.

Although proven very effective in the experimental plots, this type of drainage system would be impractical for the commercial farmer. The sawdust in the channels would have to be replaced periodically. The additional costs of such operations may be beyond the increase in returns gained through increased crop yields.

A system which provided satisfactory drainage, and one which would be practical for commercial farms consisted of tiles spaced at 22.5 feet, and 20 inches below the surface. A third system with tile spacing increased to 45 feet was found to be the least successful of the systems tested (Oregon State University, Agricultural Experiment Station, 1968, p. 31).

Further tests were conducted on Dayton soils to determine the levels of manganese concentrations on drained and undrained plots. On the undrained soils, the concentrations at the depths 0 to 3 inches and 3 to 6 inches, rose quickly as heavy precipitation began in November. The concentrations remained well above the toxic level during the entire wet period. A falling trend did not develop until May, and finally, in mid-June, the level of manganese concentration dropped below the toxic level of 1 me/100 grams (Figure 13).

With drainage, the concentration at the 0 to 3 inch depth remained stable at well below toxic levels. At the 3 to 6 inch depth, manganese concentrations rose more slowly than in the undrained plots, remained fairly stable, and dropped below toxic levels in mid-April (Oregon State University, Agricultural Experiment Station, 1968, p. 34, 35).

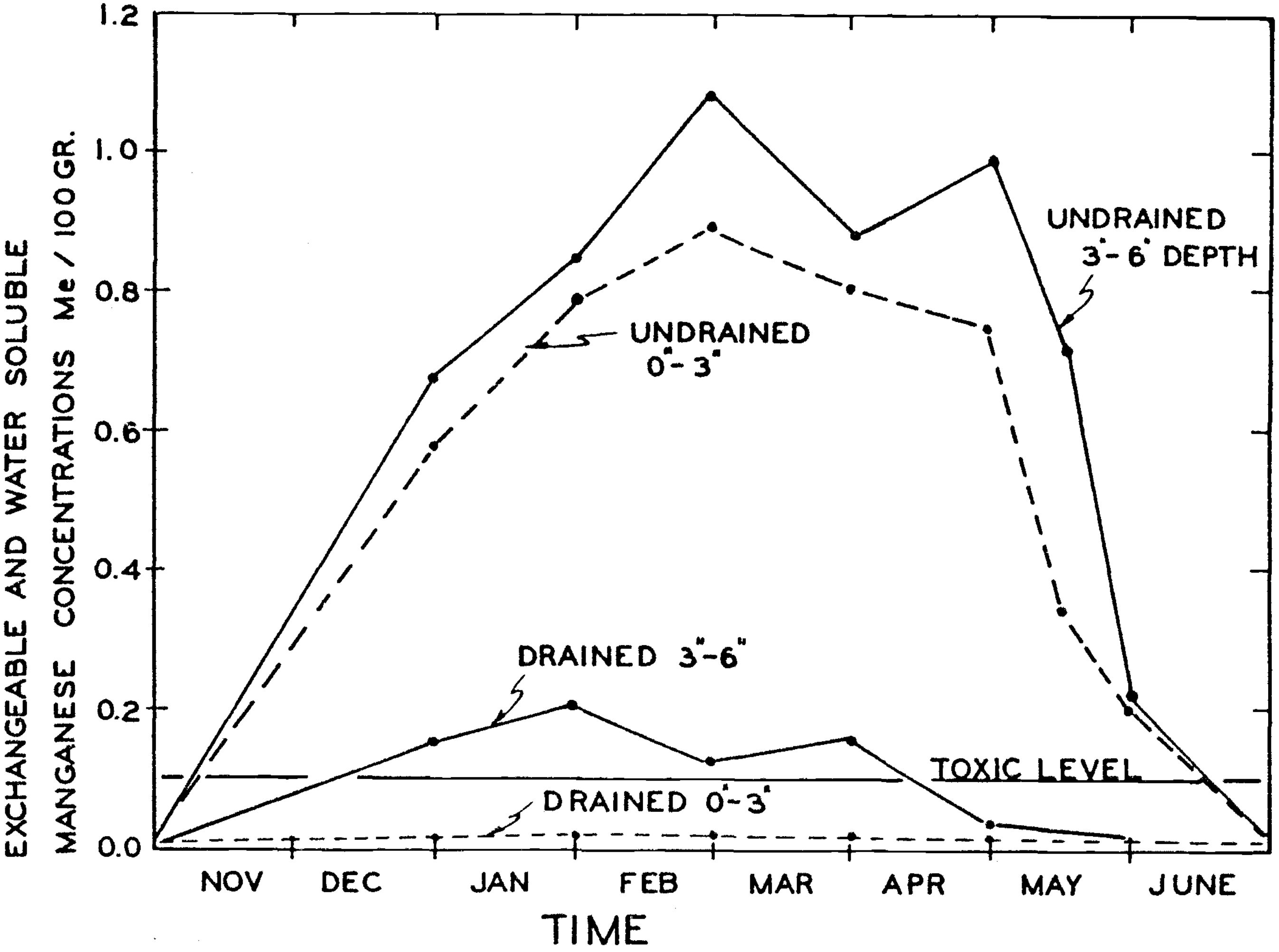


Figure 13. Manganese concentrations on drained and undrained plots.
After OSU Agricultural Experiment Station, 1968, Figure 12.

Reduced Yields

Drainage can provide significant increases in yield, particularly when combined with irrigation and application of commercial fertilizer. In an Oregon State University experiment on Dayton soils, test plots of alfalfa were fertilized and irrigated with 17 inches of water during the growing season. During the summer, four cuttings were harvested from these test plots.

The two undrained plots produced 3.44 and 6.19 tons per acre (dry matter) for a mean yield of 4.82 tons per acre. With tile drainage installed at 22 foot spacing, the mean yield of four test plots was 9.45 tons per acre, nearly double the mean yield of the undrained plots. These drained plots produced yields of 10.34, 8.75, 9.18, and 9.52 tons per acre. When the spacing of drain tile was increased to 45 feet in one test plot, the yield, at 4.34 tons per acre, was not any better than that of the undrained plots (Oregon State University, Agricultural Experiment Station, 1968, pp. 36, 39).

Drainage Costs

Drainage requirements vary considerably according to the soil type and adequacy of outlets. Some fields may require laterals spaced at 20 foot intervals to achieve the desired results. Others may need laterals at 80 foot spacings and only in the more poorly drained areas of the fields. If outlets are inadequate or not available, additional costs are incurred for pumping systems.

Costs also vary by the type of materials and size of tiles used in the laterals and main lines. For illustrative purposes, let us consider a 40 acre field which is square or rectangular. A field of this size and configuration will require the following lengths of laterals for the various spacings between laterals: 1,089 feet for 40 foot spacing, 900 feet for 50 foot spacing, and 740 feet for 60 foot spacing. Cost of the main lines of 8-inch diameter plastic tile will be in the neighborhood of $50 per acre. The combined cost per acre for the laterals and main lines will be $487 for the 40 foot spacing, $392 for the 50 foot spacing, and $340 for the 60 foot spacing. These costs are based on using 3-inch diameter perforated plastic tile for laterals in the 40 and 50 foot spacings, and 4-inch tile for part of the 60 foot spacing (Perrot, 1979).

Additional costs ranging from $4,000 to $5,000 ($100 to $125 per acre) can be expected if a pumping system is required due to inadequate outlets. Further costs can be incurred if the depth of tile placement is increased (Perrot, 1979).

The costs of installing clay tiles would be comparable to those of plastic drain tiles. For the 4-inch laterals at 40 foot spacing, the cost would be about $446 per acre. At 60 foot spacing, the cost is reduced to $303 per acre. If 6-inch tiles were used at the lower end of the field, the total costs would be increased moderately. Installed prices for the 4-inch and 6-inch clay tiles are $0.41 and $0.68 per foot (Soil Conservation Service, 1979).

For the 40 acre field, the capital investment required may be as much as $20,000, plus another $4,000 to $5,000 if a pumping system is required. These costs are for drainage only, and do not take into consideration the many other expenses the farm operator must satisfy.

A cost-sharing program by the federal government for drainage projects was helpful in reducing the farmers' costs for land improvement by drainage. This program, which aided in placing more land into agricultural production or improving production capacities, was in direct conflict with many other federal programs aimed at reducing farm output. Therefore, in 1973, the federal cost-sharing program for drainage improvements was discontinued. In 1974, the program was reinstated, but this revival lasted for only five years. On January 1, 1979, the federal cost-sharing program for drainage systems was again discontinued (Soil Conservation Service, 1979).

The disappearance of federal funds can be expected to reduce the amount of new drainage systems installed. Costs as high as $300 to $450 per acre, just for drainage improvement, appear to be beyond economic feasibility for most farmers. It should prove interesting to follow the developments arising from the latest decision to discontinue federal cost-sharing for drainage projects.

Characteristics of Drained Lands

Characteristics by Farm Types

A large proportion (46.1%) of the surveyed farms had at least part of the land drained artificially. There were 95 farms reporting 21,547 acres drained, 33.8% of the total land in the surveyed farms.

Table XVIII shows the number of farms with some drainage, and the number of acres that are drained. All of the counties had at least 50% of the surveyed farms with some drained farmland. Polk County, with 10 of its 11 farms, had the highest proportion (90.9%) of its farms with some drainage. Marion County, with 48 farms reporting some drained lands, had the highest absolute number of farms with drainage.

In looking at the actual acreages drained, Marion County reported 8,356 acres (61.8%). Linn County had a high acreage (5,954) but this represents only a small

TABLE XVIII. FARMS WITH ARTIFICIAL DRAINAGE.

County	Number Farms	%[a]	Acres Drained	%[b]
Benton	3	50.0	1,037	20.9
Linn	28	52.8	5,954	15.4
Marion	48	77.4	8,356	61.8
Polk	10	90.9	3,920	37.9
Yamhill	6	66.7	2,280	53.2
Total	95	46.1[c]	21,547	33.8

[a]Number of farms with drainage as a percent of farms surveyed in the county.

[b]Acres drained as a percent of total acreage of farms surveyed in the county.

[c]Number farms with drainage as a percent of all surveyed farms.

part (15.4%) of the total land in the surveyed farms. The large proportion of acreages drained in Marion and Polk counties (61.8% and 53.2%, respectively) correspond to the number of high value land uses taking place in these two counties. Linn and Benton counties, with large areas of their land in grass seed and grain crops, show much smaller proportions of drained lands.

The mean acreage of drained lands by farm types are shown for each county in Table XIX. The mean size of drained land for all farm types with drainage was 226.8 acres. Diversified farms made up 64.4% of the farm types with drainage. Linn and Marion counties had a combined total of 49 diversified farms which comprised 51.6% of all farms with drainage. The mean sizes of 223.1 and 226.6 acres correspond closely to the mean of 226.8 acres for all farms with drainage.

Characteristics by Soil Categories

The Woodburn category of soils was the most frequently drained (Table XX). The 10,771 acres drained was half the 21,547 acres of all soils drained within the sampled farm acreage. Amity was the next most frequently drained soil category with 5,895 acres (27.4%), and was followed by Dayton with 3,986 acres (18.5%), and other with 895 acres (4.2%).

Farmers appeared to be draining the soils which

TABLE XIX. MEAN ACREAGE DRAINED, BY COUNTIES AND FARM TYPES.

County and Farm Type	Number Uses	Mean Acreage	Standard Deviation
Benton			
Diversified	1	3.0	0
Grass for Seed	1	1,000.0	0
Livestock	1	34.0	0
Linn			
Diversified	18	223.1	298.7
Grass for Seed	8	235.6	240.5
Dairy	2	25.0	7.1
Marion			
Diversified	31	226.6	245.3
Berry	5	16.8	7.5
Livestock	1	120.0	0
Row Crop	4	212.5	132.5
Tree Fruit	2	18.0	0
Dairy	2	92.5	3.5
Other	3	19.7	9.5
Polk			
Diversified	9	374.4	596.8
Grain	1	550.0	0
Yamhill			
Diversified	6	380.0	469.1
Total	95	226.8	

Standard deviation for ungrouped data: 312.3
95% confidence interval for mean of ungrouped data: 163.2 to 290.4

TABLE XX. MEAN ACREAGE DRAINED, BY COUNTIES AND SOIL CATEGORIES.

County and Soil Category	Number Farms	Mean Acreage	Standard Deviation
Benton			
Dayton	1	1,000.0	0
Others	2	18.5	21.9
Linn			
Amity	7	340.6	413.6
Dayton	11	216.5	241.6
Woodburn	10	118.5	143.4
Marion			
Amity	10	351.1	335.2
Dayton	1	320.0	0
Woodburn	32	119.2	147.8
Others	5	143.0	145.6
Polk			
Dayton	2	132.0	70.7
Woodburn	6	585.5	641.0
Others	2	71.5	2.1
Yamhill			
Dayton	1	20.0	0
Woodburn	5	452.0	485.9
Total	95	226.8	

Standard deviation for ungrouped data: 312.3
95% confidence interval for mean of ungrouped data: 163.2 to 290.4

were best suited for agriculture, and those with the least degrees of drainage problems. This may have been in response to the already existing capacity of Woodburn and some Amity soils to support high value crops. Another factor may have been the reduced per acre costs of draining these soils. Spacing between laterals can be much greater in these soils than in the less permeable soils such as Dayton soils. In many areas, Woodburn soils needed drainage only in the wetter or lower portions of the fields.

In Table XX, the mean acreages drained by soil categories are shown for each county. Several figures on this table appear inconsistent with other information already presented. First, the mean of 1,000 acres of Dayton soils drained for Benton County is a single observation and, therefore, not a good indicator of the true mean for all farms in Benton County. It would be more appropriate to use a mean of 249.1 acres for all farms with drainage on Dayton soils.

Two additional figures which stand out are the means for Woodburn soils in Polk and Yamhill counties. In these cases, a large farm in each county pushed the mean considerably higher than the five-county mean of 203.2 acres. In Polk County, the acreage of the exceptionally large farm was 1,860, with all 1,860 acres drained. If this farm were to be disregarded, the revised mean for

Woodburn soils in Polk County would be 330.6 acres.

In Yamhill County, the exceptionally large farm consisted of 2,130 acres, of which, 1,265 acres were drained. If this farm were to be disregarded, the new computed mean for Woodburn soils would be 248.8 acres.

Therefore, for Polk and Yamhill counties, the small number of samples enabled the large farms to seriously affect the means. These mean acreages may not be good indicators of the true means of drained lands on all farms in Polk and Yamhill counties.

Characteristics by Land Uses

These large farms also affect, but to a lesser degree, the mean values found in Appendix IV, Acreage Drained by Land Uses. The 1,860 acre farm in Polk County, for example, had large acreage land uses which were on drained lands; 1,200 in grass for seed, 400 in grain, and 200 in pasture. These large acreage land use units on drained lands may have forced the means for these land uses upwards.

In Yamhill County, the 2,130 acre farm had 1,265 acres of drained lands, 640 acres in legumes for seed, 400 acres in grain, and 120 acres in row crops. In this sample, the acreages of the land uses were not excessively large, and did not appear to seriously affect the means.

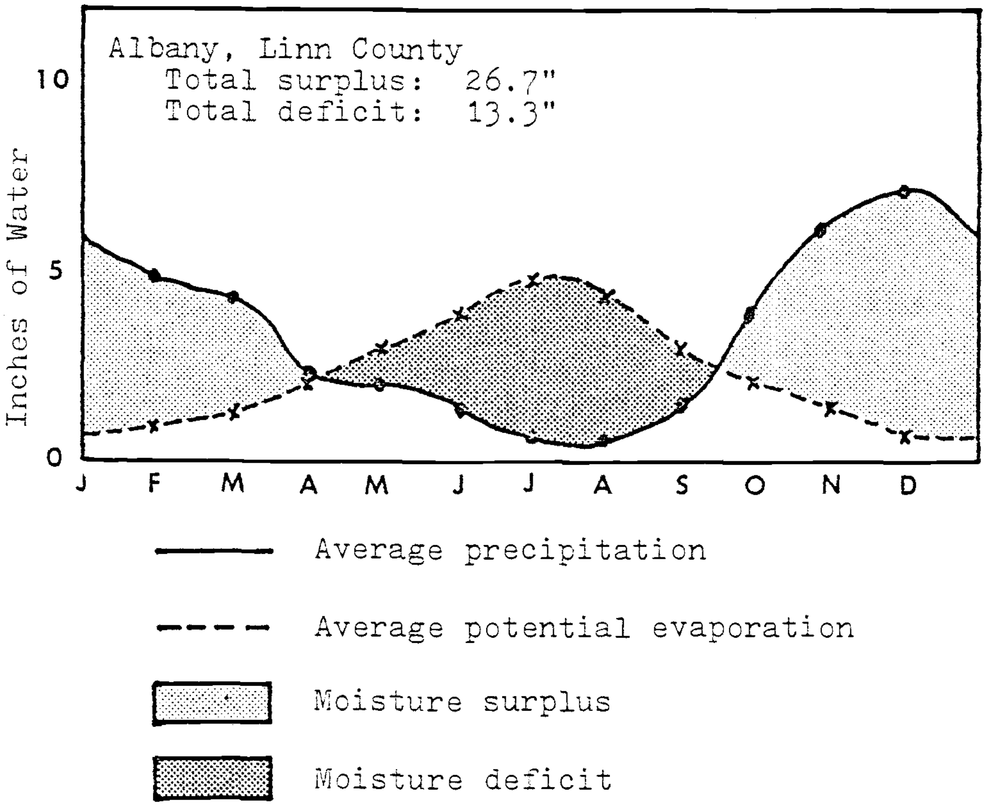
Irrigation

Irrigation is desirable on the wetlands because the period of least precipitation coincides with the growing season of most crops. This shortage of moisture during the time it is needed by crops, is aggravated in some soils because of extremely small water holding capacities. Dayton soils, for example, have available water capacity of only three to six inches, above the clay subsoil (USDA, 1972, p. 90).

Availability of Water vs. Requirements for Water

Figure 14 shows the water availability for Albany, Oregon. The average precipitation exceeds the potential evaporation from mid-September through about the first of April. The five-and-a-half month period, April through mid-September, shows potential evaporation exceeding average precipitation. This period of moisture deficit coincides with the growing season of most agricultural crops.

The growing season for some of the crops grown on the wetlands are shown in Figure 15. Most of the crops shown have growing seasons extending well into the summer months, and many other crops continue their growing season into mid-autumn. Some crops, such as tree fruits



Modified from Johnsgard, 1963.

Figure 14. Moisture surplus and deficit for Albany, Oregon.

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pasture & Hay			x	x	x	x	x	x	x	x	x	
Grass Seed			x	x	x	x						
Mint			x	x	x	x	x					
Legume Seed			x	x	x	x	x	x	x			
Alfalfa				x	x	x	x	x	x	x		
Spring Grains				x	x	x	x	x				
Fall Seeded Grains				x	x	x	x					
Orchards				x	x	x	x	x	x	x		
Berries					x	x	x	x	x	x	x	
Corn (sweet)					x	x	x	x				
Truck (Row) Crops						x	x					

Data from Agricultural Experiment Station, Oregon State University, Circular of Information 628, pp. 34, 35.

Figure 15. Growing season for selected crops, Willamette Valley, Oregon.

(orchards), berries, sweet corn, and truck (row) crops begin their growing season after the onset of moisture deficit conditions.

These crops may grow for some time on the moisture stored in the soils. However, these crops would not be able to reach maturity because the consumptive use of water would exceed the stored moisture.

In Table XXI, the consumptive use and irrigation requirements are shown for some of the crops depicted in Figure 15. Grass seed crops have consumptive use of only 8.42 inches. Most of this water requirement can be provided by the soil stored moisture. The period of moisture shortage occurs when the crops are in the hardening stage. At this period of growth, dry conditions are favorable for development of good seed. In terms of ideal amounts of water to provide the perfect growing environment, 2.66 inches of water should be supplied at the appropriate times.

The crop type requiring the least amount of water is truck (row) crops. Referring back to Figure 15, truck crops, however, are seen to begin their growing seasons in June, when the moisture deficit curve is approaching its peak. By this time, evaporation has removed a good portion of the soil moisture at the rooting depths. Hence, most (5.03 inches) of the water requirements must come from irrigation.

TABLE XXI. COMPUTED AVERAGE CONSUMPTIVE USE (CU) AND NET IRRIGATION REQUIREMENT (IR) FOR SELECTED CROPS IN THE WILLAMETTE VALLEY, OREGON.

Crop	CU, Inches	IR, Inches
Pasture Grass	27.91	15.27
Alfalfa	28.57	20.02
Legume Seed	23.08	14.99
Grass Seed	8.42	2.66
Spring Grains	15.45	10.19
Fall-Seeded Grains	22.18	15.85
Truck (Row) Crops	6.06	5.03

Source: Agricultural Experiment Station, Oregon State University, Corvallis, Circular of Information 628, Mar 68, p. 21.

Characteristics of Irrigated Lands

The 20 wetland soil series are generally suitable for irrigation. Four soil series, Amity, McBee, Semiahmoo, and Woodburn, are rated as excellent on irrigation suitability. Only two, Courtney, and Dayton with thick subsoil, are rated as poorly suited for irrigation. The remaining soil series fall into the categories of good and fair suitability (Table XXII).

Table XXIIa shows the distribution of the soils by irrigation suitability groups for each of the five counties. The excellent suitability group contains 48.9% of the irrigable land; good, 21.9%; fair, 24.5%; and poor, 4.8%.

Linn County, with 261,000 acres (38.6%), has the largest acreage of irrigable lands. Linn County is followed by Marion with 29%, Yamhill with 11.9%, Benton with 10.5%, and Polk with 10%.

Appendix VI contains the acreages of soil series, by counties, for each irrigation suitability class.

Tables XXIII, XXIV, and XXV show the irrigated land under different variables. Table XXIII shows the mean irrigated acres for the various farm types occurring in each county. The cautionary note made earlier, in reference to possibly misleading mean sizes, should be kept in mind in instances where number of samples are small,

TABLE XXII. IRRIGATION SUITABILITY GROUPS.

Group I.	Excellent irrigation suitability, no serious limitations. Nearly level soils needing drainage. Amity McBee Semiahmoo Woodburn
Group II.	Good irrigation suitability. Deep soils limited mainly by permeability and wetness. Aloha Amity (associated with Dayton) Chitwood Clackamas Coburg Holcomb McAlpin Nestucca Wapato
Group III.	Fair irrigation suitability. Nearly level to gently sloping soils limited mainly by permeability and wetness. Awbrey Brenner Concord Conser Dayton Dayton, gravelly substratum Grande Ronde Holcomb (associated with Dayton) Waldo
Group IV.	Poor irrigation suitability. Limited mainly by clayey texture and wetness. Courtney Dayton, thick subsoil

Abridged from Oregon State Water Resources Board, Appendix 1-2, Table 5, pp. 41-43, 1969.

TABLE XXIIa ACREAGE (IN THOUSANDS) OF IRRIGATION SUITABILITY GROUPS, BY COUNTIES.

County	Group I Excellent	Group II Good	Group III Fair	Group IV Poor	Row Total
Benton	30.8	18.6	19.0	2.2	70.6
Linn	83.2	65.8	86.6	25.4	261.0
Marion	124.3	33.0	34.0	4.8	196.1
Polk	43.1	11.4	12.9	0	67.4
Yamhill	48.7	18.8	12.9	0	80.4
Column Total	330.1	147.6	165.4	32.4	675.5

TABLE XXIII. MEAN IRRIGATED ACRES, BY COUNTIES AND FARM TYPES.

County and Land Use	Number Farms	Mean Acres	Standard Deviation
Benton			
Diversified	1	280.0	0
Livestock	1	34.0	0
Linn			
Diversified	11	25.6	20.1
Grass for Seed	2	175.0	35.4
Legume for Seed	3	74.3	19.1
Marion			
Diversified	29	104.2	167.9
Berry	6	20.5	9.4
Livestock	1	6.0	0
Row Crops	4	305.0	254.6
Tree Fruit	1	18.0	0
Pasture	2	15.0	7.1
Legume for seed	3	65.3	47.1
Polk			
Diversified	4	31.3	45.9
Yamhill			
Diversified	5	103.8	61.2
Legume for Seed	1	65.0	0
Total	74	87.8	

Standard deviation for ungrouped data: 137.3
95% confidence interval for mean of ungrouped data: 56.0 to 119.6

TABLE XXIV. MEAN IRRIGATED ACRES BY COUNTIES AND SOIL CATEGORIES.

County and Soil Category	Number Farms	Mean Acres	Standard Deviation
Benton			
Amity	0	-	-
Dayton	0	-	-
Woodburn	0	-	-
All Others	2	157.0	174.0
Linn			
Amity	3	123.3	130.0
Dayton	6	42.7	30.1
Woodburn	4	46.0	33.9
All Others	3	15.0	8.7
Marion			
Amity	8	93.8	88.8
Dayton	1	20.0	0
Woodburn	31	90.1	161.6
All Others	6	175.7	262.9
Polk			
Amity	1	8.0	0
Dayton	1	7.0	0
Woodburn	1	10.0	0
All Others	1	100.0	0
Yamhill			
Amity	1	65.0	0
Dayton	1	115.0	0
Woodburn	4	101.0	70.3
All Others	0	-	-
Total	74	87.8	

Standard deviation for ungrouped data: 137.3
95% confidence interval for mean of ungrouped data: 56.0 to 119.6

TABLE XXV. ACREAGE OF IRRIGATED LAND BY USES AND COUNTIES.

Land Use	Benton	Linn	County Marion	Polk	Yamhill	Row Total
Grass for Seed	-	405	408	-	-	813
Grain	120	-	15	-	-	135
Berry	-	10	205	17	15	247
Fallow	-	-	7	-	-	7
Truck Crop	-	-	3,421	-	230	3,651
Tree Fruit	-	-	30	-	-	30
Nut	-	-	-	-	-	-
Pasture	154	452	460	8	65	1,139
Legume for Seed	-	-	91	100	274	465
Sugarbeet for Seed	-	-	81	-	-	81
Nursery	-	-	30	-	-	30
Peppermint	-	-	-	-	-	-
All Others	-	-	-	-	-	-
Column Total	274	867	4,748	125	584	6,598
As % of surveyed farmland in county	5.5	2.2	35.1	1.2	13.6	9.2[a]

[a]As % of surveyed land in five counties.

and standard deviations are large. For all farms with irrigation, the average acreage irrigated was 87.8 acres.

The cautionary note also holds true when reviewing Table XXIV. In this table, the means for irrigated acres are presented for soil categories, for each county.

Table XXV shows the irrigated acreages by land uses for each of the counties. The importance of irrigation to row crops is clearly demonstrated, particularly for Marion County. More than half of all irrigated lands in the study area are in the row crops of Marion County. This is not surprising when considering that Marion County has the highest income of all counties in Oregon which are derived from agricultural products.

For Linn and Marion counties, the land use labeled grass for seed contain 405 and 408 acres, respectively. Grass grown for seed is usually not irrigated. In these cases, the grasses were late planted grasses, or newly planted perennial grasses.

Irrigated pastures account for 17.3% of the irrigated acreage of the surveyed farms. The land use which is designated as pasture includes pasture for cattle and sheep, as well as land used for hay, and hay-pasture combination.

Irrigation Types and Costs

All of the 74 irrigated land uses were watered by sprinkler systems. Of these, only five were self propelled systems. The remainder were moved by attaching auxiliary power, or were hand set or stationary set.

Costs of irrigation systems are comparable to costs of installing drainage systems. For most sprinkler systems, the costs will be from $200 to $300 per acre, but labor costs can be high for the assembly and disassembly of these systems. Wheel lines consisting of 1/4 mile of 4-inch line and 33 sprinkler heads will cost about $4100, or about $24 per acre. Pumping costs will add another $200 per acre.

The newest pivot systems capable of irrigating 132 to 150 acres will cost about $57,000 to $68,000, including the costs of the well, pump, and power source. Per acre costs for these systems are $432 and $453, respectively.

CHAPTER VI

FARMERS' PERCEPTIONS OF PROBLEMS

Methodology

The third part of the questionnaire used in the field survey pertained to farmers' perceptions of factors which may have adversely affected their farming operations. The first question referred to serious problems which may have occurred during the five-year period, 1974 through 1978. The second question asked the farmers to look forward into the coming crop year, 1979, and to speculate whether or not they would be facing any serious problems.

For both questions, the farmers were asked to list the factors, if any, which they considered to be serious problems, beginning with the one which was of greatest adverse impact. This enabled subsequent separation of the answers to each question into two categories: the most serious problem, and all problems.

The responses from the farmers ranged from "no problems" to a maximum of four problems. Before data processing, these responses were classified into ten categories for problems of the five-year period, and nine categories for problems anticipated in 1979. The wide range of factors perceived as problems required the use of a special category called "other" for both the five-year period and 1979. This large list of factors resulted from the intentionally designed, open-ended questions. The description of the problem was left to the respondent. This prevented the interviewer from leading or prompting the respondent's answers. It also allowed more accurate descriptions of the problems.

Problems Experienced during Period 1974-1978

Table XXVI shows the distribution of responses pertaining to the five-year period. Of the 141 surveyed farmers, 106 (75.2%) indicated they had experienced at least one serious problem which adversely affected their farming operations. Only 35 farmers (24.8%) experienced no serious problems.

The ten categories of problems can be further reduced to four major groups. The first group deals with profits, and includes the categories of high costs, low prices, and inflation. The 26 responses in this group represented 24.5% of the problems. The second group is related to production, and it combines the categories of weather, disease, low yields, and pests. This group brought the highest number of responses (42) and it was responsible for 39.6% of the problems reported. The third group, designated as use limitations, was made up of two

TABLE XXVI. MOST SERIOUS PROBLEM DURING THE PAST FIVE YEARS.

Problem			County			Row
	Benton	Linn	Marion	Polk	Yamhill	Total
Weather	-	12	10	3	1	26
High Costs	-	3	5	-	-	8
Low Prices	2	4	6	3	2	17
Inflation	-	-	1	-	-	1
Government	-	4	2	-	-	6
Burn Restrictions	-	11	3	1	-	15
Disease	-	-	6	1	1	8
Low Yield	-	1	1	-	3	5
Plant Pests	-	-	3	-	-	3
Other	2	5	7	2	1	17
Column Total	4	40	44	10	8	106
No Problems	2	13	18	1	1	35
Column Total	6	53	62	11	9	141

categories; government regulations, restrictions, and interference; and field burning restrictions. There were 21 responses (19.8%) of problems in this group. The last group is the category of "other". There were 17 problems (16%) cited in this group.

Looking at the categories of problems, the largest number of problems were related to weather. The 26 responses made up 24.5% of all problems. The factors which were considered to be serious problems by the farmers were drought, excessive rain, rain at the wrong time, winters which were too mild, and winters which were too cold.

By far, the most common source of problems was rain. Rain at the inopportune moment ruined hay, caused lodging of grain and grass seed crops, caused sprouting of grain, spread diseases and made the soils too soft to support farm equipment.

Winters which were too warm were blamed for allowing insects and diseases to winter over, to cause serious damage the following spring. On the other hand, winters which were too severe caused crop damages, particularly in the caneberries and some tree fruits. Grains and some grasses in seedling stages were also susceptible to damage from freeze-thaw action.

Farmers who complained of government interference were primarily dairymen, and grain and grass seed growers.

At the time the interviews were being conducted, the Oregon Legislature was debating whether or not to increase the acreages allowed for burning in 1979. Therefore, this potential problem was fresh on the minds of farmers. It is not surprising, then, that 15 of the grain and grass seed farmers thought the field burning restriction was the most serious problem.

In Appendix VI, the number of responses received in each problem category is shown by farm type where the response originated, for each county.

Table XXVII shows all of the problems cited by the farmers, by categories, and counties. The 106 farmers felt that there were 188 serious problems during the period 1974 through 1978. The trend of responses, by problem groups, generally followed the trend observed in reviewing the responses to the question of the most serious problem. Production problems accounted for the largest proportion of responses, and was followed by problem groups of profits, other, and use limitations.

In Appendix VI, the number of problems cited by the farmers are listed by farm types where the responses originated, and by problem categories, for each county.

A category which contained a large number of problems was "other". The 38 responses in this category accounted for 20.2% of all problems. The specific problems in this

TABLE XXVII. ALL SERIOUS PROBLEMS DURING PAST FIVE YEARS.[1]

Problem	Benton	Linn	County Marion	Polk	Yamhill	Row Total
Weather	-	20	14	4	2	40
High Costs	1	6	7	-	1	15
Low Prices	2	10	14	4	2	32
Inflation	-	-	1	1	-	2
Government	-	5	3	1	1	10
Burn Restrictions	-	14	3	2	-	19
Disease	-	6	10	3	1	20
Low Yield	-	2	2	-	4	8
Plant Pests	-	1	3	-	-	4
Other	3	13	18	2	2	38
Column Total	6	77	75	17	13	188

[1]Based on 188 problems cited by 106 farmers (75.2%), and 35 farmers (24.8%) experiencing no serious problems.

category are listed in Table XXVIII. Most of these problems were highly individualized to the type of farming operation or to the specific farmer. For example, the problems of "no market for row crops" and "grading of beans" were specific to row crop farms. In these cases, the problems consisted of non-notification of contracts by the cannery, and downgrading of beans when production was good.

Another example of a highly individualized problem was the grass seed farmer who farmed land in three counties. Each time he moved his large farm equipment on the highways he was required to obtain a transportaion permit from the state, and to provide escort vehicles.

Problems Anticipated in 1979

The second question pertained to factors which the farmers anticipated as problems for the coming crop year, 1979. The responses to this question, when considered by the groups of problems, showed generally the same distribution as for the five-year period, with the exception of use limitations. For the problem groups of profit, production, and other, the differences between the percentages of responses for the two periods were less than 5%, based on all problems. For the category of use limitations, only five responses were received for 1979, four on field burning restrictions, and one on government

TABLE XXVIII. OTHER PROBLEMS, PAST FIVE YEARS.[1]

Problem	Number
Excessive wetness	6
Inadequate drainage	1
Labor shortage	6
Poor labor quality	3
High labor costs	2
Weeds	2
Ryegrass in wheat	1
Wild oats in wheat	1
Unstable market	2
No market for row crops	1
Grading of beans	1
Equipment breakdowns	2
Calf shortage	1
Poor cow fertility	1
Feed shortage	1
Soil erosion	2
Problems with partners	1
Financing difficulty	1
Chemical restrictions	1
Transportation restrictions	1
Anti-agricultural mood	1
Total	38

[1]Based on 26 farmers responding with problems.

interference.

Although, in general, there were only minor differences in the comparison of groups of problems for the two periods, significant differences appeared in the comparison of problem categories. For 1979, problems associated with freeze and freeze-thaw damage became the most importnat category with 23 responses (33.8%). This high response rate was attributable to the exceptionally cold temperatures in January, 1979. At the Oregon State University Hyslop Agronomy Farm, the average temperature was 31.6 degrees Fahrenheit, 7.2 degrees below normal. Temperatures dropped as low as 12 degrees Fahrenheit on January 1. On 27 of the 31 days in January, temperatures dipped below freezing. Furthermore, on 20 of the 27 days with freezing temperatures, the daytime high was above freezing, and in most cases, sufficient to cause a diurnal freeze-thaw cycle (U.S. Weather Service, 1979).

The cold temperatures were below the tolerance level for some caneberries. Areas susceptible to cold air pockets were especially hard hit by freeze damage. On the grain and grass seed farms, many fields of new crops were severely damaged by the tearing action of the freeze-thaw cycles on the seedling plants.

The occurrence of cold temperatures and freeze-thaw cycles during the interview phase may explain the high response rate in this category.

Field burning was not expected to be as serious a problem in 1979 as it was for the period 1974 through 1978. Field burning, as a problem for 1979, received only 5 responses, compared to the 15 responses for the five-year period. The proposed ill to increase acreages presumably gave the farmers hope for increased acreages allowed for burning in 1979.

Two categories, which did not appear in Table XXVI (1974-1978) were added to Table XXIV (1979). These were labor shortage and fuel shortage. These two categories recieved 7 responses (10.3%).

The number of responses for categories of problems anticipated in 1979 are shown for each county in Table XXIX. The distribution of these responses, by farm types, are shown for each county in Appendix VIII.

When asked to list all serious problems which the farmers anticipated for 1979, 68 farmers (48.2%) responded with 94 problems. These problems are shown by the counties in which they were indicated, in Table XXX. In considering the problems by groups, production problems received 30 responses (44.1%). This was followed by profit problems with 19 responses (27.9%), other problems with 14 responses (20.6%), and use limitations with 5 responses (7.4%).

Appendix IX contains the information pertaining to

TABLE XXIX. MOST SERIOUS PROBLEM ANTICIPATED FOR 1979.

Problem			County			
	Benton	Linn	Marion	Polk	Yamhill	Row Total
Freeze and Frost	1	11	10	1	-	23
High Costs	1	1	2	-	2	6
Low Prices	1	3	2	2	2	10
Inflation	-	2	1	-	-	3
Government	-	1	-	-	-	1
Burn Restrictions	-	3	1	-	-	4
Labor Shortage	-	-	4	1	-	5
Fuel Shortage	-	1	1	-	-	2
Other	1	5	6	2	-	14
Column Subtotal	4	27	27	6	4	68
No Problems	2	26	35	5	5	73
Column Total	6	53	62	11	9	141

TABLE XXX. ALL PROBLEMS ANTICIPATED FOR 1979.[1]

Problem			County			Row
	Benton	Linn	Marion	Polk	Yamhill	Total
Freeze and Frost	1	15	12	2	-	30
High Costs	1	3	4	-	3	11
Low Prices	1	7	4	2	2	16
Inflation	-	3	1	1	1	6
Government	-	1	-	1	-	2
Burn Restrictions	-	4	3	1	-	8
Labor Shortage	-	1	4	1	-	6
Fuel Shortage	-	1	2	-	-	3
Other	1	3	5	3	-	12
Column Total	4	38	35	11	6	94

[1]Based on 94 problems cited by 68 farmers (48.2%), and 73 farmers (51.8%) anticipating no serious problems.

number of responses by farm types, for each county.

Problems which were included in the category designated "other" are listed in Table XXXI.

Problems associated with production formed the most important group of problems. The next most important group was that which involved profits. These two groups collectively accounted for 72% of all responses for problems anticipated in 1979.

TABLE XXXI. OTHER PROBLEMS, 1979.

Problems in the category labeled "other" in Table XXX consisted of the following specific problems:

Unstable market

Weed control

Soil erosion

Inadequate drainage

Disease

Early blossoming of fruit trees

Loss of animals

Geese in ryegrass

Ryegrass in wheat

Ryegrass bag shortage

Feed/forage shortage

Chemical damage to wheat

CHAPTER VII

RECENT CHANGES IN AGRICULTURAL LAND USES

Of the 141 farmers surveyed, 15 (10.6%) reported that they had made land use changes during the past year. These changes excluded the changes occurring from normal crop rotation. Fourteen of these farmers were full-time operators, and only one was a part-time farmer. Linn County, with seven new uses, had the largest number of farms reporting changes in land uses. Linn County was followed by Marion County with five new land uses, Yamhill County with two, and Polk County with one. There were no new land uses reported in Benton County.

The 15 farmers reported a total of 19 land use changes. All of the reported changes were to other types of agricultural uses or crops. There were no changes made to non-agricultural uses. The number of land use changes by counties were: Linn, 9; Marion, 5; Yamhill, 4; Polk, 1; and Benton, none.

The changes involved 773 acres which represented only 1.2% of the 63,748 acres contained in the 141 surveyed farms.

Reasons for Land Use Changes

Table XXXII shows the reasons given by the farmers for converting land to new uses. Profit motive was the most important reason with seven indications. In some cases the changes were in response to several consecutive years of low yields and low prices for the crops being grown. In other cases, changes were made in response to changing market prices.

One farmer reported that differences in gross incomes from various crops could be very large. In 1977, he had, among other crops, 40 acres of sweet corn and 16 acres of strawberries. His income from sweet corn was $10,000 ($250 per acre) and from strawberries $30,000 ($1,875 per acre). The costs of harvesting strawberries were much higher than for corn because hand-picking was required. The farmer stated that the net income derived from strawberries were considerably higher than from sweet corn, but declined to go into the specifics of costs and profits.

Changes for experimental purposes with new crops also ranked quite high, with four responses. The sizes of the experimental plots were generally in proportion to the size of the farm on which the experiment occurred. One large diversified farm of 2,130 acres had two experimental crops, a 70 acre plot of white clover, and a 7 acre

TABLE XXXII. REASONS FOR LAND USE CHANGES BY COUNTIES.

Reason	Benton	Linn	County Marion	Polk	Yamhill	Row Total
Higher Profit	0	4	2	1	0	7
Experiment	0	1	1	0	2	4
Crop Rotation	0	0	1	0	2	3
More Nutrition	0	1	1	0	0	2
Government Interference	0	1	0	0	0	1
Higher Production	0	1	0	0	0	1
Improve Soil	0	1	0	0	0	1
Column Total	0	9	5	1	4	19

plot of white clover, and a 60 acre plot of fine fescue. A smaller farm of 238 acres had a 7 acre experimental plot of white clover. The last experimental crop was a one-acre plot of mint being grown by the teen-aged son of a diversified farmer.

The third most commonly cited reason for changes was to initiate crop rotation which was not part of the normal crop rotation practice. In most cases, the new rotation was conducted to enrich the soil after having used the field for long periods in one type crop. It was also used to reduce the infestation of plant pests.

A practice which was quite common in Marion County served as crop rotation but is not included in the figures of this study. The farmers swapped land to obtain the benefits of crop rotation without incurring the problems of acquiring new equipment. The land was usually swapped for the season or perhaps two years, then swapped back. This practice permitted the farmers to continue specializing in their own crops. Land swaps were most common between the row crop farmers, and grain and grass seed growers.

The two responses on more nutrition were given by a dairyman and a diversified farmer raising beef cattle. These farmers were primarily concerned with providing more nutritious feed and forage for their animals.

In the case of the dairyman, the change was from pasture to corn silage, and for the diversified farmer, the crop changed from alfalfa to grain.

Changes in Land Uses

Tables XXXIII, XXXIV, and XXXV show the land use changes from 1977 to 1978 by acreages. Linn County had 419 acres (54.2%) of land use changes; Yamhill, 208 acres (26.9%); Marion, 136 acres (17.6%); and Polk, 10 acres (1.3%).

Land Uses Added

Table XXXIII shows the acres of crops and uses added by counties. Legumes, with 315 acres, accounted for the largest proportion (40.8%) of the 773 acres with changed uses. Grass seed followed with 170 acres (22%), and grain was third with 127 acres (16.4%).

Land Uses Deleted

Table XXXIV shows the acres of crops and uses deleted, by counties. The largest loss appeared in grain, with 355 acres (45.9%). It was followed by grass seed with 198 acres (25.6%), silage and pasture with 113 acres (14.6%) and legumes with 100 acres (12.9%). Row crops and fallow accounted for only 7 acres, less than 1% of

TABLE XXXIII. ACRES OF CROPS ADDED BY COUNTIES, 1977 to 1978[a]

	County					
Crop	Benton	Linn	Marion	Polk	Yamhill	Total
Legume	0	160	7	0	148	315
Grass Seed	0	110	0	0	60	170
Truck Crop	0	0	60	0	0	60
Silage, Pasture	0	0	63	0	0	63
Grain	0	127	0	0	0	127
Peppermint	0	22	0	0	0	22
Strawberries	0	0	6	10	0	16
Totals	0	419	136	10	208	773

[a] Data based on 15 farmers reporting 19 crops added.

TABLE XXXIV. ACRES OF CROPS DELETED, BY COUNTIES, 1977 to 1978[a]

Crop	County					
	Benton	Linn	Marion	Polk	Yamhill	Total
Legume	0	0	30	0	70	100
Grass Seed	0	198	0	0	0	198
Truck Crop	0	0	6	0	0	6
Silage, Pasture	0	80	33	0	0	113
Grain	0	140	67	10	138	355
Fallow	0	1	0	0	0	1
Totals	0	419	136	10	208	773

[a] Data based on 15 farmers reporting 19 crops deleted.

TABLE XXXV. LAND USE CHANGES BY NUMBERS AND ACRES, 1977-78

	Use Added		Use Deleted		Net Gain (Loss)	
Crop	Number	Acres	Number	Acres	Number	Acres
Legume	7	315	2	100	5	215
Grass Seed	3	170	4	198	(1)	(28)
Truck Crop	1	60	1	6	0	54
Silage, Pasture	2	63	2	113	0	(50)
Grain	2	127	9	355	(7)	(228)
Peppermint	2	22	0	0	2	22
Strawberries	2	16	0	0	2	16
Fallow	0	0	1	1	(1)	(1)
Totals	19	773	19	773		

the acreage deleted.

Net Gains or Losses in Land Uses

Table XXXV compares the numbers of uses, and acreages of added and deleted land uses, and shows the net gains or losses for each land use or crop. There were large net gains in acreages for legumes, and smaller net gains for row crops, peppermint, and strawberries.

The largest net acreage loss was for grain. Smaller net losses occurred for silage and pasture, and in grass for seed. The one-acre net loss of fallow land was due to conversion to a small-scale experiment with peppermint.

Number of Changes by Soil Categories

The land use changes occurred most frequently on Dayton and Woodburn soils. Nine of the changes (47.4%) were on Dayton soils, seven on Dayton-Amity soil association, and two on Dayton-Amity-Woodburn association. Eight of the changes (42.1%) occurred on Woodburn soils, six on Woodburn-Amity soil association, and one each on Woodburn-Willamette, and Woodburn-Willamette-Amity associations. The final two changes (10.5%) were on Amity soils of Amity-Woodburn association.

Anticipated Changes

Although the questionnaire did not address future changes, three of the farmers volunteered this information. The manner in which this information was received makes it unusable as indicators of actual trends, but still provides added insight to changes occurring in land uses. The observations generally support the conclusion that farmers who do make land use changes upgrade the uses to higher value crops and uses.

The first farmer operated a farm in Polk County near the town of Independence. He planned to convert 35 acres of idle land to blackberries. The second farmer had his farm north of Salem, in Marion County. He had a 10 acre woodlot which he planned to clear and turn to pasture. The third farmer worked a 1,000 acre farm in northern Linn County. In 1978, his wheat produced yields of less than 50% of what he considered normal, and ryegrass seed yields of 75% of normal. To compound his problems, the wheat was rained on and had begun to sprout before harvesting operations began. This farmer planned to convert a yet undecided amount of land currently in wheat and grass seed to row crops and peppermint.

Farmer Satisfaction/Dissatisfaction

Farmers who had made land use changes were generally satisfied with the results. These responses are shown in Table XXXVI. Twelve of the changes (63.2%) were considered satisfactory, while only three (15.8%) were rated as unsatisfactory. The farmers who expressed dissatisfaction had made crop changes to wheat and grass seed. Their dissatisfaction were related to the problem of unusually low yields in 1978. For wheat, the yield was about 50% on normal, and for grass seed, about 75% of normal yields. This problems was widespread throughout the Willamette Valley. The success or failure of four of the new land uses (21.1%) could not be evaluated because they had not been harvested.

TABLE XXXVI. SATISFACTION/DISSATISFACTION WITH RESULTS OF LAND USE CHANGES, BY COUNTIES.

Response	County					
	Benton	Linn	Marion	Polk	Yamhill	Total
Satisfied	0	7	3	0	2	12
Dissatisfied	0	1	2	0	0	3
No Response[1]	0	1	0	1	2	4
Totals	0	9	5	1	4	19

[1] No response by farmers who have not yet harvested or marketed crops from the new plantings.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

The Mid-Willamette Valley

Benton, Linn, Marion, Polk, and Yamhill counties have been and continue to be important contributors to the agricultural production of Oregon. In 1977, the total value of sales of agricultural products of this region amounted to 293 million dollars, 28.4% of the value of sales of agricultural products for the entire state. Grain, grass seed, and row crops are the major products in both volume and sales value.

The Wetlands as a Land Resource Base

Most of the agricultural production of the Mid-Willamette Valley takes place on the wetlands. The wetlands consist of twenty soil series which are classified by the Soil Conservation Service as having excessive soil moisture as the major limiting factor. Grass is grown for seed on the most poorly drained soils, particularly the ryegrasses, which are able to tolerate wet soils and seasonal inundation. Fine grasses and grains are grown on better drained areas, and rowcrops, tree fruits, nuts, and berries are found on the best drained areas of the wetlands.

Areas not suitable for cultivation are left in pasture or woodlots. Uncultivated area, however, are not common on the wetlands, and account for only a very small portion of the total land base.

Farm Characteristics

This study was based primarily on personal interviews with 141 wetland farmers. The land area farmed by the interviewed farmers consisted of 63,748 acres, 9.8% of the 652,000 acres of wetlands in the five-county area. Seventy-three percent of the farmers were full-time farm operators, the remainder were part-time, semi-retired, or hobby farmers.

The mean size of farms was 452.8 acres. There was, however, large variability in mean farm sizes. Farms on the poorer soils were larger, with a mean of 903.2 acres on Dayton soils, and smaller on the better soils, with a mean of 346.5 acres for Woodburn soils.

The ranges of individual farm sizes were also highly variable. Full-time farmers operated farms ranging in sizes from 15 to 5,400 acres, and part-time farmers were found working farms ranging from 5 to 424 acres. The larger farms were generally in grain, grass for seed, or row crops, while tree fruits, nuts, and berries were commonly found on the smaller farms.

Most of the farms (61%) were diversified into two or more farm enterprises. Twenty-three percent were highly diversified, with three to seven enterprises taking place on these farms.

Factors Which Limit Land Uses

The use of wetlands is influenced by physical and policy factors. The physical factors which severly limit agricultural uses are poor drainage and inadequate drainage outlets. These factors, in combination with heavy winter precipitation, create high water tables and ponding. In many areas, the adverse land qualities can be moderated or corrected by installing artificial drainage. In other areas, providing adequate drainage is difficult or economically infeasible.

The precipitation regime of this region also has a limiting effect on agricultural uses. With only one-fifth of the annual precipitation falling during the growing season of most crops, the crops which can be successfully grown without supplemental water are generally limited to the grains and grasses.

With adequate drainage and irrigation, most of the wetlands can be used for the cultivation of crops grown on the well-drained soils of the Willamette Valley. Land uses such as pasture and hay crops, which are usually associated with poor quality lands, can also benefit from land improvement projects.

Government policies influence the utility of the land. In some instances the policies limit land uses or restrict farm practices. Government imposed restraints which seriously affect land uses include acreage limitations to open field burning, and restrictions on use of chemical herbicides and pesticides. Other policies such as acreage limitations on wheat and the elimination of the federal cost-sharing program for drainage projects further act as limiting factors to land uses.

Farmers' Perceptions

The farmer's decisions are based on his perceptions of how and to what degree the physical and policy factors affect his net income. When any factor seriously interferes with his farming operations or his net income, it becomes a problem. From the interviews, 64% of the farmers experienced problems during the past five-year period. These problems fell primarily into two groups, those affecting profits, and those affecting production. The problem categories which adversely affected profits included high costs to the farmer, low prices for farm products, and inflation. The problem categories relating to production consisted of weather, plant and animal diseases, low yields, and plant pests.

The third group of problems pertained to policy limitations and included categories such as field burning restrictions; and government regulations, restrictions, and interference. This group of problems represented 19.8% of the problems cited by the farmers. Seventeen percent of the problems were in a group designated as "other". These were problems which were generally highly individualized to farm types or to the individual farmer.

Farmer Responses to Limitations and Problems

Drainage

Drainage has had, and continues to have, an important role in upgrading the land use capabilities of the wetlands. More than 33% of the land in the surveyed farms were drained. However, some of these lands required re-tiling in the older drainage systems because of clogging and broken tiles.

Current high costs of drainage systems and the elimination of federal financial support make it difficult for small farm operators to install new drainage systems. The current per acre costs of a drainage system is $300 to $400.

Irrigation

When lands are drained, irrigation systems are usually required for the cultivation of most crops. With only 6,598 acres of the surveyed farms under irrigation, and 21,547 acres of land already drained, there appears to be great potential for increased irrigation. The high costs of new irrigation systems will be likely to keep the rate of new systems at a slow to moderate pace. The current costs range from $225 to $300 per acre for the had set and wheel line irrigation systems to about $450 per acre for center pivot systems.

With the high combined costs of installing drainage and irrigation systems, it may be concluded that most of the new irrigation systems will go into watering high-value crops, such as row crops, berries, and tree fruits.

Land Use Changes

The survey revealed that 15 of the 141 members (10.6%) of the farmer population engaged in new land uses. Their entry into new crops were tempered with caution as indicated by the small mean size of 40.7 acres.

The land use conversions were generally successful, with only 15.8% of these farmers expressing dissatisfaction with the changes.

There appeared to be no general pattern to the distribution of farmers making the land use changes. Farmers in Linn County, where the poorest soils are located, accounted for 9 of the 19 changes. On the other hand, Marion and Yamhill counties, where the best of the wetland soils are found, also collectively accounted for nine land use changes.

Although in most cases, crops added by some farmers were deleted by others, there still were some indications of developing trends. Legumes for seed had a net increase of 5 uses for a net gain of 215 acres, and grain had a net decrease of 7 uses for a net loss of 228 acres. Peppermint and strawberries had 2 added uses each, with no deletions, for net grains of 22 and 10 acres each, respectively.

Concluding Remarks

The wetlands of the Mid-Willamette Valley has been and will continue to be an important agricultural base for Oregon and the United States. On the better soils of the wetlands, a wide variety of crops can be cultivated. The poorer soils, even without upgrading, provide the land base for the economically important grass seed and small grain enterprises. By upgrading the land use capabilities with drainage and irrigation, some of these poorly drained soils could produce high value crops. The high costs of land improvement, however, demand ample returns to pay for the capital improvements.

Most of the wetlands are currently limited to the production of grass seed due to the severe physical limitations. Upgrading the land use capabilities is becoming more difficult to the small farmer because of high costs for drainage and irrigation systems. Therefore, open field burning will continue to be an important issue on the wetlands.

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PERSONAL INTERVIEWS

Brooks, Royal H. Professor, Department of Agricultural Engineering, Oregon State University.

Chilcote, David O. Professor, Department of Crop Science, Oregon State University.

Fuller, James. Soil Conservation Service, Benton Office, Corvallis, Oregon.

Huddleston, J. Herbert. Extension Soil Science Specialist, Oregon State University.

Marks, Stephen M. Extension Agricultural Economist and Marketing Specialist, Oregon State University.

Mason, Robert. Social Survey Research Center, Oregon State University.

Perrot, Ken. PERRCO, Drainage contractor, Eugene-Springfield, Oregon.

Shearer, Marvin. Extension Irrigation Specialist, Oregon State University.

Youngberg, Harold W. Extension Agronomist, Oregon State University.

APPENDICES

I. QUESTIONNAIRE

"Hello. I'm Harry Tsutsui from Oregon State University. I am conducting a survey of agricultural uses of wetlands. You were selected for this survey on a random basis and your participation is very important for the accuracy of the survey. Will you please help? All of the information is strictly confidential. The survey results will be compiled for the entire study area, not for individuals. If you have any questions about the survey that I am unable to answer, please feel free to call Dr. Richard Highsmith at Oregon State University, telephone 754-3141."

Sample Nr. ________ Sample Section Nr. ________

Closest Neighbor? ___ Yes ___ No

Soil Mapping Unit ________

1. ___Yes ___No At any time in 1978 did you raise, produce or sell any amount of agricultural products, or not?

2. ___Full ___Part Are you a full-time farmer or a part-time farmer?

3. ____________ (type farm) How would you describe this farming operation?

4. ____________ (total acres) And how many acres were committed what crops in 1978?

________ Grain
________ Nursery
________ Berry
________ Ranch or pasture (cattle)
________ Ranch or pasture (sheep, lamb)
________ Grass seed
________ Truck crops
________ Tree fruits (orchard)
________ Poultry
________ Other (specify)

5. ____________ (county) ________acres In which county was the largest value of your agricultural products raised or produced, and what was the acreage in that county?

6. ___Yes ___No Would you say that 1978 was a normal or representative agricultural year?

7. ___Yes ___No Do you practice any type of crop rotation, or not? (if No, go to 9)

8. What crops do you normally rotate?

____

____

____

____

---

9. ___Yes ___No Was any land placed into different uses from the previous year, 1977, or not?
(If No, go to question 16)

10. What changes in land uses were made in 1978? That is, were any crops added or deleted in 1978? If so, what were the reasons for the changes?

Crops Added	Crops Deleted	Acres	Reason

Non-agricultural Uses:

Use Added	Use Deleted	Acres	Reason

11. ___Satisfied Were you satisfied or dissatisfied with the results of the land use changes?
___Dissatisfied (If dissatisfied, go to 13)

12. What were the reasons for your satisfaction with the land use changes of 1978, in order of importance?

1) ______________________________
2) ______________________________
3) ______________________________
4) ______________________________

13. If you were not satisfied with the results of the land use changes, what were the reasons for your dissatisfaction, in order of importance?

1) ______________________
2) ______________________
3) ______________________
4) ______________________

14. In comparison to the previous crops, what would you estimate were the costs in producing this alternate crop(s)?

%	More	or	Less	than	Previous Crop
____	____		____		____________
____	____		____		____________
____	____		____		____________
____	____		____		____________

15. In comparison to the previous crops what would you estimate were the profits of the alternate crop(s)?

%	More	or	Less	than	Previous Crop
____	____		____		____________
____	____		____		____________
____	____		____		____________
____	____		____		____________

16. What major problems, if any, were encountered during the five-year period 1974-1978 which adversely affected your farming operations, beginning with the most serious problem?

1) ______________________
2) ______________________
3) ______________________
4) ______________________

17. What major problems, if any, do you foresee in 1979, beginning with the most serious problem?

1) ______________________
2) ______________________
3) ______________________
4) ______________________

18. ___Yes ___No Was any land irrigated in 1978, or not?
(If No, gc to question 22)

19. _______Acres What was the total number of acres irrigated in 1978?

20. How many acres were irrigated by each of the methods listed below?

________ Furrows and ditches

________ Flooding

________ Self propelled sprinkler systems

________ All other sprinkler systems

21. What crops were grown on the irrigated lands, and about how many acres of each crop?

Crop	Acres
____________________________	_______
____________________________	_______
____________________________	_______
____________________________	_______

22. ___Yes ___No Was any land artificially drained, or not?
(If No, this is end of questionnaire)

23. _______Acres What was the total number of acres artificially drained in 1978?

24. What crops were grown on the artificially drained lands, and about how many acres for each crop?

Crop	Acres
____________________________	________
____________________________	________
____________________________	________
____________________________	________

II. CLASSIFICATION OF SOIL SERIES

Series	Subgroup	Family
Aloha	Aquic Xerochrepts	Fine-silty, mixed, mesic
Amity	Argiaquic Xeric Argialbolls	Fine-silty, mixed mesic
Awbrey	Typic Albaqualfs	Fine, montmorillonitic, noncalcareous, mesic
Brenner	Fluventic Humaquepts	Fine, mixed, acid, mesic
Chitwood	Aquic Haplohumults	Clayey, mixed, mesic
Clackamas	Typic Argiaquolls	Fine-loamy, mixed, noncalcareous, mesic
Coburg	Pachic Ultic Argixerolls	Fine, mixed, mesic
Concord	Typic Ochraqualfs	Fine, montmorillonitic, mesic
Conser	Typic Argiaquolls	Fine, mixed, noncal-careous, mesic
Courtney	Abruptic Argiaquolls	Fine, montmorillonitic, noncalcareous, mesic
Dayton	Typic Albaqualfs	Fine, montmorillonitic, mesic
Grande Ronde	Aquic Dystrochrepts	Very fine, mixed, mesic

Series	Subgroup	Family
Holcomb	Mollic Albaqualfs	Fine, montmorillonitic, mesic
McAlpin	Cumulic Ultic Haploxerolls	Fine, mixed, mesic
McBee	Cumulic Ultic Haploxerolls	Fine-silty, mixed, mesic
Nestucca	Fluventic Humaquepts	Fine-silty, mixed, acid, mesic
Semiahmoo	Histosols	-
Waldo	Fluventic Haplaquolls	Fine, mixed, noncal-careous, mesic
Wapato	Fluventic Haplaquolls	Fine-silty, mixed noncalcareous, mesic
Woodburn	Aquultic Argixerolls	Fine-silty, mixed mesic

III. SOIL SURVEY INFORMATION

The following list of soil survey information available for the study area is an abridged summary of Soil Survey Information Available in Oregon, printed in mimeograph form, March, 1978 by J.H. Huddleston, Extension Soils Specialist, Department of Soil Science, Oregon State University.

Benton County.

Modern (1973) SCS Soil Survey of the Alsea Area (Corvallis) (2)

Modern (1975) SCS Soil Survey of the Benton County Area (Corvallis) (2)

General Soil Maps of Drainage Basins in Oregon - I-2,3 (6)

Linn County.

Old (1924) Soil Survey (1)

Modern SCS Soil Survey in progress (Tangent) (4)

Willamette NF Soil Resource Inventory (Eugene) (7)

General Soil Maps of Drainage Basins in Oregon - I-2,3 (6)

Marion County.

Modern (1972) SCS Soil Survey of the Marion County Area (Salem) (2)

Willamette NF Soil Resource Inventory (Eugene) (7)

Mt. Hood NF Soil Survey complete by not yet published (Gresham) (3)

General Soil Maps of Drainage Basins in Oregon- I-2,3 (6)

Polk County.

Old (1927) Soil Survey (1)

Modern SCS Soil Survey completed but not yet published (Dallas) (3)

General Soil Maps of Drainage Basins in Oregon - I-2,3 (6)

Yamhill County.

Modern (1974) SCS Soil Survey of Yamhill Area (McMinnville) (2)

General Soil Maps of Drainage Basins in Oregon - I-2,3 (6)

KEY:

(1) Contact OSU Department of Soil Science.

(2) Contact the county SCS office at the city indicated in parentheses.

(3) Maps may be inspected at the county, district, or headquarters office in the city indicated.

(4) Work completed may be inspected at the location indicated.

(5) Contact the district office unless otherwise indicated.

(6) Appendices to Oregon's Long-Range Requirements for Water. Available from OSU Dept. of Soil Science.

(7) Contact the National Forest Headquarter office in the city indicated in parentheses.

IV. ACREAGE DRAINED BY LAND USES[1]

A. Benton County

Land Use	Acres Drained	Number Uses	Mean Acres Drained
Grass for Seed	1,000	1	1,000.0
Pasture	34	1	34.0
Peppermint	3	1	3.0
Column Total	1,037	3	345.7

B. Linn County

Land Use	Acres Drained	Number Uses	Mean Acres Drained
Grass for Seed	3,917	20	195.9
Grain	1,272	13	97.9
Pasture	173	6	28.8
Legume for Seed	565	3	188.3
Peppermint	27	1	27.0
Column Total	5,954	43	138.5

[1]For sampled farms.

C. Marion County

Land Use	Acres Drained	Number Uses	Mean Acres Drained
Grass for Seed	2,250	8	281.3
Grain	2,297	27	85.1
Berry	112	11	10.2
Fallow	127	3	42.3
Row Crops	2,164	15	144.3
Tree Fruit	47	4	11.8
Nut	23	2	11.5
Pasture	773	21	36.8
Legume for Seed	440	8	55.0
Sugar Beet for Seed	93	3	31.0
Nursery	30	2	15.0
Total	8,356	104	80.4

D. Polk County

Land Use	Acres Drained	Number Uses	Mean Acres Drained
Grass for Seed	1,535	5	307.0
Grain	1,862	7	266.0
Berry	7	1	7.0
Fallow	127	2	63.5
Nut	40	1	40.0
Pasture	264	2	132.0
Legume for Seed	85	2	42.5
Total	3,920	20	196.0

E. Yamhill County

Land Use	Acres Drained	Number Uses	Mean Acres Drained
Grass for Seed	65	1	65.0
Grain	1,040	4	260.0
Berry	15	1	15.0
Fallow	50	1	50.0
Row Crop	235	3	78.3
Tree Fruit	25	1	25.0
Pasture	20	1	20.0
Legume for Seed	754	4	188.5
All Others	76	1	76.0
Total	2,280	17	134.1

V. IRRIGATION SUITABILITY CLASS[1] (IN THOUSAND ACRES)

A. Group I, Excellent Irrigation Suitability

Soil Series	Benton	Linn	County Marion	Polk	Yamhill	Row Total
Amity	12.5	51.7	47.0	16.7	13.6	141.5
McBee	3.4	10.2	3.6	8.5	0.7	26.4
Semiahmoo	0	0	2.3	0	0.2	2.5
Woodburn	14.9	21.3	71.4	17.9	34.2	159.7
Column Total	30.8	83.2	124.3	43.1	48.7	330.1

B. Group II, Good Irrigation Suitability

Soil Series	Benton	Linn	County Marion	Polk	Yamhill	Row Total
Aloha	0	0	0	0	6.0	6.0
Chitwood	1.3	0	0	0	0	1.3
Clackamas	0	14.4	10.9	1.0	1.1	27.4
Coburg	3.2	7.2	0	1.0	0	11.4
Holcomb[2]	0.7	20.1	2.6	0	0.1	23.5
McAlpin	2.0	1.7	8.5	0	0	12.2
Nestucca	1.0	0	0	0.9	0.1	2.0
Wapato	10.4	22.4	11.0	8.5	11.5	63.8
Column Total	18.6	65.8	33.0	11.4	18.8	147.6

[1]For five-county area.

[2]Rated fair when associated with Dayton.

C. Group III, Fair Irrigation Suitability

Soil Series	Benton	Linn	County Marion	Polk	Yamhill	Row Total
Awbrey	2.2	4.5	0	0	0	6.7
Brenner	2.5	0	0	0	0	2.5
Concord	0	4.6	16.5	0.5	0.5	22.1
Conser	0	7.2	0	0	0	7.2
Dayton	11.0	42.1	11.5	8.1	5.5	78.2
Dayton, Ds[1]	0	4.4	0	0	0	4.4
Grande Ronde	0	0	0	1.3	1.4	2.7
Waldo	2.6	3.7	3.4	3.0	5.4	18.1
Column Total	18.3	66.5	31.4	12.9	12.8	141.9

[1]Dayton, gravelly subsoil.

D. Group IV, Poor Irrigation Suitability

Soil Series	Benton	Linn	County Marion	Polk	Yamhill	Row Total
Courtney	0	8.8	4.8	0	0	13.6
Dayton	2.2	16.6	0	0	0	18.8
Column Total	2.2	25.4	4.8	0	0	32.4

VI. MOST SERIOUS PROBLEM DURING PAST FIVE YEARS, BY FARM TYPES

A. Benton County

Problem	Farm Type Diver-sified	Grass Seed	Live-Stock	Row Total
Low Prices	1	1	-	2
Other	-	-	2	2
Column Total	1	1	2	4

B. Linn County

Problem	Farm Type Diver-sified	Grass Seed	Live-Stock	Dairy	Row Total
Weather	10	2	-	-	12
High Costs	1	-	-	2	3
Low Prices	-	3	1	-	4
Government	1	2	-	1	4
Burn Restrictions	7	4	-	-	11
Low Yield	1	-	-	-	1
Other	3	-	2	-	5
Column Total	23	11	3	3	40

C. Marion County

Problem	Farm Type: Diversified	Berry	Livestock	Row Crops	Tree Fruit	Dairy	Other	Row Total
Weather	7	1	-	1	-	1	-	10
High Costs	3	-	-	2	-	-	-	5
Low Prices	2	3	-	1	-	-	-	6
Inflation	1	-	-	-	-	-	-	1
Government	1	-	-	-	1	-	-	2
Burn Restrictions	3	-	-	-	-	-	-	3
Disease	5	-	-	-	-	-	1	6
Low Yield	1	-	-	-	-	-	-	1
Plant Pests	2	-	-	-	1	-	-	3
Other	4	1	1	-	-	1	-	7
Column Total	29	5	1	4	2	2	1	44

D. Polk County

Problem	Farm Type Diversified	Grain	Row Total
Weather	3	-	3
Low Prices	3	-	3
Burn Restrictions	1	-	1
Disease	-	1	1
Other	2	-	2
Column Total	9	1	10

E. Yamhill County

Problem	Farm Type Diversified	Grain	Row Total
Weather	1	-	1
Low Prices	2	-	2
Disease	-	1	1
Low Yield	3	-	3
Other	1	-	1
Column Total	7	1	8

VII. ALL PROBLEMS DURING PAST FIVE YEARS, BY FARM TYPES

A. Benton County

Problem	Farm Type Diver-sified	Grass Seed	Live-stock	Row Total
High Costs	-	1	-	1
Low Prices	1	1	-	2
Other	-	-	3	3
Column Total	1	2	3	6

B. Linn County

Problem	Farm Type Diver-sified	Grass Seed	Live-stock	Dairy	Row Total
Weather	16	4	-	-	20
High Costs	1	3	-	2	6
Low Prices	4	5	1	-	10
Government	2	2	-	1	5
Burn Restrictions	10	4	-	-	14
Disease	4	2	-	-	6
Low Yield	2	-	-	-	2
Plant Pests	1	-	-	-	1
Other	6	2	2	3	13
Column Total	46	22	3	6	77

C. Marion County

Problem	Farm Type: Diversified	Berry	Livestock	Row Crop	Tree Fruit	Dairy	Other	Row Total
Weather	10	1	–	2	–	–	1	14
High Costs	5	–	–	2	–	–	–	7
Low Prices	8	3	–	3	–	–	–	14
Inflation	1	–	–	–	–	–	–	1
Government	1	–	–	1	1	–	–	3
Burn Restrictions	3	–	–	–	–	–	–	3
Disease	6	2	–	–	1	1	–	10
Low Yield	2	–	–	–	–	–	–	2
Plant Pests	2	–	–	–	1	–	–	3
Other	13	1	1	1	–	–	2	18
Column Total	51	7	1	9	3	1	3	75

D. Polk County

Problem	Farm Type Diversified	Grain	Row Total
Weather	4	-	4
Low Prices	3	1	4
Inflation	1	-	1
Government	1	-	1
Field Burn	2	-	2
Disease	2	1	3
Other	2	-	2
Column Total	15	2	17

E. Yamhill County

Problem	Farm Type Diversified	Grain	Row Total
Weather	2	-	2
High Costs	1	-	1
Low Prices	2	-	2
Government	1	-	1
Disease	-	1	1
Low Yield	4	-	4
Other	2	-	2
Column Total	12	1	13

VIII. MOST SERIOUS PROBLEM ANTICIPATED FOR 1979, BY FARM TYPES

A. Benton County

Problem	Farm Type: Diver-sified	Farm Type: Grass Seed	Farm Type: Live-stock	Row Total
Freeze and Frost	-	1	-	1
High Costs	1	-	-	1
Low Prices	1	-	-	1
Other	-	-	1	1
Column Total	2	1	1	4

B. Linn County

Problem	Farm Type: Diver-sified	Farm Type: Grass Seed	Farm Type: Live-stock	Row Total
Freeze and Frost	9	2	-	11
High Costs	-	1	-	1
Low Prices	1	2	-	3
Inflation	1	-	1	2
Government	-	1	-	1
Burn Restrictions	2	1	-	3
Fuel Shortage	1	-	-	1
Other	4	-	1	5
Column Total	18	7	2	27

C. Marion County

Problem	Farm Type: Diver-sified	Berry	Live-stock	Row Crops	Tree Fruits	Other	Row Total
Freeze and Frost	5	4	-	-	-	1	10
High Costs	2	-	-	-	-	-	2
Low Prices	1	-	1	-	-	-	2
Inflation	1	-	-	-	-	-	1
Burn Restrictions	1	-	-	-	-	-	1
Labor Shortage	2	1	-	1	-	-	4
Fuel Shortage	-	-	-	1	-	-	1
Other	4	1	-	-	1	-	6
Column Total	16	6	1	2	1	1	27

D. Polk County

Problem	Farm Type Diversified	Grain	Row Total
Freeze and Frost	1	-	1
Low Prices	1	1	2
Labor Shortage	1	-	1
Other	2	-	2
Column Total	5	1	6

E. Yamhill County

Problem	Farm Type Diversified	Row Total
High Costs	2	2
Low Prices	2	2
Column Total	4	4

IX. ALL SERIOUS PROBLEMS ANTICIPATED FOR 1979, BY FARM TYPES

A. Benton County

Problem	Farm Type Diver-sified	Grass Seed	Live-stock	Row Total
Freeze and Frost	-	1	-	1
High Costs	1	-	-	1
Low Prices	1	-	-	1
Other	-	-	1	1
Column Total	2	1	1	4

B. Linn County

Problem	Farm Type Diver-sified	Grass Seed	Live-stock	Row Total
Freeze and Frost	13	2	-	15
High Costs	1	2	-	3
Low Prices	3	4	-	7
Inflation	1	1	1	3
Government	-	1	-	1
Burn Restrictions	3	1	-	4
Labor Shortage	-	1	-	1
Fuel Shortage	1	-	-	1
Other	3	-	-	3
Column Total	25	12	1	38

C. Marion County

Problem	Farm Type						Row
	Diver-sified	Grain	Live-Stock	Row Crops	Tree Fruit	Other	Total
Freeze and Frost	6	5	-	-	-	1	12
High Costs	4	-	-	-	-	-	4
Low Prices	3	-	1	-	-	-	4
Inflation	1	-	-	-	-	-	1
Burn Restrictions	3	-	-	-	-	-	3
Labor Shortage	2	1	-	1	-	-	4
Fuel Shortage	-	-	-	2	-	-	2
Other	3	1	-	-	1	-	5
Column Total	22	7	1	3	1	1	35

D. Polk County

Problem	Farm Type Diversified	Grain	Row Total
Freeze and Frost	2	-	2
Low Prices	1	1	2
Inflation	1	-	1
Government	1	-	1
Burn Restrictions	1	-	1
Labor Shortage	1	-	1
Other	3	-	3
Column Total	10	1	11

E. Yamhill County

Problem	Farm Type Diversified
High Costs	3
Low Prices	2
Inflation	1
Total	6

VITA

Setsuo Harry Tsutsui was born of Japanese immigrants to Hawaii in Waialua, island of Oahu, on May 14, 1937. After graduating from James B. Castle High School in Kaneohe, Hawaii in 1955, he enlisted in the United States Army. While in the service he received his Baccalaureate degree in Geography from the University of Nebraska at Omaha.

He served in the enlisted, non-commissioned officer, and commissioned officer ranks. His service included overseas tours of duty to Laos, Vietnam, Thailand, and Germany. His personal decorations include the Silver Star, Meritorious Service Medal, Bronze Star, Army Commendation Medal, Air Medal, and other U.S. and foreign decorations and awards. He was a Master Parachutist who served most of his active duty years with the Army Special Forces (Green Berets).

In 1975, after completing more than twenty years of continuous active serve, he retired from active duty with the rank of Major. He then began his graduate studies in September, 1975 at Oregon State University, and received his Master of Science degree in Geography in 1977. He continued directly into his doctoral studies and is expected to complete the requirements for the degree of Doctor of Philosophy in Geography in July, 1979.

He was initiated into the National Honor Society Phi Kappa Phi in May, 1979. He has accepted a position at Northern Arizona University and will join the Department of Geography in August, 1979 as Assistant Professor of Geography and Planning.