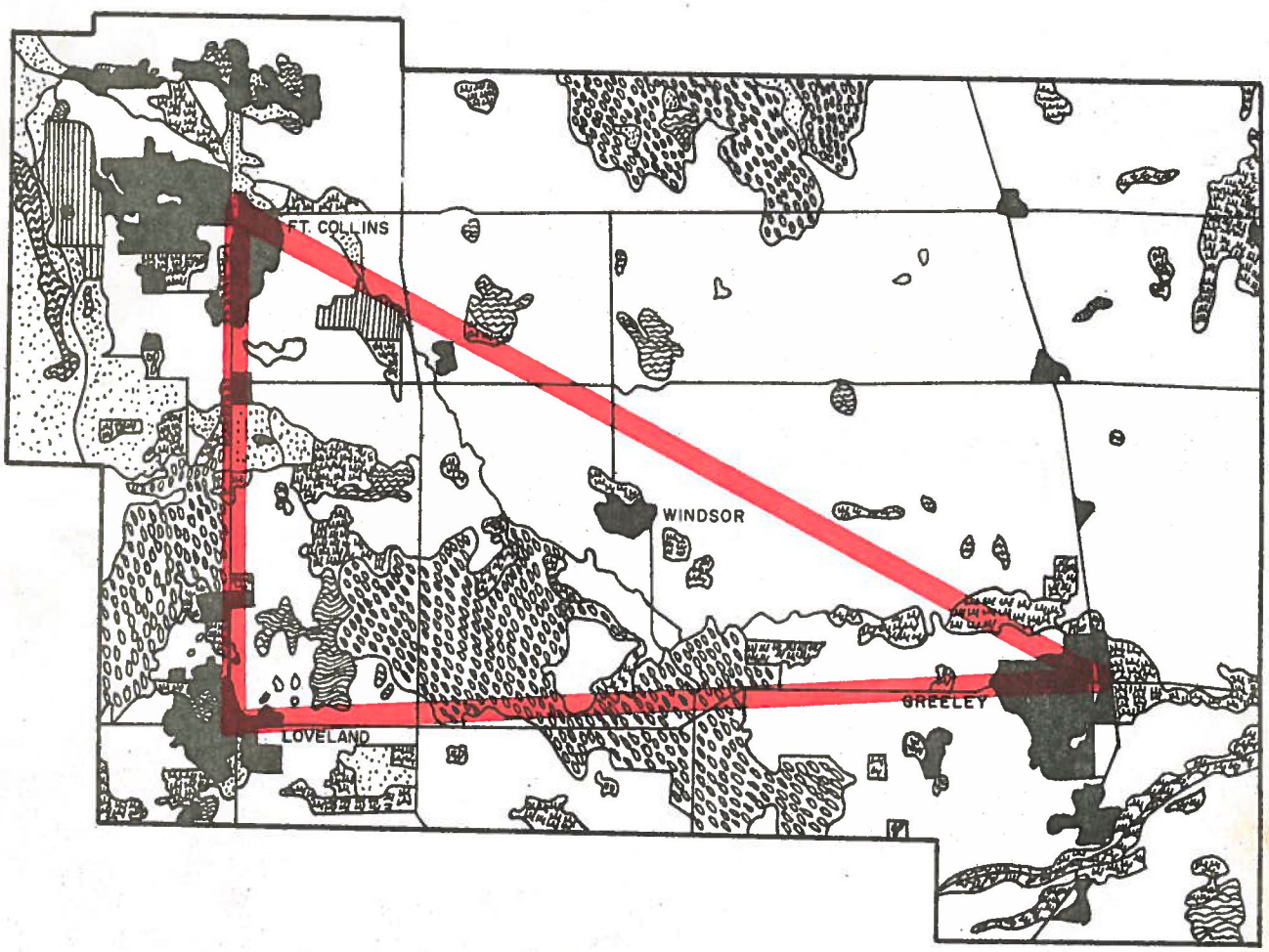
LAND USE PATTERNS, PRACTICES, AND PROBLEMS

in the

POUDRE TRIANGLE OF NORTHERN COLORADO



University of Colorado
Department of Geography

in cooperation with

The Planning Commissions of Larimer and Weld Counties, Colorado

1972

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Donald D. MacPhail

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CHAPTER 1

INTRODUCTION

Donald D. MacPhail

This report follows a series of nine preceding studies which have become a tradition in the Department of Geography at the University of Colorado. Graduate students, participating in a seminar on land use, initiate a project in the local area in cooperation with agencies of municipal or county governments.

Such a study achieves a number of objectives. The participating students undertake a realistic project which they are able to plan, execute, and publish the results within the brief span of one academic semester. The students, through ground survey, air-photo interpretation analysis, and archival search, provide new information for county and municipal agencies and for active citizen's groups concerned with planning and guiding future growth and development within their respective communities. This work provides the student participants with professional training and is a serious effort in acquiring new planning perspectives in the interest of public service by the University of Colorado.

In response to suggestions by state and county agencies, this land use seminar elected to study and analyze an important segment of the Colorado Piedmont in Larimer and Weld Counties. The project was undertaken with the support and cooperation of the planning offices of those counties. Moreover, the

Planning Division of the Department of Local Affairs of the State of Colorado cooperated by making large-scale photo-maps available. The Colorado State Geological Survey permitted the participating students to use their files of aerial photography and continues its cooperation by coordinating data from this land use and landscape mapping with other information from their own sources.

The Poudre Triangle is one of the richest agricultural areas of the United States. The area includes the flood plain of the Cache la Poudre River and adjacent uplands between the Cities of Fort Collins, Greeley, and Loveland. The area lies in the northern portion of what many call the "Front Range Corridor". This region, along the eastern flank of the Southern Rockies is Colorado's most densely populated area. Here too is where the fastest growth and economic development takes place within the State. From Pueblo and Colorado Springs in the south, to Fort Collins and Greeley in the north, the problems of growth are, in the main, similar. They differ only in intensity.

There is, however, one thing that distinguishes the area of the Poudre Triangle from that of the other parts of the "Corridor". That is the incursion of residential developments onto the rich farmland of northeastern Colorado. What are the characteristics of this area and what will be the effects on it by uncontrolled urban sprawl? The recent construction of a huge photographic processing facility near Windsor, Colorado has alarmed many who see this as but a first step in the

ultimate demise of agriculture within the State.

Consequently the seminar dedicated itself to producing a detailed land use map of the area as of 1970. Using a new mapping technique, the group also identified and mapped the salient environmental characteristics by mapping complex patterns of landscape on photo-maps of the area. With this information, a reconnaissance- level study was then completed. Various chapters of this study originally appeared as special reports, submitted by the individuals indicated. They represent the endeavors and views of the authors and in no way should be interpreted as the official views of the Department of Geography of the University of Colorado or any other cooperating agency or organization. Because of this independence from official views, the participants in this project are especially grateful to the County Commissioners of Weld and Larimer Counties and their respective planning departments for supporting the costs of field work and the printing of this report.

This is the collective and individual effort of a group of graduate students concerned about the quality of the local environment and its attendant stresses. Larimer and Weld County residents and officials may gain perspective and understanding from this study that will assist them in their efforts to perpetuate the Poudre Triangle as a pleasant and productive area in which to live. Hopefully, similar cooperative studies may continue in the future.

CHAPTER 2

THE PHYSICAL ENVIRONMENT

Lydia Grey

Landforms

The Poudre Triangle, surveyed for land use and related features, occurs mainly in the lower drainage basin of the Cache la Poudre River between the Piedmont cities of Fort Collins, Greeley, and Loveland. Bounded roughly by latitudes 40°20' N. and 40°37' N. and longitudes 104°37' W. and 105°10'W., it includes about 574 square miles, Elevation ranges from a high of 6,260 feet a.s.l. along the western foothills to a low of 4,600 ft. a.s.l. east of Greeley.

The area contains part of the east-southeast sloping plain which stretches from the foot of the Rocky Mountains in the west into the drainage system of the Missouri River. Significant relief exists in the western part of the study area which is produced by the differential erosion of eastward dipping sedimentary rock strata. Two prominent, north-south trending hogback ridges have formed in resistant sandstones while long, narrow valleys correspond to weaker shale units.

One of the tilted formations, the Pierre shale, retains a slight east-northeast dip as it extends away from the foothills to form the dominant underlying bedrock upon which topography and residual soils developed. About six miles west of Greeley, the shale gives way to the still younger Fox Hills

formation and in turn to the Laramie formation which persists to the eastern limit of the area surveyed. The Fox Hills and Laramie units are sandstones and sandstones interbedded with shale that dip gently to the east-northeast. Orientation of the rock strata is significant because weathering and erosion through time produced a series of low ridges and valleys in the study area which have a north-south to northwest-southeast alignment. The wind, in recent geologic time, scoured out shallow basins which also possess the same northwest-southeast trend. Fine-grained loess deposits in the area are the result of wind action.

Three relatively large streams have cut broad, shallow valleys into the gently sloping relief of the Poudre Triangle. The Cache la Poudre River enters the area from the northwest and joins the South Platte about five miles east of Greeley. The Big Thompson River flows eastward across the southern part of the study area and enters the South Platte about four miles west of La Salle. All drainage is eastward and the South Platte River carries it out of the area as part of the greater Missouri system.

The east-west valley occupied by the Big Thompson and the South Platte and the northwest-southeast valley of the Cache la Poudre delimit two distinct uplands. One lies north of the Cache la Poudre and the other occurs in the drainage divide between the Poudre and the Big Thompson-South Platte lowland to the south. Of the two uplands, the one to the south has

greater relief, noticeable in the relatively steep, dissected bluffs south of Windsor.

Aside from Boxelder, Lone Tree, and Owl Creeks, fairly large tributaries in the northern upland, most of the area contains numerous, short drainageways which lead into the larger valleys. Sweet et al., (1929) comment: "In places, the large stream valleys lie 100 or more feet below the general level of the nearby uplands, but in most places, the adjacent slopes are so gradual that the limits of the valleys are scarcely noticeable".

The flood plains along the major streams range from about one quarter-of-a-mile to more than a mile in width. These are subject to overflow, usually during the spring runoff from the mountainous granitic and metamorphic terrain to the west. In this source area, east of the Continental Divide, the headwaters are fed by snowmelt and high mountain lakes. Present flood plains are bordered in places by terraces which lie 10 to 40 or more feet higher in elevation. In the Fort Collins area, "the stream side of the terraces is in most places sharp and well marked by a steep gravel-covered slope. The outer edge, however, is less well defined and in places cannot be definitely determined, owing to the gradual slopes of the adjacent uplands. Soil material carried in by small tributary streams and wind-blown material have also aided in obliterating the outer terrace limits" (Sweet et al., 1929). The existing terraces are discontinuous and are usually present on only one side of the

stream, although occasionally corresponding terraces are found on both sides.

In the Greeley area for example, "the terrace along the Cache la Poudre River ranges in width from 1 1/2 to nearly 3 miles. It follows the north side of the river from the County line west of Windsor to a point within about 3 miles of Greeley. Below Greeley, it lies on the south side of the river. The principal terrace of the Thompson (sic) River lies along the south side of the stream and is a mile or more in width. The South Platte flood plain is bordered on the southeast by, a terrace ranging from 3 to 4 miles in width" (Sweet et al., 1929). The river terraces take on added significance when their land use is considered. Since they slope down the valley and downstream at about 10 to 20 feet per mile, and are well-drained and gently tilted, these were the first land irrigated in the locality and provided good sites for the first large communities.

The surface configuration of the upland varies from gently rolling to slightly hilly, with overall slopes of 40 to 80 feet per mile. The valleys and terraces which cross the uplands have lesser gradients, 10 to 20 feet per mile. The geographic extent of the upland zones is indicated on the land use map where dry farming prevails and on the map of photomorphic units which correspond to specific environmental units.

Climate

The climate is generally one of low humidity, low annual

precipitation, and clear skies. Mean annual precipitation for Ft. Collins, Loveland, and Greeley, for example, approximately 14, 13, and 11 inches respectively (Colorado Planning Division, 1957). Spring and summer are the wettest seasons. It is then that moist air masses from the Gulf of Mexico invade the plains east of the Rockies. Spring and summer are the times for maximum afternoon thundershower activity. At this time, convectional heating produces towering thunderheads in the moist air which results in showers and hail storms. Hail and tornadoes pose the major threat to the agricultural crops, yet both of these phenomena are less severe in the study area than in the plains farther to the east (Berry, 1965). Ft. Collins and Loveland have precipitation maxima in the months of May and August, while Greeley, farther east has but a solitary maximum precipitation period in May.

The driest months occur in winter, between November and February. Then, cyclonic storms moving rapidly eastward across the Rockies, deposit substantial amounts of snow on the Western Slope and along the Continental Divide. However, as these air masses descend the eastern slopes of the Rocky Mountains, strong lee winds result. Some of these are warm "Chinooks" related to air masses that have released moisture on the western flanks of the Rockies. Others are cold, subsiding winds, deflected downslope by the configuration of the mountains. Both types of lee winds have a pronounced dessicating effect on the land and water surfaces at the foot of the mountain front and

in cities such as Fort Collins and Loveland in the western part of the study area (Grant, 1972). Following the cold fronts associated with the cyclonic storms, icy air masses move down from Canada; these are dry because of their continental origin and bring only scant amounts of precipitation.

J. W. Berry (1965) has summarized the seasonal characteristics for the Greeley area and his comments may be viewed as a framework which suits the study area as a whole:

"SPRING is the wettest, windiest, and cloudiest season. Severe storms usually come from the north with northeasterly winds. About 42% of the annual precipitation occurs in spring, and much of it falls as snow. Stormy periods are usually of short duration and are often followed by sunny and mild weather that removes much of the snow cover.

SUMMER precipitation amounts to about 31% of the annual total, and much of it falls from scattered thundershowers during the afternoons and evenings. Mornings are usually clear and sunny. Cloudiness increases markedly after mid-morning, and is noteworthy because of the moderating effect on the afternoon temperatures.

AUTUMN is the most pleasing season. Precipitation during this period amounts to only 18% of the annual total. Local summer thunderstorms are over and invasions of cold air from the north are infrequent. There is less cloudiness and a greater percentage of possible sunshine than at any other time of the year. Periods of unpleasant weather are usually brief.

WINTER has less precipitation than any other season, with about 9% of the annual total, almost all in the form of snow. Winter storms are at times severe but are usually of short duration. There is more cloudiness than in autumn but somewhat less than in the spring months."

There are long-range trends and cyclical variations in the climatic patterns of the region that may be significant. First, in comparing weather data from the early part of this century with recent summaries up to the year 1970, there is a slight but perceptible increase in the mean annual temperature for the area and a decrease in the total annual precipitation. This could indicate a depletion of local east-slope water sources that are dependent on run-off or recharge of the ground water table. A higher temperature regime might also relate to higher evaporation rates, also contributing to a local depletion of available water.

Also related to declines in water resources are the periods of recurrent drought. In 1970, John Borchert of the University of Minnesota discussed the probability of drought in the decade of the 1970's for the Great Plains area. He showed that there appears to be a 21-year cycle of drought, and in the past, the 1890's, the 1910's, the 1930's and the 1950's were times of extensive drought on the plains east of the Rockies (Borchert, 1971). If the cycle holds, there should be a severe and extensive drought on the plains of Colorado in the mid-1970's. If it comes, and if it is as acute and widespread as that of the 1930's, it could play a significant role

in the growing struggle for water that is developing between established users and the new ones who arrive to enlarge the growing urban-industrial complex of the northern Colorado Piedmont in Larimer and Weld Counties (MacPhail, 1972).

Natural Vegetation

The following description is from Sweet et al. (1929) for the Greeley area and can be extended in scope to include the more westerly part of the study area near Fort Collins, and Loveland. "The Greeley area lies in the region known as the "short-grass country," the predominant grasses of the uplands being the short grama and buffalo grasses in contrast with the taller bluestem, bunch grass, and other grasses of the prairies farther east. These short grasses and many other native plants grow throughout the area. Some of these as individuals and others in associations or groups are suggestive indicators of surface soil and subsoil conditions.

Grama (Bouteloua oligostachya) and buffalo grass (bulbilis dactyloides Nutt.) grow throughout the area but make the best sod and furnish the better range on the "hard lands," that is, soil of somewhat heavy texture, especially where underlain at a comparatively slight depth by sandstone or shale, in contrast with the "sandy lands" where the sand is deep and has been blown into dunes by the wind. Wheatgrass (Agropyron smithii Rydb.) grows on very heavy soils especially in valleys where moisture is abundant. A low-growing shrub of this region, shadscale (Atriplex confertifolia Torr.), grows almost exclusively on a heavy soil, on a soil with heavy subsoil, or one in which there is restriction to downward movement of

moisture. Sand sage (Artemisia filifolia Torr.) grows exclusively on deep sandy land, making its best growth in the sand hills. Soapweed (Yucca glauca Nutt.) is also found principally on sandy or very gravelly droughty soil. Small rabbitbrush (Chrysothamnus graveolens), umbrella plant (Eriogonum corymbosum), mountain sage (Artemisia frigida Willd.) a small plantain (Plantago purshii), wild alfalfa (Psoralea tenuiflora Pursh.), wire grass (Arstida longiseta Steud.), and several other plants have a rather broad adaptation between the most sandy soil and that which is heaviest. Bunch grass (Andropogon scoparius Michx.), bluestem (Andropogon hallii Hick.), and sand grass (Calamovilfa longifolia Hook.) are tall grasses which grow on the very sandy soils of the southeastern part of the area. Squirrel-tail grass (Hordeum jubatum), locally known as bearded foxtail, grows on seepy and alkali land and its presence in alfalfa fields and other places is an almost sure indicator of such conditions.[4]

Soils

The quality of the soils of the Poudre Triangle is a prime factor in the region's great agricultural productivity. Climate, irrigation, and agricultural technology combine to form a natural resource base equalled by few other regions in

[4]Identification of these plants was made for the soil survey headed by Sweet, by Ernest C. Smith, then curator of the herbarium of Colorado Agricultural College (now Colorado State University).

the United States. The area is without peer in the agricultural economy of the State of Colorado.

The mature, residual soils of the study area vary mainly as a function of the bedrock from which they developed. In contrast, two immature soils, loessal deposits and alluvium, are of relatively recent origin. Because of the large area to be considered, a traditional description of the general characteristics of the ten major soil series must suffice. More detailed information, using the terminology of the Seventh Approximation, can be obtained from offices of the Soil Conservation Service in Ft. Collins and Greeley. The western portion of the Poudre Triangle contains lithosols which are associated with mountainous land. Here also are the Neville, Berthoud, and Laporte soil series. Soils further east include those of the Cass, Valentine, Larimer, Gilcrest, Terry, and Weld series.

The descriptions that follow summarize and paraphrase the the U.S.D.A. soil reports of the Greeley area (Sweet, et al., 1929) and Ft. Collins area (Sweet and Spencer, 1927) and are not products of the land use survey recently completed in the area of the Poudre Triangle. These brief statements highlight the character, genesis, and productiveness of the regional soils and are necessary to understand the patterns of rural land use in the sections of Weld and Larimer Counties under study. Such information is vital to the other sections of the report which follow. From these data, it is possible to

evaluate the role of particular soils in the economy of the region and the State, and determine which soils have the greatest potential in the immediate future.

Mountainous land borders the far western part of the study area and consists of steep slopes and north-south trending ridges and hills. The ridges and hills reflect more resistant underlying sedimentary rock strata. The land has much rock material either imbedded in the soil or scattered on the surface. Exposed bedrock slopes, ledges, and cliffs abound. The soil developed on this mountainous land will support only native grasses and some small shrubs. As such, it will occasionally provide pasture for livestock but is otherwise of no agricultural value.

Soils of the Neville series are shallow and incompletely developed. They occupy the narrow, north-south trending valleys between the red sandstone and shale ridges of the foothills. They are also found on high slopes and on old, high terraces along the western section of the Big Thompson River and Buckhorn Creek. Neville soils show wide diversity because of the variation in their parent material and are generally red, dull red, or brick-red on the surface. Heavier and redder subsoils and partly disintegrated parent material of red sandstone or shale occurs at slight depth in many locations. They owe their red color and sandy texture to the character of the Fountain, Lyons, and Lykins geological formations. Downslope movement of colluvium, as well as material blown by the wind, has modified these soils, and they contain sharp sand particles and

small gravel as a result. The soils of the upper valleys are shallow, stoney, or eroded. Here, the land is of low agricultural value. In the lower parts of the valleys, the soil is deeper and is used as either dry-farm or pasture land. Yields are fair to good in such circumstances.

The soils of the Berthoud series occur as alluvial fans with nearly level or gently sloping surfaces. They are found southwest and northwest of Loveland at the foot of steep hill slopes. They originate from small, eastward flowing streams which have their sources in the soft clay shales and shaly limestone beds in the western part of the study area. At the surface, the soils are a dark olive-brown, with lighter shades in a subsoil spotted with lime. Beneath the subsoil is a gravelly parent material. Some of these lands are irrigated and some dry-farmed; much is of low agricultural value while some is moderately productive. The remainder of the land associated with Berthoud soils is used for grazing.

The Laporte series covers a relatively small area. It appears as a discontinuous belt, trending north-south, along the lower foothill slopes and on low, narrow ridges along the western portion of the study area. The soils are shallow and incompletely developed. They have formed from stream-sorted material derived from weathering of the light gray, shaly limestone of the Niobrara formation. Small fragments of thin, almost white, calcareous shale or shaly limestone are included in the brown to light brown loamy surface soils. The sub-surface horizon, lighter in color, has a larger percentage of shale

and lime fragments. Partly disintegrated bedrock occurs at depths of 15 to 36 inches. The deeper soils are dry-farmed with unusually low yields. Soil scientists indicate success on these soils with apple or small fruit orchards where deep rooting is possible.

The Cass series (including the Cass and Kuner types plus riverwash) is alluvium of comparatively recent to present-day origin. These soils occupy the flood plains of the three large streams and portions of their smaller tributaries. In the western part of the study area along the Cache la Poudre, Big Thompson, and Little Thompson Rivers, a large percentage of material is derived from the high granitic areas to the west. Farther downstream, sandstone and shale and alluvial material is added. Boxelder Creek contributes angular and waterworn gravel of sedimentary bedrock sources to the Cache la Poudre. Cass soils generally have nearly black, dark brown or reddish brown surface soils and slightly lighter brown subsoils which are often heavier. Waterworn gravel, fine sand, and mica particles are scattered throughout the surface and subsurface material. Stream gravel and sand underlie the subsoil at a depth of about a foot near the stream courses and as much as five feet near the valley margins. In places, a shallow soil over the sand and gravel supports salt and other grasses, sweetclover, and cottonwoods. Because of the high water table and coarse soil texture, the land has little value except for pasture. Some of the Cass soils occur where the land consists of old, sluggish, cut-off stream channels with

numerous marshes and poorly drained areas. Occasionally, these flood plain soils are drained and cultivated, with fair yields of beans, corn, alfalfa, and other crops. Where areas of Cass soils are higher or are modified by windblown and colluvial material, they are used for dry-farming of small grains and are fairly productive. Such is the case about eight miles northwest of Loveland and northeast of the mouth of the Poudre Canyon.

The Valentine group of soils originate from recent windblown material and, thus, sand and fine sand predominate. Within the study area, the main areas are in the extreme northeast, about six miles west of Ault, in the area between the Cache la Poudre and South Platte Rivers west of Greeley, and in the area south of La Salle. Well-formed dunes and ridges and undulating terrain mark the presence of Valentine soils in the higher areas. The wind transported at least some of the loessal material from nearby river beds. These soils have limited agricultural potential. In the past, when the natural sod was broken by cultivation, they tended to blow badly. However, there is a heavy subsoil phase within this group which conserves moisture well. It is fairly productive under irrigation and is associated with the production of alfalfa, corn, beans, small grains and other crops. In other places, where the same soil phase is dry-farmed, wheat and beans are productive crops.

The Larimer series consists of old, fluvial wash transported from granitic outcrops west of the study area and from red sandstone ridges in the foothills zone. Stream-carried and stream-spread, the material blanketed much of the plain east-

ward. Three major locations account for the Larimer soils: a large unit west and southwest of Ft. Collins; an area north of Ft. Collins where the soils developed from a much older, higher, and gravelly surface; and in portions of the level uplands north of Windsor where these soils surmount small hills and ridges. The shallow surface soil profile is brown or red-brown and changes to a deeper red-brown and then to a gray-brown in the subsoil. Gravel is common throughout and lime or hardpan layers are best developed along the edges of terraces and on hilly slopes where seepage carries the calcium carbonate to the surface. Larimer soils are fairly productive. However, they are less so than soils of either the Gilcrest or Weld series. Where Larimer soils hold moisture well, they are productive when dry-farmed. Under irrigation, beans, alfalfa, corn, grains, and fruit are common. The gravels which underlie the Larimer soils seem to have a high potential for surface mining.

The Gilcrest soil group includes the Greeley, Ft. Collins, and Gilcrest soil types, some of which are level and smooth at the surface and which have sandy and gravelly components in a heavy subsoil characterized by well defined lime strata and a deep gravel. Northwest to north of Greeley, the soil is not irrigated but rather dry-farmed. The Ft. Collins type within the group is highly productive, well drained, and comparatively free of alkali. Sugar beets, alfalfa, small grains, and other crops are produced where this soil type occupies broad stream terraces or bench lands adjacent to the larger rivers of the study area. Generally less productive than the Ft. Collins type is the Greeley

soil type. As a fine sandy loam, it is productive under irrigation. A lower phase near Greeley produces alfalfa, sugar beets, and other crops.

Soils of the Terry series occupy rolling to very hilly country and also level and basinlike uplands. They are closely associated with Weld soils, however they are thinner and less well-developed. Generally, the Terry soils are more difficult to farm, require more water, and are less productive than Weld soils. The Terry series is essentially residual and has derived its main characteristics from the underlying parent material. Since the bedrock changes from the clay shales and Hygiene sandstone of the Pierre formation in the western part of the Poudre Triangle, to the light yellow-brown, soft, fine-grained sandstone associated with the Foxhills formation and the dark grayish brown, soft, clay shales of the Laramie formation to the east, there is a noticeable color change in the Terry soils in these areas.

To the west, the surface soils of the Terry series are dark brown or dark, olive-brown with slightly lighter subsoils of the same hues. The subsoils also contain light-toned nodules of lime accumulation and partly disintegrated shale or sandstone. They are derived by weathering in situ over the Pierre formation. Heavier soils weather from underlying shales while light-textured soils from sandstones. In numerous, scattered, poorly drained localities, the Terry soils possess harmful quantities of alkali, are difficult to manage, and are only moderately

productive. Good drainage can be a positive factor in restoring areas, plagued with problems of alkali accumulation, to production. The Terry soils can be as productive as the Weld series if they are deeply weathered or bear a deep mantle of windblown loess. As a rule, they are more uneven and more difficult to farm. Terry soils are located in the upland south of Loveland and on the western part of the drainage divide between the Cache la Poudre and Big Thompson Rivers. They also occur in scattered localities north and northeast of Ft. Collins. They become the dominant soil series near the northern and northeastern borders of the study area and beyond. The drainageways off the bluffs to the south of Windsor and north of Milliken contain Terry soils. Elsewhere, they are scattered throughout the Poudre Triangle. Some of these soils are irrigated and others are dedicated to pasturing dairy and beef cattle. However, the Terry soils are used more extensively for dry-farming than any other group or series, at least in the study area. Crops produced include beans, wheat, barley, corn, and various grain sorghums and millets.

The Weld series has the largest areal extent in the study area. These soils are well developed and occupy nearly level or gently rolling uplands. At the surface, they vary from dark brown or olive brown in the western part of the study area to yellowish brown or light brown as one continues east. As with other soils, these differences reflect bedrock changes from the Pierre formation in the west to the Fox Hills and Laramie form-

ations further east. The lime-bearing subsoils also vary with location--from light-colored, olive-gray in the west to grayish brown in the east. The lower subsoil grades into a fine sandy loam which extends to a depth of five feet or more. Beneath this horizon is shale or sandstone. In addition to weathering from such bedrock, the Weld soils have been modified by a heavy surface deposit of well weathered, wind-blown material of local origin. The fine-textured loess has many sources. It may be scoured from local clays and sandstones, scooped out of small deflation hollows, and carried upslope from the major flood plains and their adjacent terraces. For the most part, the deep, friable subsoils are free of alkali, are well drained, and easy to cultivate.

The productive Weld soils dominate the area geographically and economically. They occur in several phases. One of these, the Weld fine sandy loam, is the dominant upland soil in this group and is used exclusively for intensively irrigated farming which is oriented to diverse crops such as alfalfa, sugar beets, small grains, potatoes, truck crops, and sorghum.

The valley phase of the Weld fine sandy loam occupies narrow strips of land along drainageways and small, shallow circular or elliptical depressions produced by wind action. This phase shows a north to northwest trend, is lower than the adjacent land has a darker color and heavier subsoil texture. Soft sandstone or thin layers of fine gravel underlie the subsoil. With this soil, there can be the problem of a high water

table which requires adequate drainage before it can become highly productive.

The Weld loam (including its heavy phase) occupies a large portion of the divide between the Cache la Poudre and Big Thompson Rivers and also the top of the divide between the Little Thompson and South Platte Rivers. A large part of this soil is not under irrigation; instead, it is dry-farmed and considered to be the best of its kind in the area for this practice, especially where small grains are concerned. Yields are good and more certain than with other soils. Under irrigation, with the exception of the Fort Collins loam (a member of the Gilcrest group), this soil has higher average productiveness than any other soil in the area. Grouped according to productivity, the soils of the area fall as follows:

Table I

Poor	Moderate to Poor	Moderate	Good
Berthoud	Cass	Cass	Gilcrest
Laporte		Larimer	Weld
Mountain lithosols		Terry	
Neville		Valentine	

Understanding the soils of the area will help to give greater insight into the present land use practices described in the next chapter. A large part of the Poudre Triangle has historically been one of the leading agricultural areas of the nation. Now, however, pressures for change are appearing which may alter the local economy and environment most significantly. Thus, understanding the different types and qualities of soil

within the area should help to form guidelines for future growth and development.

CHAPTER 3

THE PRESENT LAND USE SYSTEMS

Darrel C. Hansen

The Poudre Triangle lies within the Colorado Piedmont, approximately fifty miles north of Denver. It is a particularly appropriate area for a land use study because of its uniqueness. Although in a semi-arid region, agriculture flourishes here because the Cache la Poudre River and the Colorado-Big Thompson transmountain diversion provide sources of irrigation water, and because significant acreages of land exist which are level enough to be irrigated by conventional agricultural techniques.

The eastern portion of the study area includes an important segment of Weld County, Colorado which ranks second among all counties of the United States as a feeder of cattle and calves (Higbee, 1963). The Monfort Feed Lot, Inc., which makes a significant contribution to this record, is located immediately north of Greeley. The land use map of the area shows the widespread distribution of feedlot activities. These in turn profoundly affect the range of crops grown locally such as alfalfa and corn. A dramatic change in the traditional land use structure of the study area is shown in the roughly square-mile area of industrial land about two miles southeast of Windsor. Here, Kodak is establishing a major processing plant as part of its national industrial system. It is quite likely that this is but

the first step in a process of change that economists have been predicting for this part of the Colorado Piedmont for many years (Clawson, 1963).

The Land Use Survey

The study of the Poudre Triangle is an outgrowth of a graduate seminar in land use at the Department of Geography of the University of Colorado. A laboratory area and a practical field exercise were needed for students participating in the seminar. In addition, such practice would have to be a true apprentice-type situation where a professional level of attainment would be possible. There is a precedent of successful cooperation between the Department of Geography of the University of Colorado and various municipal, county, and state agencies on land use problems in previous years which were undertaken as a voluntary public service.

After discussing several potential problem areas, the Poudre Triangle was selected. Strong support was assured by the county planning offices of Larimer and Weld Counties and the graduate students felt that here they could perform a meaningful service for the citizens of that area of the State. Because of its agricultural significance, a relatively large area was undertaken with the objective of orienting the study toward agricultural land use by employing aerial photo-interpretation procedures.

The survey was completed in three major phases. The first included mapping photo-identifiable land use features on

1:24,000 scale photo-maps with 1970 imagery; this work was supplemented by sterographic study of corresponding aerial photos made available by the Colorado State Geological Survey. Further information was obtained from the matching 1:24,000 scale topographic maps published by the United States Geological Survey.

The second phase involved a field check of the accuracy of previously plotted data, and mapping of additional information revealed through field observation of those objects not easily identified by air-photo interpretation methods. Knowledgeable individuals in city and county planning offices and other agencies were interviewed to obtain information not readily apparent from field mapping.

The third phase included further study of the large-scale photo-maps, seeking a correlation of photographic patterns with land use practices. Some patterns are very distinctive and appear repeatedly on the aerial photographs and photo-maps. Well-defined, composite images called "photomorphic" patterns (MacPhail, 1971) were identified, and a random, square-mile sample of each was selected, using a table of random numbers, for more intensive field study. The actual land surface corresponding to the photomorphic patterns is referred to herein as a <u>landscape unit</u> because of the strong correlation between cultural response to underlying physical features and the field patterns they produce. For example, some field patterns are rectangular, running in cardinal directions; others are elongate; others have similar shape but oriented diagonally with respect to north; still other fields show round patterns produced by circular

sprinkling systems. Field sizes relate to the size of farms and photographic tones infer crop types and associations. The drainage patterns, also part of the same complex photomorphic images, relate directly to the quality of underlying bedrock or related land form. The resulting landscape units have a homogeneity and geographic extent that make them useful for planning purposes (Baker and Dill, 1971).

The land uses mapped were finally measured by planimeter and the information then compiled. The categories of land use classification and the amounts found in each for 1970 are listed in Tables 2 and 3.

TABLE 2

Poudre Triangle

Land Use Mapping Code

Purpose: To map land use categories on aerial photography for the eventual compilation of a land utilization map of the Poudre Triangle, an area in the vicinity of Ft. Collins, Greeley, and Loveland.

Directions: The Land Use Classification Manual of the Inter-County Regional Planning Commission of Denver, Colorado (now the Denver Regional Council of Governments or DRCOG) is employed in this study (Inter-County Regional Planning Commission, 1966). As a general rule, only areas larger than a conventional city block (approximately five acres) are mapped, because there are limitations in the mapping process with scale reductions. In some instances, small areas are of particular significance to the study, so their locations are identified on the map and their areas computed into the total area. Areas on the table are in square miles which can be converted to acres by multiplying by 640.

For convenience in interpreting Table 2, a key of applicable code symbols follows:

Land Use Mapping Key

0 Vacant

01 Land

02 Structure

03 Water Area

04 Land Platted for Development, but without Construction Activity*

1 Residential

11 Single Family Dwelling

11/12 Single and Multiple Family Dwellings Existing Together in One Neighborhood

12 Multiple Family Dwelling

13 Group Quarters

14 Mobile Home Dwelling

15 Plotted Areas with Streets and Utilities Installed, without Homes*

2 Commercial

22 General Retail Business

24 Intensive Business

3 Services

31 Administrative Offices

32 Finance, Insurance, Real Estate Services

35 Wholesaling Services, without Stock

4 Industrial

41 Extractive

42 Primary Products Manufacturing

43 Secondary Metal Products Manufacturing, Processing, Fabrication, Assembly

*This symbol not in Land Use Classification Manual.

44 Secondary Non-Metal Products Manufacturing, Processing, Fabrication, Assembly (including agricultural products)

45 Wholesaling, with Stock

47 Non-Manufacturing, Open Storage

48 Construction, Contractors' Storage

5 Transportation

51 Transportation Right-of-Way

6 Communications and Utilities

62 Radio, Television Communications

64 Gas, Electric Utility System

66 Sewerage System

67 Disposal Facilities

7 Public and Quasi-Public

71 Correctional, Protective Facilities

72 Cultural Facilities, Civic Organizations

73 Religious Facilities

74 Educational Facilities

75 Medical and Related Facilities

76 Cemeteries, Mausoleums

77 Military Bases, Installations

8 Parks and Recreation

82 Outdoor Sporting, Recreation Facilities

83 Open Space Park and Recreation Areas

84 Unimproved Forest Land

9 Agricultural

912 Horticulture

921 Irrigated Crop Production

922 Non-irrigated Crop Production

931 Livestock (Including Dairy)

932 Feedlots

933 Poultry

95 Pasture, Grazing Land

TABLE 3

Poudre Triangle

LAND USE SUMMARY

Of the 515 square miles surveyed for 1970 land use, seven categories account for 96 per cent of the total study area. These included irrigated farming, dry-farming, pasture and grazing, vacant land, single-family residential areas, water surfaces and educational land. The overwhelming single class is irrigated farming which, in 1970, comprised two-thirds of all of the land surveyed. The detailed list of each category of land use follows with the area in square miles and the per cent of that category in the total study area indicated. There were 47 different classes of land use recognized and mapped. A two-digit code was in use throughout except for the agricultural lands where a three-digit code was employed in order to distinquish irrigated from non-irrigated farmland.

TABLE 3 (continued)

Poudre Triangle

LAND USE SUMMARY#

Land Use Code	Total Area (Sq. Mi.)	Per Cent*
01	33.59	6.5
02	.23	
03	14.83	2.9
04	.75	.1
05	.04	
11	17.98	3.5
11/12	1.33	.2
12	.24	
13	.77	.1
14	.87	.1
15	1.77	.3
22	.96	.2
24	1.64	.3
24/42	.11	
31	.51	.1
32	.10	
35	.01	
41	1.61	.3
42	1.40	.3

#Note: Percentages of areas comprising less than 0.1% of total not included.

Land Use Code	Total Area (Sq. Mi.)	Per Cent*
43	.22	
44	.05	
45	.04	
47	.20	
48	.02	
51	3.96	.8
62	.01	
64	.02	
65	1.86	.3
66	.19	
67	.40	
71	.02	
72	.02	
73	.06	
74	7.68	1.5
75	.05	
76	.47	
77	.02	
82	.41	
83	2.83	.5
84	.25	
912	.33	
921	327.98	65.5
922	42.28	8.2
931	1.52	.3
932	4.37	.9

Land Use Code	Total Area (Sq. Mi.)	Per Cent*
933	.01	
95	40.66	7.9
Total Area	514.57	

*Note: Total Percentage figures would equal more than 100% due to rounding of figures.

General Comments Concerning Land Use

The significance of this area to the nation's agricultural production has already been recognized. Field crops can be broadly organized into two general categories, those destined for human consumption such as beans and sugar beets; and those destined for feeding livestock such as sugar beet tops and pulp, corn, alfalfa, feed grains and grass pasture.

Sugar beets require considerable hand labor for thinning and hoeing. Historically, the beet sugar industry started when there was a shortage of sugar, and a relatively large pool of immigrants was available to provide inexpensive labor. As labor has become more expensive, production costs have been controlled somewhat by using machines to dig, remove tops, and load sugar beets during harvest--all jobs which were originally accomplished manually. Thinning and hoeing still must be accomplished by hand and it now appears questionable how long beet sugar production can continue to compete with cane sugar. Beet sugar is now able to compete with cane sugar only by virtue of federal subsidies and the complex international political system of quotas and tariffs. The future for sugar beet production thus appears to be somewhat problematical.

The crops destined for feeding livestock appear increasingly important. Transhumance is practiced wherein cattle and sheep are pastured during the summer in mountain pastures and moved to the Piedmont for late autumn grazing on harvested crop land and winter feeding in feedlots. Contract feeding of livestock is a significant segment of the agricultural economy. Therefore the

feedlots, which comprise slightly less than one per cent of the area, provide the focal point for consumption of most of the local field crops; giving them significance disproportionately with the area they occupy. The Monfort Feedlots consume the crops produced by more than fifty other farms (Higbee, 1963).

Dairying, like feedlots, occupies a small proportion of the mapped area, but also has a high degree of significance. Since fluid milk production depends greatly on the availability of a local market, the importance of Denver, Boulder, Fort Collins, Greeley and other nearby urban centers becomes clear. The projected population growth of the Piedmont, means an expanding market for dairy products; so growth of dairying is quite safely predictable as a local rural land use.

Neither dairy nor feedlot operations could exist under current practical operating techniques without the grain and fodder provided by the fields. Although some grain crops are produced by dry-farming, per-acre yields obviously are higher where rainfall is supplemented by irrigation. Without irrigation, it would be impossible to produce sugar beets, corn, beans, or alfalfa. Water rights to surface flow or productive wells are vital to most of the areas of agriculture. Water rights are considered so important that they are frequently sold independent of land sale (anonymous farmer, Nov. 9, 1971).

The Land In Conflict

The Colorado Piedmont has experienced tremendous population growth since World War II. Part of the growth can be attributed to industrial and urban expansion, and some simply because people wanted to avoid the congestion and adversities of urbanization. Many residents, employed in urban positions, consider rural neighborhoods desirable homesites for a plethora of reasons, ranging from pasture for the family pony to a genuine distaste for nearby neighbors. They create modern-day "estates" in the countryside where they prove to be incursions on agricultural land and frequently represent non-productive use.

At the same time, farmers and ranchers have been facing the discouraging dilemma of static or decreasing prices and simultaneously increasing operating costs. The result is that agriculture requires a large initial capital investment for property, machinery, livestock, feed, seed, fertilizer, and other operating expenses, while promising a very small profit margin. Thus, agriculture as an occupation offers little incentive to counter the temptations of high land prices which can be offered by realtors and land speculators.

The roadways and lanes of the rural areas are lined with houses of people who work in the city but prefer to live in the country. Farmers often sell frontage lots to ease economic stress. Suburban residential tracts constantly invade agricultural land beyond the urban fringe, by-passing available vacant

but more expensive land in the built-up areas. It would be unusual if such changes did not create disruptions for established rural residents. Such disruptions do exist and while it is not the purpose of this study to compile a detailed catalog of the various irritants, a few examples are in order.

Reasons frequently cited for moving to the country include space for the children to play, room to pasture the family horse (or horses), and to get away from the noise and activity of the city. No farmer likes having his crops trampled by playing children or stray animals, having his machinery fouled by toys lost or neglected in his fields, or having livestock set loose by broken fences or open gates. Children playing with machinery, or in areas where it is being operated create a multitude of time-consuming delays. At the best, hunters invading farmland are a nuisance; many are abusive, cause expensive damage, and are actually a threat to the farm family and livestock.

Often, people move into a rural area and quickly start issuing complaints about features inherent to farming operations such as odors emanating from feedlots, silage pits, and beet sugar factories. Others find that farming is mechanized and harvest season brings the operation of equipment that extends far into the night; so that sometimes, instead of avoiding noise, they have succeeded in exchanging that of the city for that which is characteristic of the country.

Farm population generally has shown an overall decline

since 1940. In 1940, 23% of the United States' population were farmers; in 1957, the percentage had decreased to 12% (U.S.D.A., 1958). During the same period, the acreage of harvested lands increased. The primary reason is that the declining profit margin simply requires a larger operation to produce an acceptable level of income. Those who have succeeded in farming have done so because they improved their efficiency with machinery (Higbee, 1963).

Effective employment of machinery requires acreage large enough to justify the investment and fields large enough to facilitate machine use. Farm areas, shattered and functionally disrupted by dispersed subdivisions, are at a disadvantage. It is easy to understand, when taking all into account, why so many farmers feel that farming is hardly worth the trouble.

Tax problems are also frequently cited as deterrents to agriculture. Improvement taxes frequently discourage adequate maintenance of property and application of an improper tax scale may make farming economically impossible. Tax legislation and assessment requires constant surveillance to minimize inequities.

CHAPTER 4

LAND TENURE IN THE POUDRE TRIANGLE

Rich Beardsley

Land tenure in the study area as a whole does not appear to be consistent with land tenure characteristics represented by the random samples mapped and studied within previously designated landscape units. Data compiled with respect to the landscape units (represented by photomorphic images on local photo-maps) show that, except for pasture land and a partial section of circular sprinkler irrigated farmland, rural agricultural lands in the Poudre Triangle are dominantly owner-operated.

In contrast, other data compiled indicate that both irrigated and non-irrigated farmland are 54.4% to 66.6% tenant-operated and from 33.3% to 45.5% owner-operated. These data were taken by sampling one random section per township within the principal agricultural areas surrounding both Ft. Collins and Greeley. In addition, no section was sampled unless it had at least four operators. This was done because the Soil Conservation Service (SCS) estimates the average farm size to be approximately 160 to 240 acres within the area sampled. The number of sections sampled represent approximately 4% of the total study area.

An explanation of the substantial difference in the two sources of data may be that an insufficient number of sample areas was used to test the character of the landscape units

represented by photomorphic images. Those areal samples were originally designed to give supporting, reconnaisance-level data and not firm, statistically sound information. Experience in using random sampling of landscape units based on photomorphic images in Chile and the Tennessee Valley shows that many more sample areas would be needed for quantitative analysis.

It is interesting to note that informal and undocumented estimates of land tenure by the SCS in Ft. Collins put both irrigated and non-irrigated lands as being 75% tenant-operated and 25% owner-operated in Larimer County. The SCS in Greeley estimated that irrigated lands were 70 to 80% tenant-operated and non-irrigated lands were 90% owner-operated in Weld County.

The samples taken specifically for land tenure and the SCS estimates differ from the 1964 United States Census of Agriculture which put the percentage of tenancy at 21% and 36.9% for Larimer and Weld Counties respectively. These figures compare with 17.7% tenant-operated lands for all of Colorado and 17.1% for the entire United States in the same year. The 1970 Census of Agriculture indicates 19.9% of all farms in Larimer County were tenant operated and 26.8% in Weld County. These data would appear to be consistent with samples from the random landscape units previously described, although those samples are not delivered by numerical percentage. However, the U. S. census figures represent categories not specifically included by this study. Moreover, there is a good probability that land tenure may be different in the more productive, irrigated farmland than in upland, dry-farm areas, and that such

differences are obscured by county-wide statistics of the census reports. Thus, it is conceivable that apparent discrepancies in land tenure data are actually not in conflict. It is clear that additional research is needed on land tenure in the two-county area.

This study used "tenant-operated" as a term including anything other than fully owner-operated, whereas in the census, the term was more narrowly defined.

The Ft. Collins SCS estimated that the trend toward tenant operation of rural land began in the mid-1950's. The Greeley SCS estimated that the trend began in their area some fifty years ago. Both offices expressed concern that more and more prime agricultural lands were being withdrawn from agricultural production in favor of other land uses such as development for commercial and residential areas. While the Kodak plant being located at Windsor, Colorado is not in itself responsible for this trend, it is indicative that these agricultural lands are increasingly being considered for such developments.

Landowners who dealt with Kodak were willing to sell their land at very inflated prices, thereby allowing them to move to other farmlands and double their holdings. This would not necessarily be significant except that good agricultural land is a finite resource. A few landowners may benefit by this kind of development, but the fact remains that a growing population will be making greater demands for food production. Withdrawing prime agricultural land from production would be inconsistent with this demand in the long run.

Another factor relevant to decreasing lands suitable for food production is the incidental demand on land use created by such developments as Kodak. Kodak, for example, needs water to operate. So do the agricultural lands, if they are to be fully productive. Kodak, according to the SCS, has purchased water rights from the North Poudre Irrigation Company. While they have leased these purchased water rights back to the landowners for their use, the leases expire in ten years. In addition, landowners and operators fear that Kodak will have little interest in maintaining the ditch system necessary to transport the water that they lease. If the landowners and operators bear that expense, some will be forced to cease operation. Thus, even greater amounts of productive land may be withdrawn from production, at least in ten years, if not sooner.

As non-agricultural land use attitudes develop, land speculation will grow. As speculators trade parcels of land in anticipation of non-agricultural development, the land may continue to be farmed for a time, but by a greater proportion of tenant-operators. Tenant-operators tend not to manage land with long-term agricultural returns in mind (U.S.D.A., 1958). Therefore, yearly production may falter even before the land is withdrawn completely from production.

Even though the trend toward tenant-operation has apparently existed for some time (as evidenced by SCS estimates) and continues to exist (as evidenced by recent samples within

the study area) there is no reason to believe that the trend will be reversed. At present, only wealthy persons can afford to purchase farms large enough to be economically feasible. A 160-acre farm in the Greeley area will sell for over $100,000. Normally purchasers are professional people such as doctors and lawyers who would not operate the farms themselves. Since land values keep pace with inflation, farmland is less and less likely to become accessible to persons primarily interested in farm operation alone.

Land tenure is closely related to agricultural production. Tenant-operation is not by nature a long-range operation for those tenants actually farming a particular property. An increase in tenant operation signifies a potential decrease in long-term agricultural production. Such a trend should be carefully evaluated by those responsible for insuring adequate agricultural production for future needs, especially when that resource is already limited.

TABLE 4

SAMPLING OF LAND TENURE, FT. COLLINS, LARIMER COUNTY, COLORADO

DECEMBER 1971

(Random sample of sections with four or more operators per section from five townships around Ft. Collins)

Section and Township	Portion of Section Owner-operated	Portion of Section Tenant-operated
Sec. 32, T.8N., R.68W	3/4	1/4
Sec. 2, T.7N., R.68W	1/2	1/2
Sec. 9, T.6N., R.69W	City Dump	1/2
Sec. 4, T.6N., R.68W	1/4	3/4
Sec. 16, T.7N., R.67W	- - -	1
Total (4.5)	1.5 (33.3%)	3.0 (66.6%)

TABLE 5

SAMPLING OF LAND TENURE, GREELEY, WELD COUNTY, COLORADO

DECEMBER 1971

(Random sample of sections with four or more operators per section from five townships around Greeley)

Section and Township	Portion of Section Owner-operated	Portion of Section Tenant-operated
Sec. 34, T.7N., R.64W.	3/4	1/4
Sec. 14, T.6N., R.64W.	1/2	1/2
Sec. 20, T.5N., R.64W	1/2	1/2
Sec. 11, T.4N., R.64W.	1/2	1/2
Sec. 5, T.7N., R.65W	3/4	1/4
Sec. 9, T.6N., R.65W.	7/8	1/8
Sec. 3, T.5N., R.66W.	1/4	3/4
Sec. 21, T.7N., R.66W.	1/4	3/4
Sec. 18, T.6N., R.66W.	1/4	3/4
Sec. 16, T.4N., R.66W.	3/4	1/4
Sec. 22, T.7N., R.67W.	----	1
Sec. 8, T.6N., R.67W.	1/4	3/4
Sec. 27, T.5N., R.67W.	1/2	1/2
Sec. 3, T.4N., R.67W.	1/4	3/4
Total(14.01)	6.38(45.5%)	7.63(54.4%)

TABLE 6

SAMPLING OF LAND TENURE IN RANDOMLY SELECTED SECTIONS OF LAND BY LANDSCAPE UNIT (PHOTOMORPHIC AREA)

(Collectively these total 1.7% of entire study area)

Landscape Unit	Dominant Land Tenure
Ia - Dry-farm	Tenant-operated
Ib - Dry-farm, north-south strips	Owner-operated
IIa - Rectangular, irrigated	Owner-operated
IIb - Diagonal, irrigated	Owner-operated
IIc - Circular, irrigated	Tenant-operated (contracted)
IId - Rectangular, irrigated	½ Owner-operated, ½ Tenant operated
III - Pasture	Tenant-operated (rented)
IVa - Unimproved pasture	Owner-operated
IVb - Foothills grassland	Owner-operated (unproductive)

Summary of random landscape unit samples:

Tenant-operated	- 39%
Owner-operated	- 61%
Total	- 100%

TABLE 7

LAND TENURE CHARACTERISTICS BY COUNTY, STATE, AND COUNTRY, 1945, 1959, 1964 - According to the United States Census of Agriculture, 1964 Vol. 1, part 41.

	Larimer Co.	Weld Co.	Colorado		US(1000's)
All farm operators					
1945	-----	-----	47,618	1940	6,102
1959	1,292	3,3730	33,183		3,711
1964	1,194	3,419	29,798		3,158
Full-owners					
1945	-----	-----	22,986	1940	3,085
1959	706	1,306	15,485		2,119
1964	703	1,320	14,366		1,818
Part-owners					
1945	-----	-----	10,809	1940	616
1959	226	857	10,580		811
1964	219	802	9,719		782
Managers					
1945	-----	-----	528	1940	37
1959	7	47	373		21
1964	12	34	427		18
Tenants					
1945	-----	-----	13,295	1940	2,365
1959	353	1,520	6,745		760
1964	260	1,263	5,286		540
Proportion of tenancy					
1945	-----	-----	27.9%		38.8%
1959	27.3%	40.8%	20.3%		20.5%
1964	21.8%	36.9%	17.7%		17.1%

CHAPTER 5

LAND ECONOMICS IN THE POUDRE TRIANGLE

Lance Clarke

Introduction

The purpose of this discussion is to examine in a collective fashion some of the factors of land economics in the Poudre Triangle between Loveland, Ft. Collins, and Greeley, and to generalize on land values, their determinants and changes. The emphasis of analysis will concentrate on the rural, agricultural, and undeveloped lands of the study area rather than on the developed urban areas. The economics and ramifactions of land use modification from agricultural to more urban-type uses are of primary interest to those involved in planning for the defined study area.

Two parameters of land value will be discussed and analyzed for each of the landscape units of the study area and for several of the randomly chosen areal samples examined in this report: 1) the assessed value, or that which is determined by the County Assessor for purposes of establishing tax liability, and 2) the market value, or that which is determined by a willing seller and a willing buyer on the open market.

Acknowledgment for the basis and pertinent facts of this portion of the report is made to the Weld County Planning Office, the Weld County Assessor's Office, and several realtors of the Greeley area.

Assessed Values

As mentioned above, in order to establish real property

tax liability, the County Assessor appraises and computes a value for each parcel of land in the county. For urban parcels, this appraisal and evaluation is based upon information gained from recent open market sales. For rural, agricultural parcels, the appraisal and evaluation is based only on the agricultural economic value of the land, or its possible and expected productivity. This value is called the "actual value", and taxes are computed on the basis of 30% of "actual value". In other words, a parcel may be appraised at $250 per acre based on expected productivity, but the property tax liability is figured on a value of 30% of $250, or $75 per acre. This 30% figure is known as the "assessed valuation". In other words, the "actual value" of a parcel refers to the total value of a parcel based on the Assessor's Office appraisal of expected agricultural productivity, not the adjusted 30% figure.

The "actual value" of irrigated farmland in the study area usually falls between $250 and $400 per acre. Investigation of specific records revealed that of the irrigated landscape unit samples, the type "IIb" has an "actual value" of $350 to $400 per acre; type "IIa" has an "actual value" of from $300 to $366.66 per acre; and type "IIc" has an "actual value" of from $150 to $200 per acre. (See Fig. IV)

The "actual value" on dryland farms in the study area generally is between $33.33 and $60 per acre. The specific sample section for type "Ib" has an "actual value" of $66.66 per acre.

Dry, native grass pasture in the Poudre Triangle is given an "actual value" of between $10 and $11.66 per acre. Type "III" fall in this range, and type "IVa" has an "actual value" of between $3.33 and $10 per acre.

Feedlots are universally assigned an "actual value" of $1,000 per acre (Weld County Assessor, 1971).

Assessed valuation and "actual values" as determined by the County Assessor are useful in judging economic values of land in terms of agricultural production and in comparing relative values of rural land for agricultural purposes. But in the study area, these do not at all reflect the value of land in terms of going prices. To determine the cash value of rural land, it is necessary to investigate current market values.

Market Values

Market or cash value, as previously defined, varies significantly from the "actual value" as determined by the Assessor. If one were to buy rural land with the purpose of continuing to operate it indefinitely in agriculture, rationally the "actual value" should not be exceeded as purchase price. However, according to realtors who are concluding transactions daily in this region, no one is buying land in the study area for the purpose of maintaining agricultural use. All purchases are based on speculative desires to eventually alter land use to residential, commercial, or industrial purposes. Rapid population growth and recent industrialization in the area have affected speculation so that the agricultural productivity value

of the land has virtually no influence on the purchase price of a parcel. It only affects the price to the extent that the seller who has invested heavily in his land to make it productive will, therefore, probably demand a higher price than a seller who has little capital invested in his land. The primary determinants of cash or market value are individual site, water rights, replacement value (purchase price of another farm) to farmer-seller, and only minimally, productive capacity of the parcel (Austin et al., 1971).

Average irrigated farmland, with a normal "actual" economic value of around $300 per acre, is currently selling for a market value of $700, $800, to $1,000 per acre, depending on location, water rights, and the owner's willingness to sell. Average dry-farmland, which would carry an "actual" economic value of approximately $50 an acre is selling at a market value of $200, $300 to $600 per acre depending on location.

Thus, it is estimated that land in type "IIa" would sell for $700 per acre, in the "IIb" sample for $1,000 per acre, and in type "Ib" for $600 per acre. This variance is based on location and water rights. Type "IIa" sample area has good water, but it is east of Eaton, somewhat removed geographically from the present thrust of development. The "IIB" sample area possesses good water rights and is west of Eaton, in the present growth zone. The "Ib" sample area, on the other hand, does not carry water rights, but it is near the Highway 34 bypass.

The most dramatic disparities occur with the low "actual value" pasture and waste lands. Landscape unit "IVa", which has an "actual value" of between $3.33 and $10 per acre would probably command $1,000 per acre because of its high residential value based on scenic location (Austin et al., 1971).

Some of these speculative prices may be over-inflated in terms of alternate uses because of geological limitations. For instance, the "IVa" sample area on high bluffs may provide an unusual scenic residential location, but this advantage is offset by the possibility that conventional lawn irrigation may trigger downslope mass movement due to slumping.

It is obvious that "actual value" has virtually nothing to do with the market value or cash value of rural lands in the Poudre Triangle. Industrialization and population growth are influencing present sales on future, speculative, changed land use. Of primary importance in site selection are scenic and wooded areas for residential development, proximity to adequate transportation, and reasonable accessibility to established urban and service centers. Also of great importance are the water rights attached to land title. Irrigation water becomes more valuable year by year. Adequate water enhances the parcel value for either agricultural or speculative purposes. Terms of subdivision regulations require a developer to dedicate a certain amount of water to the public systems. If the land carries no transferable water rights, the developer must make a sizeable cash contribution to the public agency of

jurisdiction. Thus, speculative buyers are extremely interested in obtaining lands with adequate transfereable water. Similarly, farmer-owners are cognizant of the value of their water and are reluctant to sell. All these combine to drive market values further upward (Austin et al., 1971).

Conclusions

Unfortunately, because of the diverse factors influencing selling prices, it is difficult to make any kind of base map that accurately expresses market values in the study area. Variance from parcel to parcel can be exponentially dependent upon scenic attractiveness, proximity to established urban areas, water rights, accessibility, and the objectives and needs of the speculative buyer-developer. No specific statement or theory can be valid or useful. However, agricultural productivity can be regionally compared merely by attaching the average "actual values" for the various land types (landscape units) to the land type base map included in this report. (See Fig. 4)

The rapid growth and change occuring in the Poudre Triangle pose great problems and a great challenge to the rationality of the political system and the ingenuity of land planners. This area could become a showplace of modern development or another agglomeration of mistakes. There are presently no lands in this region restricted to agricultural use. No zoning change is required to alter agricultural land use. A developer need only go through normal subdivision procedures

with the County Planning Commission. There is some consideration of the beneficient process of preserving certain productive agricultural tracts in the face of urban development (Lorenson, 1971). This might prove to be quite difficult in the Poudre Triangle where development is already well underway. At this point in time, it is hard to argue that it would be equitable to tell an owner of productive land that his parcel must remain in agriculture with a value of $300 per acre while his neighbor with less productive land sells to a residential developer for more than three times that amount. What would be the form of compensation to the owner of land restricted in use?

Perhaps growth and industrialization should not have been allowed in this area initially. Perhaps prior planning should have channeled such development to less populated, less productive lands. But this did not occur. Residential growth and industrialization are here, and it is difficult to see how they can be halted. Planning efforts in this region should now concentrate on creating an orderly and humane development pattern based on performance standards.

Indeed, a probable but unfounded case can even be made that the productive land of this area is not really competitive, is losing its productivity, and is being depleted by years of intensive use. The 80-acre farmer can't truly compete economically with the developer of a new 400-acre residential tract. If it is necessary to establish agricultural preserves,

this should be done now in those places where industrial and urban pressures do not yet influence speculative land values.

CHAPTER 6

A DEMOGRAPHIC STUDY OF WELD AND LARIMER COUNTIES

Robert Magnuson

Introduction

The demographic analysis of the study area consists of five parts. One is current population statistics and growth from 1910 to 1970. Part two presents population forecasts using the migration and natural increase method to the year 2000. Part three is a population age composition characteristic projection for intermediate and high school (entering students) to the year 1980, using the Hamilton-Perry method. Part four is an agricultural employment statistical study from 1940 to 1970. Finally, part five is a statistical comparison of urban - rural county populations from 1950 to 1970.

This demographic study will be conducted within two major area divisions due to census tracts and county boundaries not conforming to the boundaries of the study area. Population data could only be related to the county and municipal levels. Thus, the demographic study of the counties of Weld and Larimer will present a general overview of population trends and the municipal level study, using the Cities of Ft. Collins, Greeley, and Loveland, will present specific trends within the study area.

TABLE 8

Current Population and Growth 1910-1970

STATE	1910	1920	1930	1940	1950	1960	1970
Colo.	799,024	934,629	1,035,891	1,123,296	1,325,098	1,753,925	2,207,259
COUNTY							
Larimer	(information not available)					53,343	89,900
Weld						72,344	89,297
CITY							
Ft. Collins	8,210	8,755	11,489	12,251	14,937	25,027	43,337
Greeley	8,179	10,958	12,203	15,995	20,354	26,314	38,902
Loveland	3,651	5,055	5,506	6,145	6,773	9,734	16,220

All these cities were above the median change increase of the State (25.8%) between 1960 and 1970. Ft. Collins had a 73.2% rate of increase, Loveland had a 66,6% rate of increase over 1960, and Greeley had an increase of 47.8%. It should also be noted that the two cities that increased the most between 1960 and 1970 were both located in Larimer County.

Population Forecasts

Part two, a population forecast for the counties and cities of the study to the year 2000 is perhaps the single most important population study for land use purposes. Certainly current population estimates and studies of the present composition and distribution are essential as a point of beginning in planning analyses, and in the continuing task of revising and detailing features of the resulting plans.

They also serve an important function in day-to-day decisions relating to all kinds of public works and land development activities. Yet frequently the original and comprehensive plan studies undertaken in an urban or rural area and their subsequent major revisions can be scheduled around a decennial census period to take advantage of the detailed and accurate data available only at these particular times. But no planning activity is fulfilling its proper function unless plans are developed within a context of a continuum of needs extending from the present into the foreseeable future.

What is foreseeable and what period into the future should be selected for population forecasts depends a great deal upon past growth characteristics of the study area, how large it is, and the specific uses to be made of the forecasts. Also, any area that includes a sudden growth cycle presents a more difficult problem of projection than those experiencing growth at a slower pace.

In projecting the populations of the two counties and three cities, the migration and natural increase method was used. Forecasts derived from this method involve separate analyses of two components, migration and natural increase. This study only provides projections of total populations instead of breaking the total population into different segments of age and sex except for the one educational student projection. It starts with a current population, and by introducing adjustments for migration and then for natural increase on a year-by-year basis, it develops estimates for any date designated.

Adjustments made in these population projections were based on 1) past relationships between the direction and volume of net migration in the area and the levels of national economic activity as related to the rise or decline in per capita incomes, and 2) the relationships between the relative rates of increase in national employment and population and the outlook for economic development and expansion of employment in the area during the periods of forecast, such as the growth of the City of Windsor in Weld County. From these considerations, I made judgements of minimum and maximum net migration and natural increase quantities and applied these estimates to examined trends of growth. Thus, these projections will usually be based largely on a subjectively reasoned approach rather than an extrapolation of past trends only.

TABLE 9

Projections of Population

	1970	1980	1990	2000
Larimer County	89,900	116,000	160,000	210,000
Weld County	89,297	125,000	180,000	230,000
Ft. Collins	43,337	70,000	100,000	135,000
Greeley	38,902	59,000	87,000	120,000
Loveland	16,220	27,000	38,000	50,000

A major factor influencing growth in Weld County after 1970 was the increased migration of persons to the area as a result of increased employment potentials in the City of Windsor.

The City of Windsor had become the site, in 1971, of Kodak's second largest plant.

Educational Projection

Part three, an age comparison projection, using the Hamilton-Perry method, was used to examine the increases and projected numbers of thirteen and sixteen-year olds within Larimer and Weld Counties and the Cities of Ft. Collins, Greeley, and Loveland. The ages of thirteen and sixteen were used to depict the number of students about to enter intermediate school and high school and thus give an estimated idea of the need for long-range facility needs and land requirements for educational sites.

The Hamilton-Perry method uses the formula, $P_x^8=(P_x^7-10\cdot P_x^7)$ divided by P_x^6-10. By using decennial census data, one can estimate the age composition for the decade ahead, say 1980, by examining 1970 and as it was ten years earlier in 1960. P_x^8 is the population of age group x (thirteen and sixteen-year olds in these cases) in 1980; P_x^7 is the population of age group x in 1970; P_x^7-10 is the population of age group x-10 in 1970; and P_x^6-10 is the population of age group x-10 in 1960. Any projections for the under-10 age group in 1970 may be estimated assuming that age specific fertility rates prevailing in 1970 will remain constant until 1980. I felt that the increased migratory development in Larimer and Weld County made it impossible to study age groups of less than ten years of age.

TABLE 10

Population Estimates, Teenage Groups*

		1960	1970	1980
Weld County	No. of 13 yr. olds	1507	1765	1557
	No. of 16 yr. olds	1233	1704	1868
Larimer County	No. of 13 yr. olds	1017	1592	2118
	No. of 16 yr. olds	837	1490	2238
Ft. Collins	No. of 13 yr. olds	383	609	722
	No. of 16 yr. olds	312	565	837
Greeley	No. of 13 yr. olds	442	623	721
	No. of 16 yr. olds	375	593	837

*(Due to the unavailability of 1960 census information for Loveland, similar estimates for Loveland are not included in this study).

The one interesting facet of this age composition study was that in the 1980 projection of Weld County's thirteen-year olds, there was a decrease in numbers from 1970. All the rest of the comparisons increased normally showing that educational facilities must continually be expanded in order to house these new students. Weld County, due to the decrease of thirteen-year olds, may be able to keep the remaining facilities of intermediate schools county-wide except for the urban area of Greeley.

Agriculture Employment

Part four, the agricultural employment statistical com-

parison, shows a marked decrease in the number of agriculturally employed from the years 1950 to 1970. The greatest decrease was in the period of 1950 to 1960 which was probably due to increased mechanization, a trend which continued through the 1960's. This constant decrease of people working on farms seems to follow the national trend of the small farmer being bought-out by the larger farms and the eating away of farm land by sprawling urbanization. Weld County showed a lesser decrease mainly due to the amount of its rich land that remained in farms, which was subsequently relatively unaffected by the influences of urbanization. The latter influences were felt to a greater degree in Larimer County.

In some of our field interviews, there was indicated a shortage of "good" help during harvest and beet thinning times. Most residents said this was due 1) to increased employment opportunities at Monfort Feedlot; and 2) to the tendency of farm workers to leave rural areas to accept better paying jobs in factories.

TABLE 11

Employment Statistics in Agriculture, by County

	1940	1950	1960	1970
Larimer County	2,896	2,765	2,053	1,736
Weld County	8,308	8,613	6,437	5,294

Urban-Rural Populations

Part five, the urban-rural population comparisons from 1950-1970 shows a considerable increase in urban populations. In Weld County, rural populations more than doubled urban populations in 1950, and by the year 1970 the rural population in

Weld County, a very strong agricultural area, still outnumbered urban populations of the county. In Larimer County, a less productive agricultural area than Weld County, urban and rural populations have risen from a near comparable number in 1950, to almost a 100% increase of the urban population over the rural population in 1970. Thus, Larimer County is becoming an urbanized area at a higher rate than Weld County.

TABLE 12

Urban-Rural Populations 1950 - 1970

Weld County	1950	1960	1970
Urban	20,354	26,314	41,472
Rural	47,150	46,030	47,825
Larimer County			
Urban	21,710	34,761	59,557
Rural	21,844	18,582	30,343

Fig.2

POPULATION PROJECTIONS OF WELD AND LARIMER COUNTIES

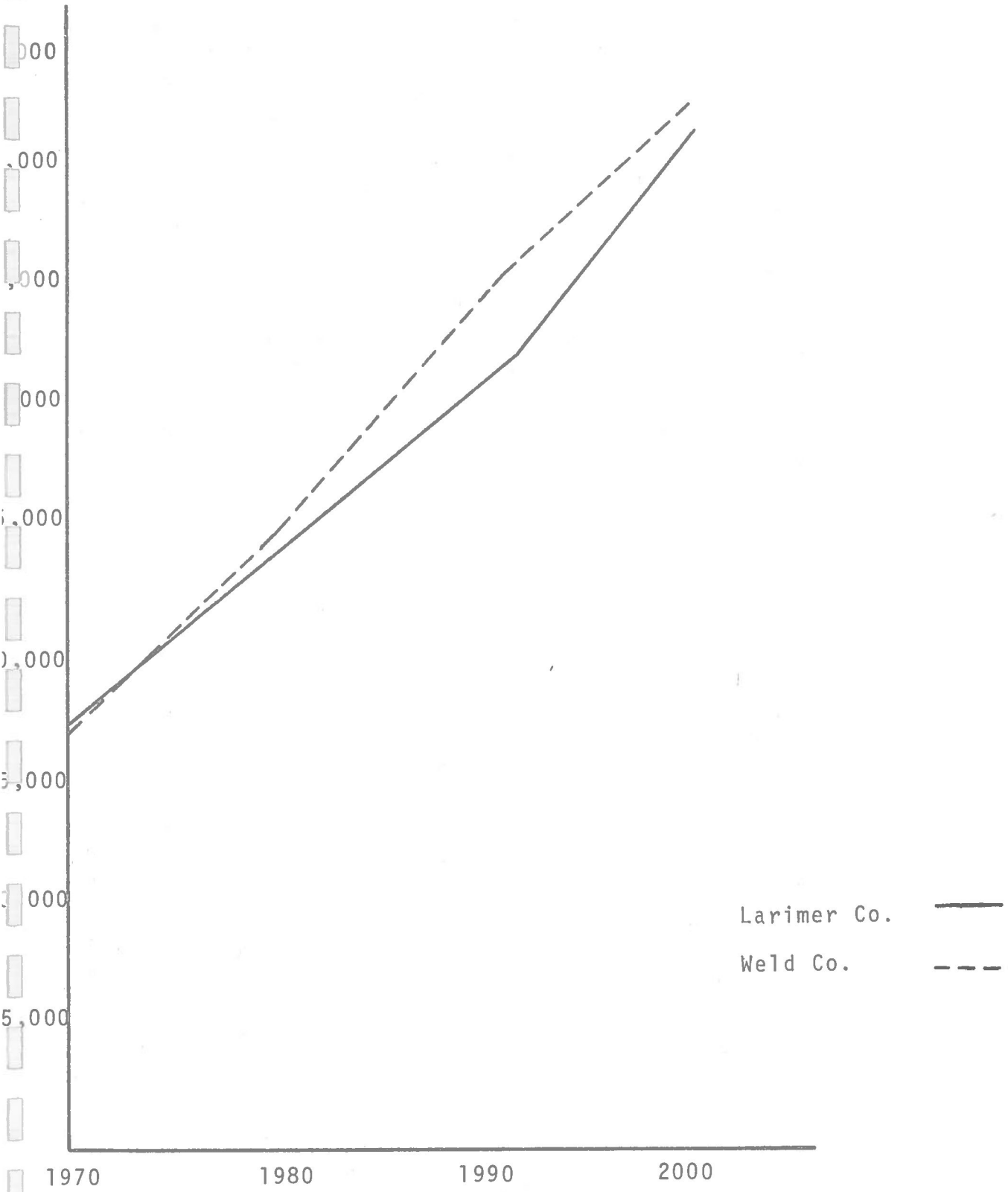
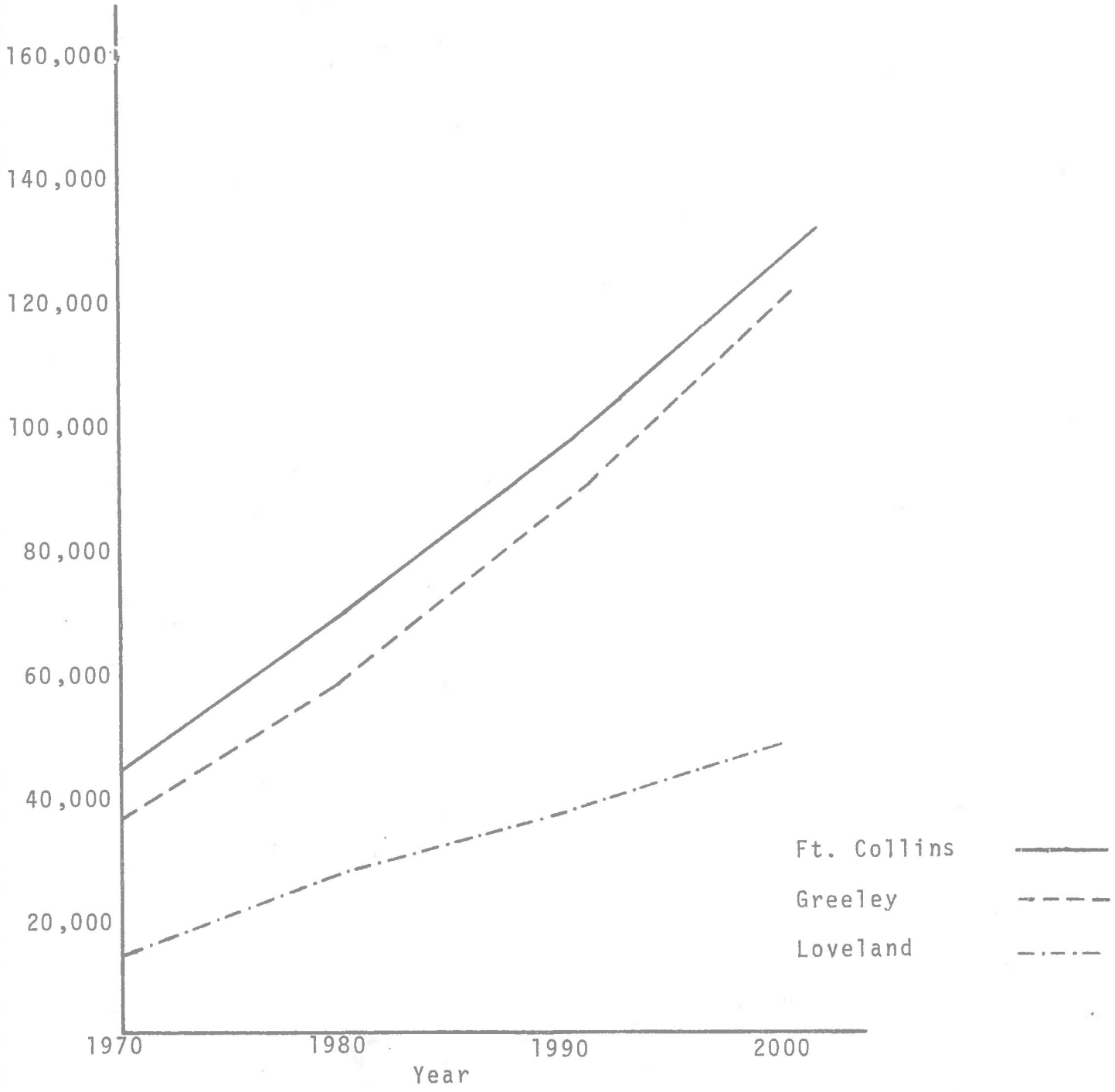


Fig. 3

POPULATION PROJECTIONS FORT COLLINS, GREELEY, AND LOVELAND



Landscape Units – 1970 The Poudre Triangle

CHAPTER 7

PHOTOMORPHIC ANALYSIS OF LANDSCAPE UNITS

Poudre Triangle of Larimer and Weld Counties

Darrel C. Hansen, Lance Clarke, and Robert Magnuson

LANDSCAPE UNIT Ia

(See chapter 3, pages 26-27)

Photomorphic appearance: Extremely elongated rectangular patterns, 8-20 times as long as wide. Strips are oriented with cardinal directions, normally on north-south axes. Photo textures are fine with alternating strips of very light gray and medium gray, sometimes mottled by somewhat circular patches of very light gray.

Geographic description: The area is continually rolling, and although relief is normally less than 100 feet, essentially all land is on gentle slopes. Fields are 100-200 yards in width and normally a mile or more in length. Some alkali concentrations are evident at the bottoms of some of the poorly drained swales. Fields are alternately in grain and fallow. There are no trees and the natural vegetation is grass.

Land use characteristics: The sample area represents only a portion of the owner's property, and neither the owner nor the operator live on the property. Although no one lives on the sample section, several residences for non-farm families have been built and others are under construction on surrounding sections. One informant adamantly expressed his disgust for

his new neighbors who, after intruding into his rural neighborhood, were now antagonizing him with demands that he 'clean up' his place by removing weeds from pasture land, removing occasionally used machinery, and by forming a compact which seeks to enforce standards of architecture, landscaping and maintenance with little regard to the requirements of farming operations. This is an excellent illustration of the conflict between those who must operate in a rural environment, and 'intruders' who desire a veneer of rural life, wanting to enjoy the advantages of a spacious environment, but having little feeling or sympathy for the problems of those who derive their living from farming.

The sample area is not irrigated. The alkali flats are evidence that drainage is inadequate to permit irrigation. The land is operated on a sharecrop basis. Wheat is the favored crop, but barley or rye are sometimes grown as back-up crops if wheat is destroyed by hail or other such catastrophes early in the growing season. Strips are planted in alternate years and allowed to lie fallow the other years. The average yield is reported to be 30-35 bushels of wheat per acre.

(D. Hansen)

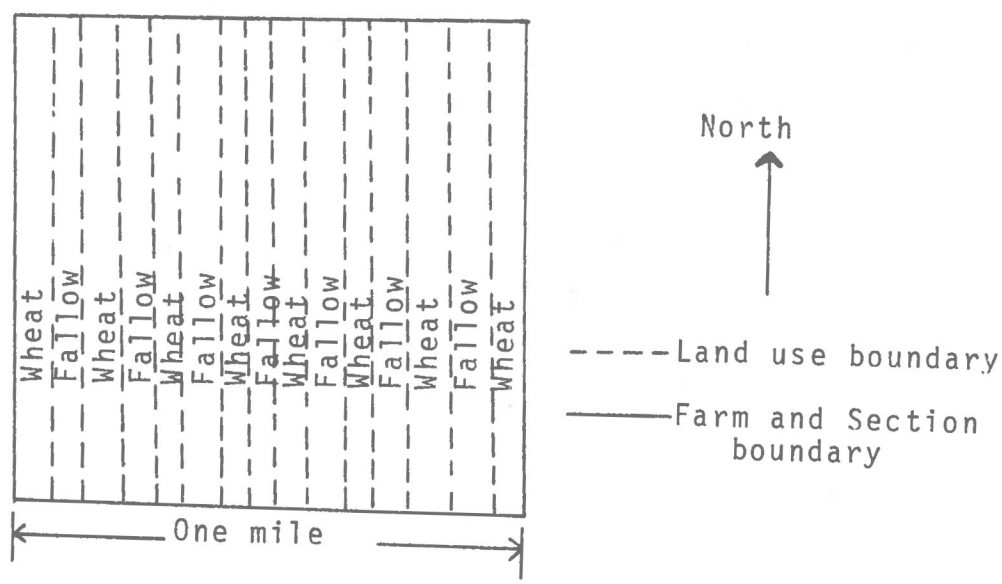


Fig. 5 Land Use Sample Area

LANDSCAPE UNIT Ia

LANDSCAPE UNIT Ib

Photomorphic appearance: The photo image of this land-type is typified by generally massive rectilinear fields of usually between 80 and 160 acres. The orientation follows the squareness of section lines and the fields vary in tonal quality from light through medium gray. The particular sample area shows field sizes of between 60 and 160 acres in a rectangular, north-south orientation and in shadings of light to medium gray.

Geographic description: The immediate region in which this sample is located is quite high. It overlooks much of the surrounding countryside, with a general gentle sloping toward the north. The surrounding region is gently rolling with the slope varying 20 feet or so for each half mile. The north boundary of the sample section interfaces with a very obvious draw of dendritic drainage, and from there proceeds northeast toward the Cache la Poudre River.

The landscape is essentially bare except for field vegetation, brush and trees in low drainage areas, and trees around farmsteads.

The dominant soil in the sample area is Weld loam, becoming more sandy as one proceeds in an easterly direction from this sample area.

There is no evidence of immediate urbanization pressure.

Land use characteristics: The immediate area is primarily utilized for wheat production. The sample area is typical as it is

all dry-farm; wheat in a three-year rotational pattern involving winter wheat, spring wheat, and land in fallow. Productivity averages around 25 bushels per acre, but 35 bushels per acre are not uncommon in a good year. The sample area has one owner who singly operates the farm. He does not own or operate any other land in the region, and he lives off the premises. Surprisingly, this owner-operator resides in California and commutes several times each year.

The farming operation in the sample area can sometimes be hindered by wind, hail, insufficient rainfall, and total land inadequacy, but has been and continues to be operated profitably in wheat production. (L. Clarke and R. Magnuson)

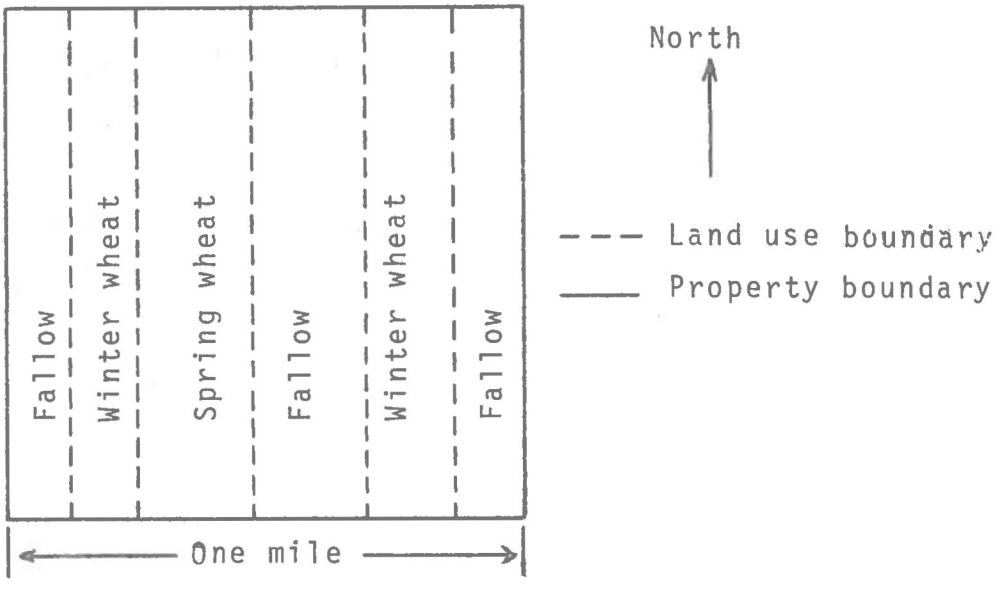


Fig. 6 Land Use Sample Area

Landscape Unit Ib

LANDSCAPE UNIT IIa

Photomorphic appearance: Rectangular patterns, usually elongate with dimensions varying between 0.1 and 0.5 miles and boundaries coinciding approximately with cardinal directions. Tones vary from white to dark shades of gray, with fine textures. There is an average of four to five farmsteads per square mile.

Geographic description: There is very little local relief. The land is used predominantly for irrigated crops with little if any natural vegetation remaining. Trees occur only along some irrigation canals and ditches, and beside some farmsteads. Relief is too slight to exercise significant control over field orientation.

Land use characteristics: The sample section consists of four farms, two of approximately 100 acres each and two of approximately 200 acres each. (The boundary separating the smaller farms on the west from the larger farms on the east was originally determined by an irrigation canal.) The two larger farms are owner-operated and appear quite prosperous. One of the smaller farms is operated on a salary basis by the owner's brother, the other by the owner, who is also employed at the sugar factory in Eaton.

Primary crops are corn, sugar beets, alfalfa, beans, and a limited amount of pasture. Corn is harvested both as silage and as feed grain, which is usually fed to cattle on the farm,

with surpluses sold to large feedlot operations. After harvesting, sugar beet fields are rented or leased for sheep to graze the beet tops.

Approximate average yields reported were:

Sugar Beets: 22-25 Tons per acre

Corn Silage: 23 Tons per acre

(D. Hanson)

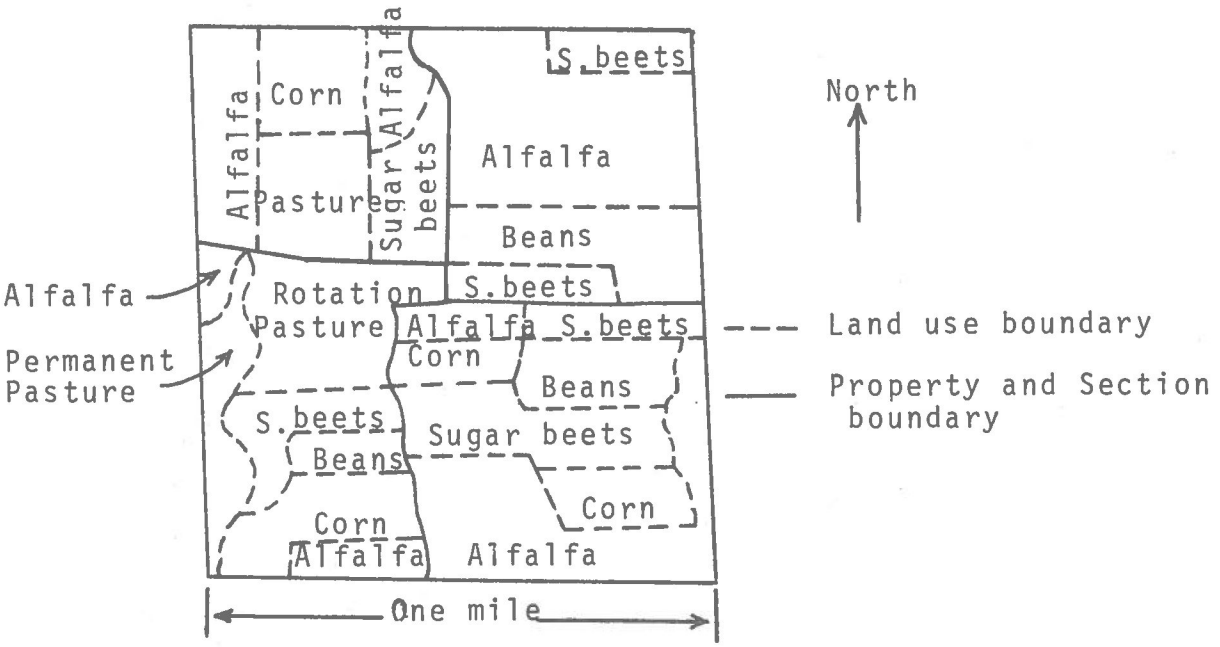


Fig. 7 Land Use Sample Area

Landscape Unit IIa

LANDSCAPE UNIT IIb

Photomorphic appearance: The photo image of this land type is typified by a gross pattern of elongate, parallel, rectilinear fields broken up by the incursion of diagonal small fields oriented along a northwest to southeast axis. This diagonal pattern includes fields of various sizes (20 to 80 acres) and in tones from white, through all shades of medium gray to a very dark gray. The particular sample area shows over 20 fields in a section, varying in size from 20 to 60 acres.

Geographic description: The immediate region in which this sample is located is fairly high, with a ridge in the west which runs from the northwest to the southeast. There is a definite slope to the southeast, and the southwest corner of the section where the ridge occurs is the highest point in the sample area. There is very little overall relief or rolling pattern.

The landscape is quite intensively farmed and there is little cover aside from trees around farmsteads.

The dominant soil in the sample is Weld fine sandy loam with the valley phase in the northeast corner and south center of the section.

There is no obvious evidence of any urbanization process in or near the sample section.

Land use characteristics: The immediate region is well irrigated and quite intensively farmed. The sample area is typical

as all fields are irrigated and the products are sugar beets, corn, alfalfa, and beef cattle. The major emphasis is mixed between the cash crop, sugar beets, and cattle production. All the corn and alfalfa produced is retained by the farmers for feed purposes. There is a crop rotational pattern whereby sugar beets and corn are rotated yearly and corn and alfalfa are rotated every four or five years. Average beet yield is 16-20 tons per acre, and as mentioned earlier, the corn and alfalfa is retained for silage. The sugar beets are sold to the sugar factory in Eaton and the cattle are marketed in Denver.

The section is farmed by four owner-operators, each of whom have about one quarter of the section. The owner with the biggest cattle feeding operation utilizes four full-time employees in addition to the owner, while the others function with one full-time hired hand each. All the operations utilize additional part-time help during the heavy seasons of harvest and beet-thinning. Two of the owner-operators own and farm additional contiguous lands and one of the other owners has some non-contiguous dry-land pasture. The farm sizes here range from slightly more than 1/4 square-mile to almost 3/4 square mile.

The primary problem expressed by these owners if the difficulty of obtaining good hired help. They mentioned the increasing industrialization of the area and the accompanying attraction of higher factory wages as the basis for this problem.

One of the owners is frequently approached by realtors wishing to obtain the property for residential use, but there is no present evidence of change in land use from agricultural to urban.

(L. Clarke and R. Magnuson)

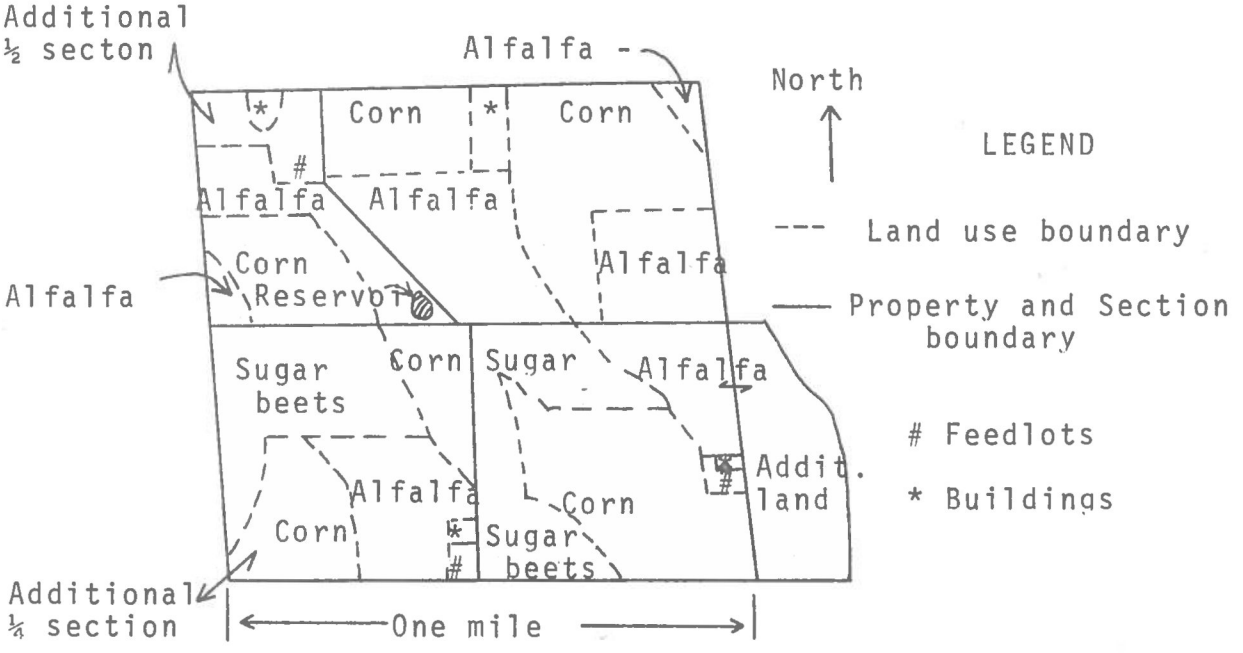


Fig. 8 Land Use Sample Area

LANDSCAPE UNIT IIb

LANDSCAPE UNIT IIc

Photomorphic appearance: Square fields of one quarter-section in size with an enclosed circular area one half-mile in diameter occur here. They are within the square so that the arcs of the circle are tangential with sides of the enclosing square. The tone is very even within the individual circles and is light or medium gray. The areas in the corners, included by the square but excluded by the circles, vary in tone from light to medium gray. They have a more uneven texture than the area within the circles.

Geographic description: The area is gently rolling with relief too great to permit irrigation by flooding methods. Surrounding farms are operated by dry farming methods, however, fields exhibiting this pattern are irrigated by rotating sprinkler systems. Corner areas, which are beyond the reach of sprinklers, are used for housing, open storage, and in cases show no apparent use.

Land use characteristics: Farming is intensively developed to profit from large investments in sprinkler systems. Crops are rotated annually alternating between corn and sugar beets. Corn is harvested both as silage and feed grain and fed to cattle. Grazing rights to beet tops are rented to sheep herders after the sugar beet harvest. The operation of the farms is by contractual arrangement between owner and tenant. The

Blehm Land and Cattle Company owns three-quarters of the sample section and uses all feed grown to support feedlot operation. In anticipation of future growth of Greeley, feedlot water lines were planned to coincide with dimensions required for housing development. This, plus intensive cropping practices, suggest that only short-term agricultural occupance of the land is expected.

Approximate average yields reported:

Sugar Beets: 23-24 Tons per acre

Corn Silage: 21 Tons per acre

(D. Hanson)

LANDSCAPE UNIT IId

Photomorphic appearance: Photo image is fine textured, ranging from very light gray to medium gray. Patterns are blocky rectangles, ranging from squares to rectangles with 1:4 width-length ratios. Rectangles show a slight tendency to orient their long axes in a north-south direction. Geometric symmetry is occasionally broken by an irregular line representing a stream.

Geographic description: The sample area is very flat and would be devoid of discernable relief were it not for a shallow valley running through the northeast quarter of the section. There are a few trees along the stream. All other land is under cultivation. Relief exerts no apparent control over land use; and it appears fields have been graded to irrigate north and south from the center of the section.

Land use characteristics: The sample section is divided into four farms of unequal size. The smallest, comprising 80 acres, is occupied by the owner's son's family and one other family, but is operated by a neighbor on a share-crop basis. Two farms are quarter-sections, one formerly emphasized dairy operation, but the owner has sold his dairy herd due to his age; the other quarter-section is presently an active dairy operation, but is advertised for sale as property for commercial development. The remaining farm comprises approximately 235 acres (part of the western edge of the farm has been lost to interstate highway

and cloverleaf right-of-way) and represents only a fraction of an incorporated farm. The largest acreage is planted in corn, most of which is harvested as silage and used to feed cattle. Some sheep are pastured in the sugar beet and corn fields after harvest to forage on beet tops and corn left after harvesting. Approximately 40% of the acreage is planted to corn. Nearly equal proportions of sugar beets, wheat and alfalfa make up most of the remaining cultivated acreage. Other land is used for beans and irrigated pasture. Yields average 18-20 tons of corn silage per acre or 20-25 tons of sugar beets.

Owners expressed expectations that Fort Collins will eventually engulf their farmland, and noted the rapid increase of non-agricultural people occupying homes in the neighborhood. Farmers feel that it is becoming increasingly difficult to farm profitably and find it necessary to intensify land use or to operate more extensive areas through incorporation. Irrigation water is supplied partly from Kitchell Reservoir and partly from private wells.

(D. Hanson)

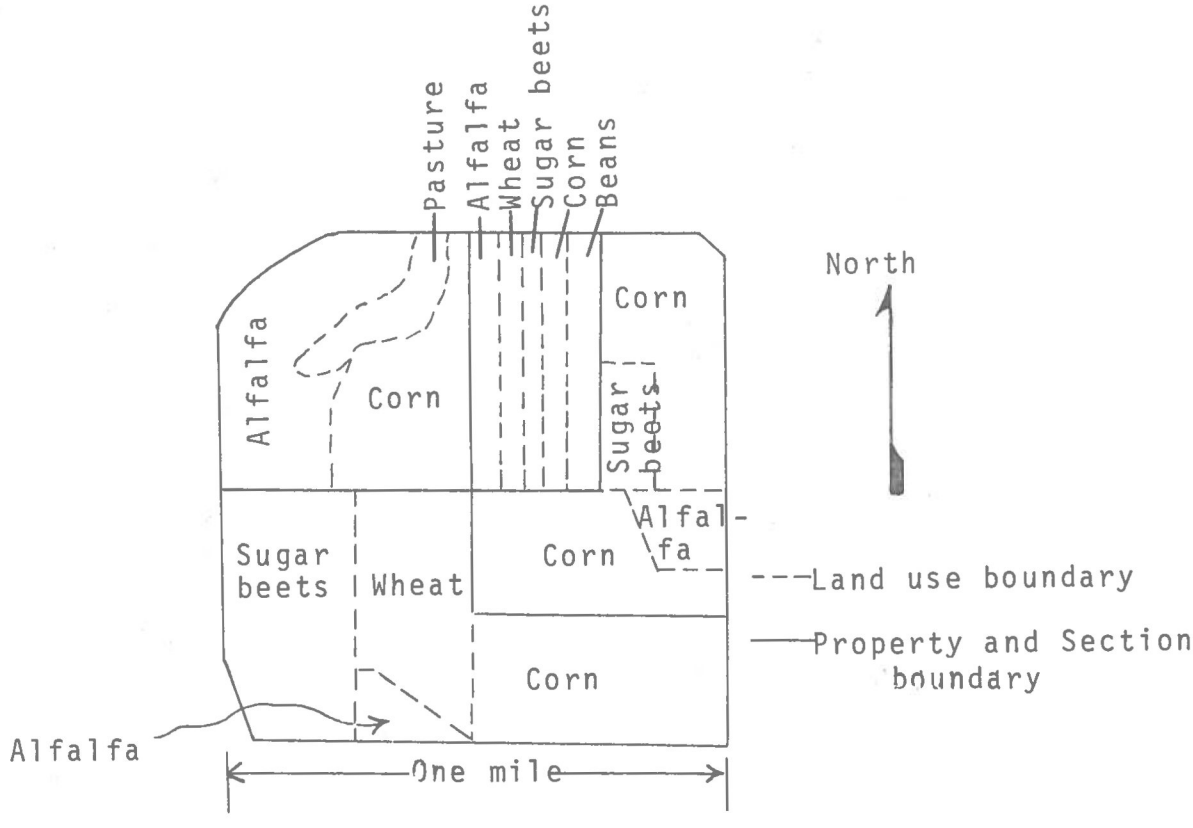


Fig. 9 Land Use Sample Area

Landscape Unit IId

LANDSCAPE UNIT IIIa

Photomorphic appearance: The photo image of this land type is typified by medium gray tones and an apparent roughness of texture. There is no evidence of row crops or separable field patterns. Field sizes vary from 10 to 160 acres.

Geographic description: Generally the land-type of the above photo description is pasture, or marginal swampy, or brush and scrub land. The immediate region in which the sample is located is sparsely settled and of mixed usage in an urban fringe setting. The land is rough and slightly rolling. Some swampy areas occur. Localities are haphazardly becoming urbanized with scattered trailer parks and small home sites. There is a mixture of some dry farming, some swampy land, pasture, and apparently vacant land.

The actual sample area basically slopes to the west and is bounded on the west by a slight rise. The landscape, which is quite barren, is characterized by short bunch grasses, marshy vegetation, brush, and a few small trees. There is a low area where an occasional creek runs down the center of the sample area from north to south.

The southern part of the sample is quite marshy. The soils proceeding from the south to the north are: the Terry silty clay loam (Valley Phase), the Terry loam (Valley Phase), and the Terry fine sandy loam. The Weld loam occurs in the northernmost part of the section which is in crops.

The sample area is located virtually midway between Loveland and Fort Collins, quite close to the main connecting highway, and definitely shows signs of urbanization pressure.

Land use characteristics: As stated above, the immediate region is in mixed usages and is becoming urbanized. The sample area is being utilized as pasture. The sample has two separate parcels and two separate owners, both of whom live off the premises and lease the pasture to horse owners. The owner of the northernmost parcel owns other non-contiguous properties in the study area, and he also rents a house and outbuildings which are on his property.

Both owners express the speculative desire to turn their property into industrial or residential use as soon as possible.

(L. Clarke and R. Magnuson)

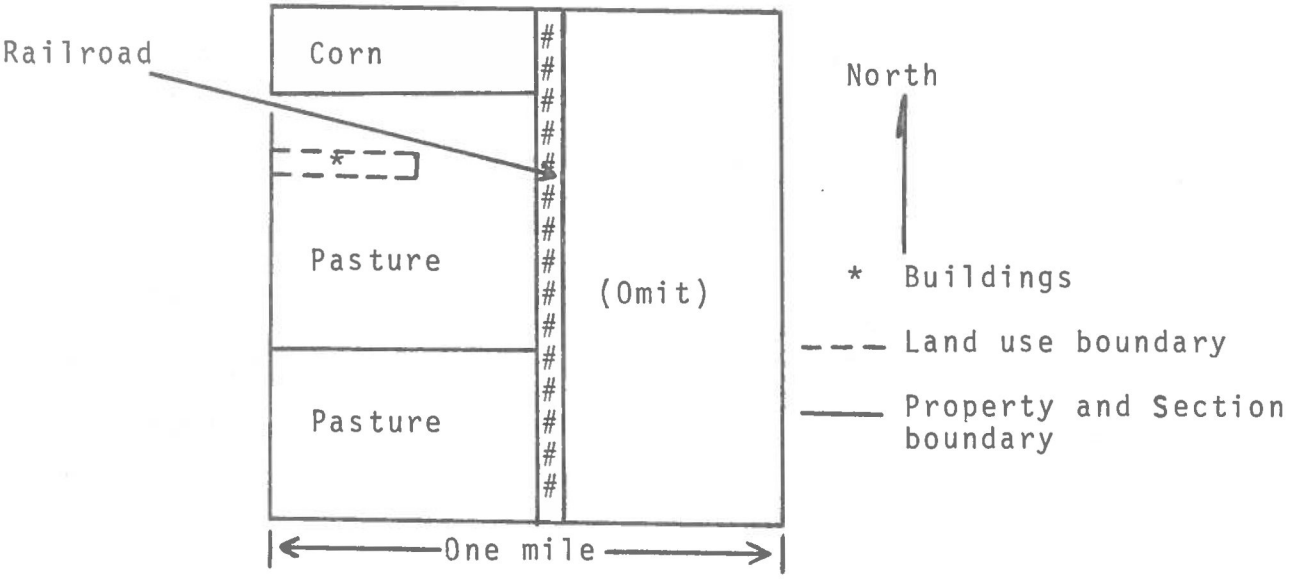


Fig. 10 Land Use Sample Area

Landscape Unit IIIa

LANDSCAPE UNIT IIIb

Photomorphic appearance: Parallel boundaries enclose medium-gray and very light-toned areas. Part of the units have a granular photographic texture associated with dark-toned meandering stream lines. Braided stream patterns are common.

Geographic description: These are invariably flood plains and meander belts of the major streams of the study area. Point-bar deposits are seen on the meander loops. Meander scars of former channels are common. Cottonwoods and willows are often dense along the lowest parts of the drainageways. The ground cover generally consists of grasses and sedges and brushy willow.

Land use characteristics: This is permanent pasture land. The surface deposits are porous sands and gravels which are most frequently underlain by rather impervious clays and shaley bedrock. Thus, the water table is usually near the surface. Shifting channels in the past created a rough surface. The areas are subject to periodic flooding. The combined features limit the present use to grazing and gravel operations, although there is a recreation potential not yet developed.

LANDSCAPE UNIT IVa

Photomorphic appearance: These are irregularly shaped areas of light to medium gray tone in which dendritic drainage patterns are usually apparent. Adjacent patterns vary from elongate, rectangular fields to river channels. There is little evidence of farm houses or buildings in these areas.

Geographic description: The area is one of moderate to severe relief. Essentially all of the land surface slopes too steeply to be amenable to irrigation. Some well weathered rock outcrops are apparent. The natural vegetation appears to be grass with some shrubs. Surrounding lands are quite flat and are presently in irrigated agriculture. Most occurrences of this land-type are on the valley bluffs of the Cache la Poudre River where high drainage density reveals shale susceptible to erosion.

Land use characteristics: The predominant land use is summer pasture for cattle. The steep eastern slope is being developed into a ski slope by the City of Greeley.

Surrounding irrigated lands are used primarily for production of corn and alfalfa which is in turn fed to beef cattle. One farm owner had recently switched from a Jersey-based dairy operation to contract feeding of beef cattle when the stock is off the summer range. He had recently sold 40 acres for development into a trailer park, but retained the water rights to the property. Other agricultural land and livestock is owned

by a man living in Grant, Nebraska, and is operated by tenants on a profit-sharing basis. Owners and tenants interviewed expect urbanization of their land as Kodak develops in the area immediately north, and as Greeley grows westward. No average yield figures were reported.

(D. Hansen)

LANDSCAPE UNIT IVb

Photomorphic appearance: The photo image is an even medium gray with linear ridges oriented north-south providing the only significant features.

Geographic description: The area is predominantly cuesta and strike valleys, formed by geologic strata dipping eastward. Slopes are estimated at 20-30^{o} and are sparsely vegetated with grass, yucca, and occasional shrubs.

Land use characteristics: A neighbor reported that the land is owned by a doctor and is seldom used for grazing. The sample area is uninhabited and no other land use is apparent.

The slope appears to be formed by a fairly resistant sandstone which would normally be quite permeable and well drained. The drainage conditions would indicate that irrigation would not be efficient on the steeply sloping land. The valley bottoms further west are less permeable, often underlain by shale.

(D. Hansen)

CHAPTER 8

THE REGIONAL OPTIONS

Donald D. MacPhail

The preceding pages point to a variety of concerns relating to the Poudre Triangle of Larimer and Weld Counties. One of these is the possibility of the permanent loss of the best agricultural land in Colorado and some of the best in the nation. The displacement of farming by industry and urbanization is just beginning here. A Year-2000 projection for the four cities of Ft. Collins, Windsor, Greeley, and Loveland alone totals 375,000 urban residents (Development Research Associates, 1972). Is it a process that should be curtailed or encouraged to continue? There are arguments in both directions.

The issues are extremely complex. The farmer, on the one hand, faces economic pressures with a continuing price-cost squeeze. Fortunately for him, his property taxes are not based on current market values for his land. If they were, the rate of abandonment of farming would be more rapid than at present in the area. But the spiraling land prices, produced by speculation in anticipation of growth, constantly tempt him either to sell or become a speculator himself.

Why the concern? Why not be satisfied with the play of the market place? As Marion Clawson (1963) wrote a decade ago-

> In another generation, all available water and all the most suitable land areas near the present larger cities of the West will be taken over completely by these cities, to the exclusion of agriculture. Agriculture will disappear

largely or completely from Arizona's Salt River Valley, and around Tucson, along the middle Rio Grande in New Mexico, along most of the Rocky Mountain from north of Denver, from the Salt Lake Valley, from all of southern California south of the Tehachapis (except in the Imperial Valley), and from the Santa Clara Valley.

Lance Clarke, writing in this report, tends to agree with Clawson. This however, reflects a laizzez-faire economic analysis, and does not recognize the "new" economics which includes consideration of social and environmental costs (Barkley and Seckler, 1972). Colorado law now requires environmental impact statements from new developers. There are other aspects of land use alteration than the simple transfer of money and title.

Stanislaw Leszczycki (1972), President of the International Geographical Union, points to the need to recognize three human environments: 1) the densely settled, urban-industrial agglomerations and centers, 2) the zone of intensive productive and non-productive activities with moderately dense population, and 3) the natural zone, which is sparsely settled and has sporadic and extensive production activities. In analyzing a model of these zones, he calls attention to fourteen different types of environmental hazards or disfunctions. Among these are problems of air and water pollution, degradation of soil, obnoxious odors, and waste disposal. The important point that Dr. Leszczycki makes is that, as the standard of living rises, there is a comparable increase in the environmental disfunctions and an even sharper increase in environmental costs needed to stem the attendant degradation.

It would be useful here to consider comparative environmental and social costs relating on one side to urban-industrial land use and those in the adjacent sector of intensive rural production. These two zones are clearly present in the Poudre Triangle.

1 - Urban - Industrial Zone

a) High land values with higher potential governmental income from property taxes.

b) High population density with a large number of environmental disfunctions and high costs of control and abatement.

c) High-cost transportation-utility infrastructure. In the dense, built-up areas, the square feet dedicated to roadway tends to rise by a rough factor of ten with population increase (Lamm and Strang, 1971).

d) High costs of schools, police, courts, fire protection, and other public services.

e) A rapid rate of urban growth can be counter-productive in terms of social costs beyond a critical size of cities.

2 - Intensively Productive Rural Zone

a) Lower property base as source of potential revenue for local government.

b) Need for low taxation as an incentive for continued operations.

c) High aesthetic environmental and open-space amenities.

d) Less complicated and lower level of pollution risks.

e) Lower costs of development and maintenance of transportation-utility infrastructure.

f) High-quality food-producing reserve for future population increases.

Taking into consideration the above, there are still other aspects of the problem of displacing agriculture with urban-industrial land uses. The present trend of farming in the northern Piedmont includes an increase of dairying and feedlot operations. These are intensive, urban-oriented farming activities. They may survive the initial onslaught of urban sprawl, but in the long run, they require substantial cropland and land for fodder crops nearby. In northeastern Colorado, they cannot survive without water. A pound of beef requires between 20,000 and 50,000 pounds of water and a pound of milk requires 10,000 pounds of water (Lamm and Strang, 1971). Thus, land use legislation and zoning are insufficient without an accompanying control on water transfers if agriculture is to be preserved in the Poudre Triangle.

Again, we return to the question, why preserve the irrigated farmland anyway? There can be a strong argument made that Colorado fared much better in the nation's recent recession than highly industrialized urban areas, such as the Los Angeles Basin and the Puget Sound Lowland. One of the prime reasons has to be that Colorado has greater economic diversity. A relatively

homogeneous resource and production base is much more susceptible to the rise and fall of government spending programs or fluctuations in the marketing system. Would this not then be a strong reason to encourage the maintenance of high-quality agriculture and, thus, the preservation of a diverse and healthier state and regional economy?

From the national point of view, export strength in the future is more likely to be based upon agriculture than industry. The under-fed and developing nations want their own industry to employ the rural emigrants who surge into their exploding cities. Here, perhaps, international corporations may participate in the industrialization processes. But these nations do not want labor-saving devices when local labor is cheap. They want our food surpluses. If we lose our most productive agricultural lands, we will not be able to meet this opportunity as a nation.

If we cannot curtail population growth, we as a nation will also need all of these lands within half a century. The lands held back in the soil bank are not the best. The farmers of the region and nation continue to operate from their most productive soils. Now is the time to view our most fertile lands (and Weld and Larimer Counties should be included) as scarce and special use areas, just as we regarded our scenic lands a century ago. If we do, then we should take rapid steps to set them aside and preserve them. The present land-tenure situation in the Poudre Triangle indicates that massive conversions of land use can happen very swiftly there. Tax easements

might be one of a number of steps needed to accomplish the preservation of good farmland.

The establishment of agricultural preserves has precedent. Other areas have already taken this initiative, Hawaii and parts of California. In such a process, it is vital to be able to identify those lands worthy of preservation. This study takes a step in this direction. The important preliminary act of identifying different land types or landscape classes is complete. By relating productivity levels, land capability assessments, and land values, it appears that "Landscape IIb" has the overall best quality, followed somewhat closely by "Landscape IIa". Further study of additional parameters may be needed, but after this first reconnaissance-level inventory, it seems that the Poudre Triangle possesses a substantial amount of high-quality rural land.

This study raises questions that need immediate attention by interested and qualified national and state agencies, and by county planning commissions on the local level. A rational program which guides the future growth and development of the region and the State demands close coordination on all three levels of government. There are many land use options open to the residents of northern Colorado and the time of decision has arrived.

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