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The Political Ecology of Southwest Michigan Agriculture, 1837–2000

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Flying over southwestern Michigan, the Kellogg LTER site (Fig. 5.1), one looks down on what appears to be a glorious example of the agricultural landscape of classical American populism. The farm units are discernible by their woodlots, windbreaks, and rural roads, and are fairly small, or at least approximate what some have called a human scale. There is a mixture of pasturage, grain production, fruit trees, animal enterprises, and other forms of agriculture from tree farms to glass-house nurseries. Each farm seems to have a residential homestead and many have small gardens, red barns, and white or blue silos, interspersed with more recent structures for heavy machinery. In this populist image, the farms are prosperous, independent, and sustainable, and the farm families are harmonious and fulfilled.

Three things are noteworthy about this landscape. First, appearances are deceiving. Although today's fields remain more or less continuous with historical agricultural unit sizes, much of agricultural production is now generated by farm operators who rent lands across extensive distances to maintain economically viable levels of gross production and net profitability (Sublett, 1975). At the same time, the majority of farm owner–operators are pluriactive—they and members of their households pursue multiple modes of income generation—given the difficulty of making a viable living from agriculture. Most farmers have debt loads greater than 50%, and more than half of net farm income comes from government payments. In addition, there is tremendous concern about the negative impacts of farming on the environment.

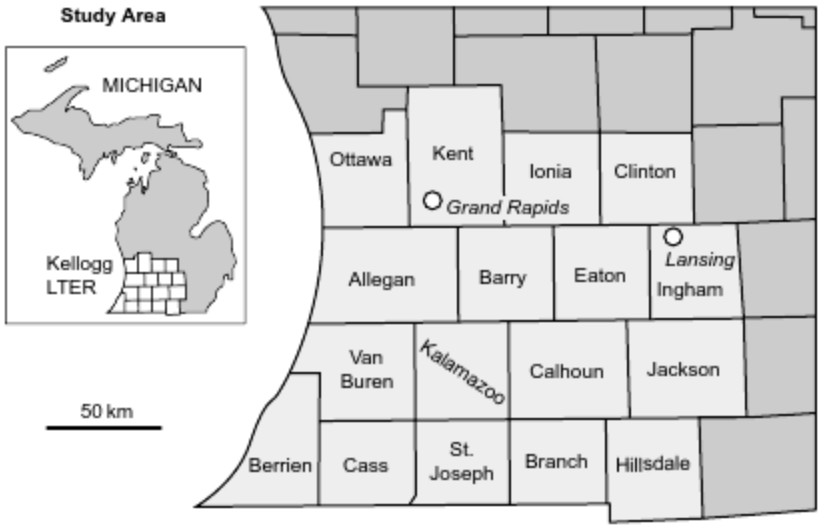

Figure 5.1 The southwest Michigan study site.

Second, new forms of exurban rural development (e.g., small aggregations of megahomes; dispersed modest rural residences on 5–10-acre parcels; clusters of inexpensive, prefabricated housing on recently converted, and still treeless, agricultural fields) are encroaching on what have historically been agricultural spaces. Within these fairly new and increasingly prevalent patterns of exurban development, woodlots hide newly constructed country homes, the residents of which are very selective in their appreciation of the sounds, sights, smells, and slow-moving machinery of agriculture.

Third, it obviously has not always looked this way. Michigan's rural landscape is the contemporary product of historical agricultural activity, including its diversity of enterprises, its golden ages and financial crises, its ecological harmonies and discordances, and its social affinities and contradictions. In fact, the state's agricultural landscape is the accreted and residual product of a series of agricultural periods. It is the dynamics of, and transitions between, these periods that have produced the social and ecological characteristics of Michigan's diverse rural areas and a good bit of the history of the state's urban centers.

Most important for our narrative, each of the historical periods reconstructed the landscape differently. Each of the periods of Michigan agriculture is an outcome of the interaction among the previous period of agriculture, the historical and current social institutions, and the ecological context. The influences among these three realms are reciprocal and relational (Fig. 5.2), influencing and stimulating, enabling and constraining each other. These transformative processes can be seen at local, regional, state, national, and international scales in forms that shifted as the national agricultural economy developed, as technoscientific advances emerged, and as the international export of commodity surpluses

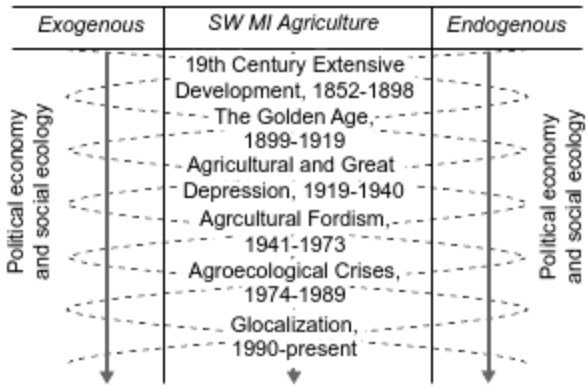

Figure 5.2 Regional agriculture as the relational mediation of endogenous and exogenous nature and society.

became the global trade of inputs and services, bulk and specialty commodities, and fresh and processed foods. Each of the historical periods is marked by a restructuring of the agricultural landscape associated with emerging political economic processes. The region many people now call southwest Michigan is a result of these transitions in the agricultural landscape.

Pre-European Settlement History and the Geophysical

The first four billion years of the history of the land that comes to be called Michigan is a series of glacial flows and tropical ebbs. Fifteen thousand to 20,000 years ago, the last glaciers retreated across eastern and central North America. Geomorphologically, the glaciers left behind a terrain that slopes upward gradually from the lakeshore to a ridge about 50 km inland. From the ridge, the terrain falls gently to the northeast, and, after descending into a valley, rises somewhat farther to the southeast, reaching in the Muskegon highlands a height of approximately 175 m above the lake level.

The interaction of all the geology that had gone before with the retreat of the last glacier means that rich soils, wetlands, and prairies are predominant in the southwestern part of the state, and sandy soils are predominant in the west-central and northwestern part of the state. More specifically, geophysically, the southwestern region is composed of predominantly Southern Michigan and Northern Indiana drift plain, peppered with small pockets of Indiana and Ohio till plain and the Southwestern Michigan Fruit and Truck Belt soils (Fig. 5.3).

The region averages 889 mm of rain annually (Fig. 5.4), with the greatest rain- and snowfall in the west as a result of the lake effect precipitation. The southwestern corner of Michigan has an average growing season that is 20 days longer than the rest of the region (which averages 130–160 growing days), with a fairly smooth and moderate gradient from southwest to northeast across the region.

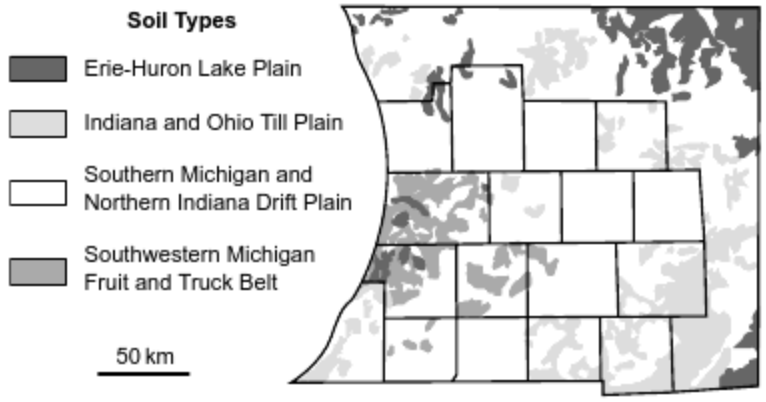

Figure 5.3 Southwestern Michigan soil types.

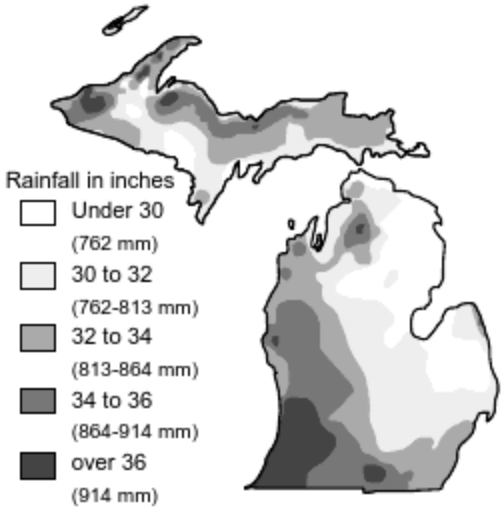

Figure 5.4 Average annual precipitation in Michigan. Data derived from Michigan's averaged annual rainfall between 1961 and 1990. The data were collected from stations that were observed by the National Oceanic and Atmospheric Administration (NOAA) cooperative and USDA-National Research Conservation Service (NRCS) SnoTel Networks, and from other state and local networks.

As a result of the combination of soil and climate, southwest Michigan was, prior to European settlement, predominantly hardwood forest and swamp, whereas the white pine forests to the north grew on fairly porous sandy loams.

The Precontact Archaeology of Southwestern Michigan

Southwestern Michigan changed dramatically at the end of the Pleistocene and the beginning of the Holocene with the deglaciation of the western Great Lakes. Diminishing ice masses, changing drainage and impoundment, variable lake levels, and shifting outlets created a dynamic environment as new biomes opened to

human settlement. Southwestern Michigan was one of the first areas of the state to become free of glacial ice and available for human occupation ca. 14,000 BP.

The earliest inhabitants of southern Michigan are commonly known as paleo-Indians. The archaeological record of this time period is scant as a result of taphonomic issues associated with the downcutting of fluvial systems (Monaghan, Lovis, and Hambacher, 2004), low population and site densities, and low site visibility resulting from mobile foraging strategies (Lovis, 1988; Meltzer and Smith, 1986). The majority of the archaeological record consists of individual finds of distinctive spear points with so-called *flutes*. In addition, large hide scrapers, gravers, and an array of flake tools have been recovered. These distinctive spear points and their associated tool kit disappear from the archaeological record of southwestern Michigan ca. 9500 BP.

During this time, the local environment changed markedly, particularly with respect to water levels in the Lake Michigan basin (Larson, 2001). Vegetation changed from tundra to spruce parkland to deciduous forest; and the resident fauna (e.g., mammoth, mastodon, Scott's moose, giant beaver) became extinct ca. 10,000 BP (Holman, 1995; Lovis, 1999). The subsequent Archaic period in southwestern Michigan is largely associated with the exploitation of deciduous forest and prairie grassland from ca. 9000 BP through about 2500 BP (Kapp, 1999; Larson and Schaetzl, 2001; Monaghan, Lovis, and Hambacher, 2004).

The Archaic period is traditionally subdivided into three parts: Early, Middle, and Late. Both the Early and Middle Archaic periods have scant archaeological records. It is with the Late Archaic that we obtain a more in-depth glimpse of human adjustment to southwestern Michigan. Nevertheless, the majority of this information on the Late Archaic occupations is mixed with chronologically later Woodland occupations, making their isolation and interpretation difficult (Robertson, Lovis, and Halsey, 1999).

Faunal and floral remains reveal use of the region during spring for the exploitation of fish such as lake sturgeon (*Acipenser fulvescens*), and during late summer and autumn for intensive extraction of a range of mammals and nut foods, including walnut, hickory, acorn, and beech. Moreover, there is evidence for an indigenous cultigen, the sunflower, dating to ca. 2960 radiocarbon years BP (Parker, 1990, pp. 406–410), whereas Mesoamerican cultigens such as squash are notably absent from this region (Egan-Bruhy, 2002; Wright, 1964).

Most of the southwestern Michigan region as defined in this study falls within the Carolinian zone (Cleland, 1966). The Carolinian biotic community included oak–hickory forests along with wetter and dryer forest associations, making this an excellent zone for procurement of a variety of plants (aquatic roots, nut crops, fruits, starchy and oily seed plants) and animals (fish, various mammals, and avian species). Prairies also occurred sporadically throughout southwestern Michigan, but to date no archeological research has focused on the use of the ecozone by prehistoric peoples.

At approximately 2600 BP, the appearance of ceramic pots in southwestern Michigan signals the beginning of the Early Woodland period. These thick-walled, cord-impressed vessels were used to render and store edible nut oils and also (like proto-crockpots) to slow simmer other foodstuffs (Ozker, 1982). Most

important in this period, Early Woodland groups began to aggregate seasonally at earthworks and utilize small, seasonal base camps along the St. Joseph and Kalamazoo river valleys (cf. Garland, 1986; Garland and Beld, 1999).

A synthesis of archaeological surveys on the Grand River suggests two clusters of base camps that may reflect different cultural groups. One group was focused on resource extraction on the lower portion of the Grand River and the other was located further upstream at the confluence of the Maple and Grand rivers (Brashler and Mead, 1996). A number of earthwork sites may have served to more fully integrate groups living in southwestern Michigan, and also groups from the Saginaw basin on the eastern side of the state (Beld, 1993; Beld, 1994; Brashler and Mead, 1996; Garland and Beld, 1999; Holman and Kingsley, 1996). At habitation sites in particularly advantageous spots for fishing and procurement of other aquatic resources, there may be recurrence in site location between Early Woodland and subsequent Middle Woodland mortuary mounds. This influence is most notably seen in the burial goods and interments at the mound sites on the lower Grand River, but more mundane evidence is also present in the non-mortuary pottery throughout the region.

Unfortunately, few Middle Woodland sites in southwestern Michigan have been excavated, and even fewer analyzed in a manner that would produce good botanical data. One site appears to have been intensively occupied during the warm months of the year. Intensive fishing (sturgeon) and deer hunting were the primary subsistence activities (Brashler and Holman, 2004; Brashler, Laidler, and Martin, 1998). The botanical assemblage does not indicate either intensive plant collecting or horticulture, and no agricultural tools have been recovered from the site. In fact, nowhere in Michigan during this time period is there evidence for intensive harvesting of indigenous cultigens (Monaghan, Lovis, and Hambacher, 2004).

Recent evaluation of traditional models of Middle Woodland subsistence and settlement in southwestern Michigan finds support for seasonal northward forays for hunting and gathering (Brashler and Holman, 2004). Middle Woodland groups from the Grand River appear to have made seasonal hunting and gathering forays to the Traverse Corridor, where cultural interaction with more northerly groups was possible. These groups used the transitional zone for spring fishing and foraging for fruits (grape, cranberry, nannyberry), aquatic animals (fish, clams, turtles) and plants (wild rice), and terrestrial game (elk, deer, porcupine). Within the rich resource base of southwestern Michigan, this economic strategy appears to continue well into the early Late Woodland period (ca. AD 500 to 1200).

Two cultural traditions based on the distribution of different ceramic pot styles are found within southwestern Michigan (Brashler, 1978). The Allegan tradition encompasses the St. Joseph and Kalamazoo rivers from Lake Michigan to the center of the state; the Grand River forms the southern edge of the Spring Creek Tradition (Brashler, Garland, Holman, Lovis, and Martin, 2000). Archeological data from the Kalamazoo River indicate movements of people up and down the river valleys with a "river-oriented economy [that] may have included hunting in winter, maple sap collecting in spring, fishing in both spring and summer, collecting riverine resources, and harvesting nuts in the fall" (Holman and Brashler,

1999, p. 215). The shared area included a complex mosaic of deciduous and wet forest habitats that provided hunting opportunities, but was not abundant in other resources. During early Late Woodland times we see small temporary campsites in this shared area and continued interaction with people from Saginaw Bay (Brashler and Mead, 1996).

About AD 1200, the conservative Late Woodland lifeway of southwestern Michigan was affected by interaction with Upper Mississippian groups. In some cases it is clear that these new people moved into the region; in others it seems that the local Late Woodland peoples took on some Upper Mississippian lifeways, but remained essentially Late Woodland. Changes in material culture include the presence of stylistically similar shell-tempered pottery and the widespread incorporation of the growing of corn, beans, and squash (Smith, 1992). Corn became important here, not as a replacement of indigenous horticulture, but as a complementary supplement to a diversified economy. No matter how many large, semipermanent, relatively densely populated villages were formed, corn remained in this supplementary role.

Recent limited excavations at Moccasin Bluff (O'Gorman, 2004) document the presence of a previously unrecognized sheet midden (accumulation of organic habitation debris on an old surface of the site) and two small pit features dating to ca. AD 1440 to 1500. Recovery of dietary remains yielded no corn, but indigenous starchy and oily seeds (including goosefoot, maygrass, knotweed, amaranth, sumpweed, and sunflower) along with a variety of fruits (pin cherry, pokeberry, grape, and blackberry or raspberry) and a high density of wood charcoal are present (Adkins, 2003). Further work is needed to determine whether the seed plants are domesticated and cultivated or wild. An abundance of deer and fish, and lesser amounts of beaver, porcupine, elk, wild turkey, turtle, and mussel bone and shell remains were also recovered (Martin, 2003).

There is no clear picture of later Late Woodland in the Grand River valley after AD 1200, and Brashler and Mead (1996) suggest that there may be an actual hiatus or reduction in its use perhaps as a hunting ground with a few scattered base camps. The archaeological record is currently ambiguous in many ways about the period just prior to European contact. Critiques of old models and the addition of new data require new approaches for understanding not only late prehistory, but also the beginnings of history in this region. It seems certain that the Potawatomi were living in southwestern Michigan prior to the early 1600s, when they were encountered by the French in Green Bay after taking refuge there from Iroquoian attacks (Clifton, 1998). The historical picture is one of large, permanent villages and winter hunting forays, corn agriculture including other cultigens and wild plant materials, and selective hunting of large mammals and fishing. But the question of how to reconcile the prehistoric record of southwestern Michigan with a vastly different historical picture requires new ways of thinking about the past, as well as directed acquisition of better data (O'Gorman, 2004).

The two primary groups of interest in southwest Michigan are the Potawatomi and the Ottawa. Between 1600 and 1650, the Ottawa were located around Georgian Bay in what is now Ontario, Canada (Cleland, 1992). They were relatively sedentary, relying on whitefish (*Coregonis clupeaformis*) and longstanding, well-developed

farms that produced enough yield to be stored for their winter consumption, and to supply French trappers and traders throughout the region (McClurken, 1988). The Ottawa were an integral part of the French fur industry, regularly sending hunting parties into the interior of Michigan, primarily for beaver.

The Potawatomi were part of a larger group of Woodland Indians, or *Anishnabeg*, in lower Michigan. They were "Algonquian-speaking swidden agriculturalists" (Cleland, 1992, p. 87). The Woodland Indians tended to be more mobile than the Ottawa. They lived in villages, "gardening" in the summer, and separating into smaller hunting groups in the winter. Their "hilled" intercropped gardens of corn, pumpkins, squash, and beans were developed in fields that had been cleared via tree girdling and burning (Cleland, 1992). Like the Ottawa, Potawatomi villages were located near or adjacent to waterways, but the Potawatomi fished for lake sturgeon rather than whitefish (Cleland, 1992).

Trapper, Trader, Missionary, and Early Settlement Activities

Four major rivers traverse southwest Michigan flowing from east to west—the St. Joseph, the Grand, the Kalamazoo, and the Muskegon. Two bear the names by which the Native American inhabitants of the region knew them, and two carry the names the European invaders gave them. When the first European missionaries and explorers arrived in the 1600s, they came via Lake Michigan. Because the region was largely covered by dense forest, they used the large rivers to penetrate inland. They established a few small settlements, which provided bases from which traders and trappers could operate. The earliest nonnative populations—French missionaries, fur trappers, and traders—found indigenous fruits, including crabapples, strawberries, and raspberries (Kessler, 1971).

The Potawatomi became part of the fur industry in the late 1600s and were later positioned at important waterways, giving them a geographical advantage in seeking new sources of beaver farther west. Although the French fur industry abruptly ended in 1696, the British continued to trade in fur until the industry crashed in the early 1800s (Cleland, 1992).

With the material aid of the British, the Iroquois displaced all native groups in western Ontario and Michigan's Lower Peninsula. Cleland (1992, p. 92) defines this period as the "Great Diaspora"; it is believed that there were virtually no aboriginal groups in Michigan's lower peninsula in 1670. The Ottawa went to the most northern regions of Lake Michigan and the southern coast of Lake Superior. The Woodland Indians went to the western coast of Lake Michigan, predominantly in the Green Bay region of what is now Wisconsin. After reconstituting with other displaced peoples, the group became known as the Potawatomi (Cleland, 1992).

By the early 1700s, both the Ottawa and the Potawatomi began repopulating Michigan, in part because they both sought regions with biophysical features that permitted access to fish and the ability to raise corn (McClurken, 1988). Within 60 years, both groups became reestablished in the southern Lower Peninsula. The Ottawa settled in the north and the Potawatomi in the south, with the Kalamazoo River valley as the major dividing line between them (Tanner,

1987). However, it was not uncommon for these groups to have villages near each other (Cleland, 1992).

The most prominent Ottawa settlement was a cluster of eight villages along the western portion of the Grand River that was established by 1755 and remained prominent from 1763 to 1812. The Ottawa eventually attained a population of approximately 1,200 people and remained in this region until the end of the removal period in the mid 1800s, but ventured south of the Grand River only for hunting. Four main villages scattered across the southwest Michigan region were the most prominent Potawatomi settlements (Tanner, 1987). They primarily "settled in the prairie openings and bottomlands of the Kalamazoo and St. Joseph rivers" (Cleland, 1992, p. 148).

According to Cleland (1992), a systematic census of Michigan Indians took place in the late 1830s, but it was conservative, purposely excluding some groups. He believes there may have been as many as 30,000 Native Americans across the southern third of the Lower Peninsula that were broken into smaller groups averaging around 150 people each. During this time, women became prominent because they produced marketable goods—wild rice, maple syrup, and corn—for an increasing European American population that numbered approximately 31,640 people (Cleland, 1992), of which 69% were in the southeast (McClurken, 1988). By statehood in 1837, the white population had risen to 174,543 and only 45% were in the southeast. Those migrating into the southwest Michigan region were now interested in the Grand River valley because of its rich agricultural lands. By 1840 the white population "outnumbered the Ottawa by nearly 200 to 1" (McClurken, 1988, p. 77).

As Europeans settled Michigan (as part of the overall push westward), the Great Lakes Indians fared somewhat, if only marginally, better than most Native Americans. The Ottawa were able to switch from provisioning French traders to supplying European American settlers coming from New England and New York. They were a significant part of the early settlement process, supplying pioneers with a wide range of sustenance goods including leather, moccasins, canoes, baskets, fish, deer, pigeon, and turkey. Despite uncertainty about the original population levels, it is believed that the deer and a significant portion of the edible bird species were decimated during this time.

Both for their own subsistence and for trade with the European Americans, the Ottawa gathered honey and cranberries, and cultivated 3,000 apple trees and 2,500 acres of corn, as well as a variety of vegetables (Tanner 1987). Maple syrup was one of their most important commodities. In fact, production of the latter was of such significance that it was shipped to New York, Boston (McClurken, 1988), and England (Cleland, 1992).

During the late 1830s, some Ottawa began to take on "civilized" characteristics (e.g., dress, agricultural practices, language, religion) (Cleland, 1992). Of particular importance was the purchase of lands using their annuities from the 1836 Treaty of Washington (Cleland, 1992). Land ownership was the basis on which some Ottawa were declared citizens of Michigan (not the United States) by the governor. Their farms were interspersed among the white landholdings (Cleland, 1992). Despite their importance to the settlement of the Grand River valley, 900

Ottawa were removed in 1857 and sent north. Many others lost their land as a result of a series of financial maneuvers, some legal and others not. For instance, the agent in the General Land Office swindled the Ottawa out of their legally designated homesteads (i.e., the Indian Homestead Act of 1872) across an entire township in Ingham County (Mason Township) via loan sharking and foreclosing on $20 loans (Cleland, 1992).

In 1830, the Potawatomi population was estimated at 2,500 across nine small villages in present Kalamazoo County; by comparison, Detroit had about 2,200 whites. Most of the Potawatomi were moved out of the Great Lakes region during the removal period, 1834 to 1842, but approximately 300 people who claimed to be Catholic were allowed to stay and were legally recognized as citizens of Michigan (Cleland, 1992). After statehood, many left the area and moved to northwest Michigan. The Potawatomi entered into hundreds of treaties with the U.S. government. The Treaty of Chicago (1833, ratified in 1835) was particularly important in the opening of southwest Michigan to white settlement. It essentially consolidated the remaining Potawatomi in regions away from where the new road connecting Detroit and Chicago was to be built. As these groups were pushed out of the area, pioneers complained because they, like those who moved into the Grand River valley, relied on the native population for provisioning (Cleland, 1992).

European American Settlement and Beyond

Several factors drew the first settlers to southwest Michigan in the decades before 1850. One was grain production. From the colonial period up to the early part of the 19th century, wheat production in the mid-Atlantic region dominated national production (Brigham, 1910). In the first decades of the 1800s, however, eastern market saturation and increasing land prices prompted many settlers to take advantage of low land prices in the newly opened Northwest Territory (Freedman, 1992; Gray, 1996). A second factor was transportation. The completion of the Erie Canal in 1825 facilitated the westward movement of new settlers and supplies, and led to the establishment of a land office in Kalamazoo in 1834. Settlement in the region immediately accelerated (Fig. 5.5). Transportation was also important for the movement of commodities back to eastern markets. The third factor was fruit production. The introduction of an exotic, the peach (*Prunus persica*), early during the 19th century is credited with the start of commercial fruit cultivation in southwest Michigan (Armstrong, 1993). Railroads and land speculators hyped land in southwest Michigan as the next Garden of Eden. The combination of the three factors meant that extensive farming development preceded Michigan's statehood in 1837 (Gray, 1996). On these farms, animal enterprises were important, both for self-provisioning and for petty commodity exchange, as well as for draft power.

During the 1820s, white settlers began moving into the prairies that the Potawatomi farmed (Cleland, 1992). The earliest settlers (i.e., after 1815) were keenly aware that the attractive landscape had been produced by the Native Americans. They saw fields that were either in use or abandoned. The settlers

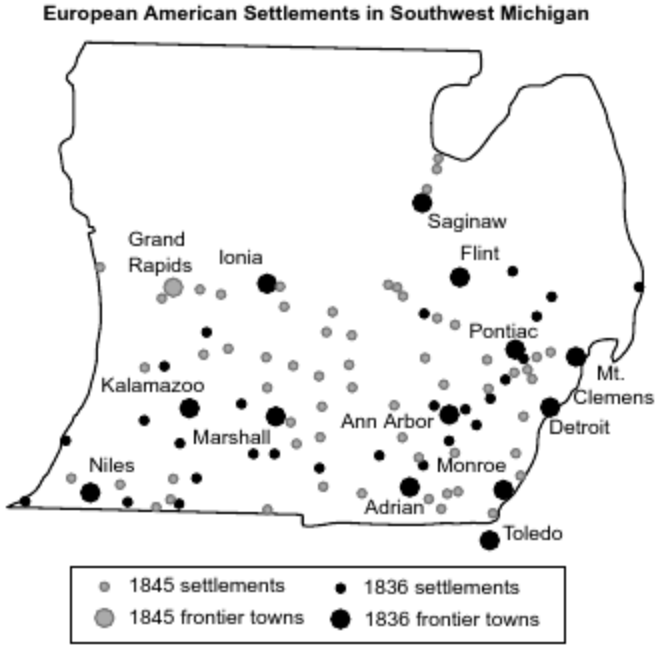

Figure 5.5 The number of European American settlements in southwest Michigan increased substantially between 1836 and 1845.

specifically sought "openings" and "prairies" because they perceived these areas to be both easier to cultivate and protected by the surrounding woods. They thought that these abandoned areas must be fertile and viable using "modern" farming practices.

"Oak openings" were said to have a park-like appearance with trees of uniform size—4–5 ft. high—with an orchard appearance, whereas the prairies were described as vast and "picturesque" (Lewis 2002). Early settlers believed the "wet" prairies were the result of lake evaporation and "dry" prairies the result of periodic ground fires from aboriginal peoples. Lewis (2002, p. 68) states that "burning remained so prevalent in the late 1820s that the territorial government passed legislation to protect settlers' property." The most desirable lands were oak openings, prairies, and timbered lands. Swamplands had a significant influence on settlement patterns in Michigan because they were entirely undesirable. Pineland also was avoided. The lands identified as Class 1 and 2 were the most desirable for mixed farming and, presumably, farmed first, as were areas believed to be free of malaria (Lewis 2002). Later settlers had to drain swamps and clear dense forests. In 1833 it was reported that wheat, Indian corn, oats, barley, buckwheat, potatoes, turnips, peas, apples, pears, plums, cherries, and peaches were easily grown in abundance in the southern Lower Peninsula.

It is important to note that early accounts of the biophysical environment are difficult to follow and use because writers had various agendas and incentives to portray Michigan in a positive light. Furthermore, many of the writers lived through the first half of the 19th century, the tail end of the Little Ice Age (1350–1850), in which there were extreme weather changes, especially with regard to winter temperatures.

Fast Forward

Almost 200 years later, agriculture is still a dominant aspect of southwest Michigan; 55% of the land in the region is in farms. The early emphasis on wheat production has shifted to crops that support industrial agriculture—especially corn and soybeans. Animal enterprises now are concentrated on a smaller percentage of the farms in fewer locales across the region. Vegetables and fruit are very important in parts of the region. Currently, almost half the fruit acreage in the state is located in the southwest Michigan region; within the region, 5 of the 17 counties account for 92% of the fruit land. These specialty crops engage growers in a unique set of agroecological, socioeconomic, and geopolitical relationships that influence spatial–temporal changes across the landscape. Indeed, it is the diversity of agriculture in southwest Michigan that is its outstanding characteristic. After describing how we delineated the region we call southwest Michigan, we turn to an analysis of the social and ecological interrelationships that produced the several transitions of southwest Michigan agriculture from its beginnings in the early 1800s to its situation at the present time.

Regionalization Methods

Since the glaciers receded, the shoreline of Lake Michigan—the western boundary of southwest Michigan—has been fairly constant. With the establishment of the Michigan Territory in 1805, and the move to statehood in 1837, the southern boundary of the region was politically and institutionally established. With the depletion of central lower Michigan's white pine forests—for the construction of Chicago and the fencing of the Great Plains (Cronon, 1991)—the southern edge of the cutover area emerged in the late 1870s as the northern boundary of the region. Lastly, it was not until the completion of post–World War II highways and the development of suburban Detroit that the eastern boundary of this region emerged, separating counties that were part of metropolitan Detroit to the east from the counties of southwest Michigan to the west. Our point is that, although an identifiable southwest Michigan region has existed for at least 150 years, the boundaries of the region have evolved and continue to do so with changing events and circumstances.

We initially constructed the region on three bases. The first was the geographical and political boundaries of the lake, the state, and the counties just noted. The second was historical geographical market orientation; before the most recent period of globalization, agricultural commodities either stayed within the region

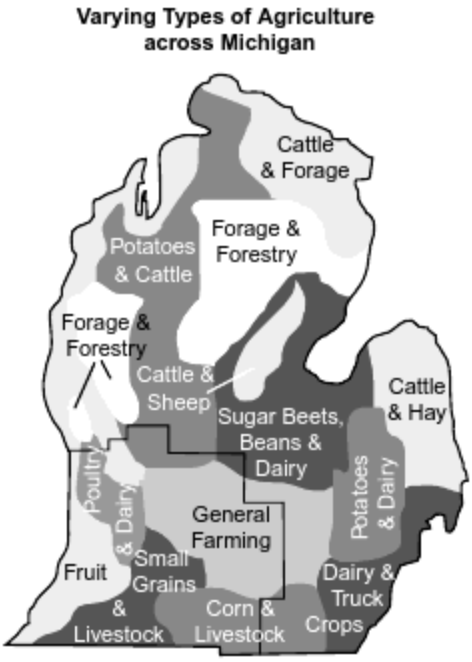

Figure 5.6 Lower Michigan's farming areas in the 1930s. Data based on a map from *Michigan History Magazine* (1938) and the Michigan Historical Center.

or flowed westward toward Chicago. Counties with similar cropping patterns to the east of this region directed their agricultural goods eastward to Detroit or Toledo. The third basis was structured by the dominant crops shared, historically and in the present, across these 17 southwestern counties. A notably different mix of crops predominates to the northeast and the north (Fig. 5.6). In the following narrative we show how the social and ecological characteristics and political economic and environmental relationships most important to southwestern Michigan's agricultural landscape have been transformed repeatedly since statehood in 1837.

Regional Agriculture

Our study of southwest Michigan focuses on the means by which agriculture draws upon, reproduces, and transforms particular ecological and social landscapes that then, in turn, affect subsequent iterations of the agroecological landscape's development. Central to our analysis is the idea that the history of agriculture lies at the heart of southwest Michigan's contemporary ecological and social conditions. In contradistinction to conventional agroecological studies (e.g., Hecht, 1985; Pfeffer, 1983), which generally start with biogeophysical characteristics and explore regional conditions of comparative advantage and agricultural opportunity, we start with agriculture and attend to its modification of, and strategies

for dealing with, biogeophysical conditions. Similarly, in contradistinction to conventional sociological studies (e.g., Albrecht and Murdock, 1990; Mann and Dickinson, 1978; Murdock and Albrecht, 1998) that start with social and technical divisions of labor in agriculture and assess the regional ecological consequences and natural obstacles to agricultural development, we follow an agroecological turn (e.g., Altieri, 1995; Allen, 1993) and explore the ways in which the social and the biogeophysical interact to produce particular forms of agriculture.

We view agriculture as an absolutely pivotal arena in which the states of agroecological nature and rural society are produced. We argue that agriculture in southwestern Michigan is both the prime historical cause and the most significant consequence of social ecological development. It is the foundation upon which settlement first occurred and the economic base for the regional urban economy prior to the advent of intensive industrial development in the early 1900s in the Grand Rapids area and after World War II in the rest of the region.

Pivotal to our account, however, is that the social and ecological characteristics of the region have combined to produce an impressively diversified agricultural landscape. In contrast to both agroecologists and sociologists who defined and compared regions as homogeneous entities, we seek to understand a continuous diversity. We have an agricultural region, but not one that has specialized in any one commodity to any marked extent despite the region's not particularly diverse ecological and social landscape. Often in the analysis of agroecosystems, climatic, topographic and pedological diversity are understood to determine, or are opposed to, historical, technological, and political economic conditions. In rural sociology or the sociology of agriculture, the opposite is usually the case; social relations trump ecological conditions. Our approach seeks to avoid both extremes. In southwest Michigan, overemphasizing the social and underplaying nature would represent a misunderstanding, on the one hand, of the importance of small differences in microclimatic conditions and, on the other hand, of the accommodations producers and crops have historically been forced to make in and to the landscape.

The traditional North American agricultural narrative (e.g., Pfeffer, 1983; Swanson, 1988) is one that suggests region-specific processes of agricultural specialization and homogenization (e.g., the Cotton Belt, the Corn Belt), offset in some areas by the ecological capacity to foster enterprise diversity. In this traditional narrative, agriculture is generally presented as initially founded by family farms that grow crops—or at least a garden—for their own consumption, produce bulk commodities for the market, and rotate pasturage in support of draft, consumption, and market animals. Over time, each farm generates sufficient surplus that children can be established on new farms of their own in a process of social reproduction defined in Marxist terms as petty or simple commodity production (Chevalier, 1983; Friedmann, 1978) and in Jeffersonian terms as agrarian populism (Sanders, 1999; Williams, 1969). An additional component of this model, the agricultural ladder, suggests that even hired hands can accumulate enough wealth to purchase farmland when conditions are propitious (Heller and Houdek, 1996; Winters, 1978). These petty commodity/populist conditions are then seen in the traditional narrative to be whittled away during the 20th century as the

technical demands of mechanical, chemical, and biological intensification, and the market demands of commodity specialization, force fencerow-to-fencerow monocropping. This process at the level of the farm is usually combined with ecological and economic conceptions of regional comparative advantage to generate processes that some describe as regional simplification and others describe as agricultural progress or economic rationalization or ecological modernization. Although we accept the basic elements of the traditional narrative, we suggest that major modifications must be made in the narrative to make it applicable to the southwest Michigan region.

Regional Periodization

We have divided the region's history into six periods. Beyond our earlier discussion of Native American inhabitants and early European American settlers, we provide few data on agricultural practices during the first period, prior to Michigan's statehood in 1837. Nineteenth-century European American surveyors and settlers observed ridged fields or garden beds, ranging in size from about 5 cm to more than 40 cm in height and from about 1 m to 2 m in breadth, that are indicative of more agricultural investment than simple horticultural pursuits and are usually associated with growing corn, beans, and squash (Schoolcraft, 1860; Hinsdale, 1931). Although these structures and the Native American transhumant agriculture of that period are of cultural value and anthropological interest, they are essentially erased by the agriculture implemented by the European Americans in the 19th century.

From 1837 to 1898, two primary processes occurred. On the one hand, the forests were gradually and partially cleared and removed, and the land was drained in the pursuit of extensive self-provisioning and partially market-oriented agriculture. With the advent of more new industrial inputs, farmers would at times extend agricultural production into lands they had previously set aside as woodlots or wasteland. On the other hand, with increasingly efficient transportation infrastructures related to the advent of Chicago as a metropolis and a rail hub with trunk lines to the east (Cronon, 1991), more intensive production developed. Most southwestern Michigan agricultural products not intended for the rural markets and emerging urban centers in the region have historically been oriented westward toward Chicago.

Grains, fruit, and livestock have historically dominated agricultural production, social practices, and emerging technoscientific institutions, although the relations between these commodities—as well as their downstream processing, distribution, and consumption—have shifted in the process of midwestern agroindustrialization (Page and Walker, 1991). Midwest agroindustrialization represents a coevolutionary process by which (1) rural agricultural goods fed urban processing and distribution industries; (2) farm implement industries, initially developed in rural areas and towns, fed both agricultural intensification and urban industrialization; and (3) these two processes were mutually reinforcing. Midwest agroindustrialization includes a necessary and parallel intensification in financial and

technoscientific services. Whereas Cronon (1991) sees Chicago as dominating its hinterland, our focus on regional agroindustrialization stresses the way southwest Michigan is composed of its rural areas and its urban centers and their interactions, and deemphasizes the role of Chicago.

By stressing the temporality of regional development, rather than the dominance of one spatial actor, we are able to explore the differing historical dynamics that have contributed to the social and ecological processes and legacies of agriculture in southwest Michigan. Our periods start shortly after statehood and build to the present in five segments. The first encompasses the largely extensive forms of agricultural development during the second half of the 19th century. The second is associated with the technological, productive, and institutional intensification tied to the Golden Age of American Agriculture from the turn of the century to 1919. The third period combines the Agricultural Depression of the 1920s, and its deepening by the financial and industrial depressions of the 1930s.

The fourth period is that of postwar agricultural Fordism—when mechanical and chemical intensification, the Cold War, and the increasing integration of rural social life into urban consumer society radically alter agricultural social and ecological relationships. The last period, which can be broken into two parts, is that of agricultural and rural restructuring, starting in the early 1970s. Initially this process was driven by the new forms of government regulation, social movements, and cultural priorities associated with the environmental movement (and its coincident development alongside increasing production costs related to oil shocks and increasing debt associated with intensification). Agricultural and rural restructuring subsequently accelerated in southwest Michigan after the rise of neoconservative fiscal policies and neoliberal global economics during the early 1980s.

Before we turn to the chapters of our narrative, a couple of caveats are in order. First, agricultural labor is not a major theme in our story; although the supply of agricultural labor and the challenges of the agricultural labor movement were important at various times in other parts of the country, they were not major influences in the southwest Michigan region. Second, race and ethnicity do not appear in our narrative. We noted earlier the obliteration of Native American agriculture; although a couple of areas in the region are settled by former slaves from southern states, they are never very prominent. Certainly one could see in the efforts of the settlers an attempt to impose on the Michigan landscape the agriculture they brought with them from their European origins; but it was never possible to see a distinctively German or Norwegian or Italian farming pattern in the resulting arrangements (Thaden, 1959), perhaps because the ethnic patterns had already been modified by one or two generations of farming in the eastern United States.

Political Economy

Nineteenth-Century Extensive Development, 1837–1898

Settlement, clearing of trees, draining of land, crop experimentation, infrastructural development, the identification and utilization of microclimatic niches, and

commodity development all characterize the patterns of extensive development in southwest Michigan during the boom–bust market cycles of the 19th century. Although southwestern Michigan was climatically and pedologically well suited for wheat production, settlers were confronted with a densely forested landscape and many areas of swampland; both of these forms of land cover required complex social institutions to clear and drain before they could be successfully farmed. At the same time, the lakeshore, wetlands, and mixed deciduous forest of the region provided a complex mix of microenvironments and a wide diversity of flora and fauna for hunting, crafts, and harvesting.

Small prairies sprinkled across the landscape provided the initial land for wheat production (Dunbar and May, 1995), and it was in these areas of southwest Michigan that small settlements first developed (Gray, 1996). Although the majority of the logging industry extracted white pine—the state tree—from the area to the north of this region, the hardwood forests and swamps of the southwest were predominantly cleared and drained as part of the process of the establishment of agriculture. After the Chicago fire in 1871, hardwood extraction from southwest Michigan intensified, although this boom had ended by the 1880s and forestry in western Michigan as a whole was all but over by the 1920s (Sparhawk and Brush, 1929).

Prior to the development of railroads during the latter half of the century, lakes, rivers, and canals were the primary means of transporting agricultural crops long distances. In many cases in southwest Michigan, crops were shipped first along rivers to Lake Michigan, where they were taken by steamer to Chicago or, in some cases, to eastern markets (Hartshorne, 1926). The extensive development of agricultural production was further stimulated during the latter half of the century by the development of canals (O'Kelly, 2007) and railroads, which reduced transportation costs to regional markets, although monopoly pricing power caused notable protest (Dunbar, 1969).

Early developments in the mechanization of agriculture (steam tractors, cultivators, reapers, threshers, balers) had several impacts: an increasing dependence on off-farm services, a shift from collective community labor to private labor, and the extension of production into areas of the farm that had not previously been farmed. Also during this period, farming became inextricably joined to a system of social institutions (economic, governmental, and academic), ranging from public institutions like the USDA and land grant universities, to private ones like the Chicago Board of Trade and the Grange (Stoll, 1998).

During this period, the diversified agriculture that would be characteristic of southwest Michigan began to develop. Although wheat predominated in terms of acreage, hay for animals was the second largest acreage, and fruit was not insignificant.

The Golden Age, 1899–1919

With the opening of central American and southeast Asian markets after the U.S. victory over the Spanish in 1899, agricultural transformations in southwest Michigan reflect broadly robust markets. And, with the institutionalization of

federal funding for Progressive agricultural science and cooperative extension programs before and after the turn of the century, agricultural transformations in southwest Michigan also reflect the national tendency toward intensification both in mechanization and fertilization, and in plant and animal breeding. On the technical and mechanical side, what was being supplanted and displaced was the need for human labor to accomplish certain tasks (e.g., harvesting); draft animals were still needed to pull the machinery that accomplished those tasks. In particular, the establishment of statewide, county-level Cooperative Extension Service offices as part of the land grant university at Michigan Agricultural College began a century of what was intended to be close, two-way communication among Progressive farmers, extension agents, and university scientists. Production problems, technical needs, and development desires moved from the field to the laboratory, and science in the form of solutions and recommendations moved from the university to the farm.

This is the Golden Age of American Agriculture and it runs up through the end of World War I. Although the diversity of 19th-century agriculture was largely a result of the patterns of extensive development in the region, during the 20th century increasing market orientation, technological sophistication, and institutional complexity gradually reduced the on-farm diversity without homogenizing agriculture across southwest Michigan. Significant volumes of grain produced in Michigan were exported, but the majority of its agricultural commodities were consumed domestically.

The Agricultural and Great Depressions, 1920–1940

As with the rest of the nation, in the 1920s southwestern Michigan entered into an agricultural depression despite the industrial and commercial boom of the Roaring '20s. The return of European agriculture to viability after World War I depressed important markets to which U.S. agriculture had grown accustomed, and caused national overproduction crises in grain and animal sectors. Michigan grain producers were affected directly as the export segment of the total grain market decreased. When they turned to feeding livestock as a way to realize value from their grain crops, they found that livestock markets were also depressed by the loss of European outlets. In contrast, fruit growers were actively planting during this time, which indicates a sense of financial security, because it takes many years for most fruits to reach full production.

Most important, however, and partially as a response to the crisis, during this period "Progressive farmers" moved aggressively into mechanized production (tractors for plowing and cultivation, combines for harvesting, sprayers for pest control). The greater productive capacity of tractors was a boon to those farmers who could afford tractors; less time was required per acre for tillage and planting, cultivation, harvesting, and pest management, which meant that it required fewer persons to provide the labor needed for a given farm. On the opposite side of the coin, however, because intensification meant that the same number of workers could operate more acres and that land no longer had to be used to produce feed for draft animals, tractor-driven increases in productivity across the nation

exacerbated overproduction (Berlan, 1991). Intensification also fostered social ecological transformations grounded in agriculture in two ways—as noted, mechanization meant that farmers no longer needed to keep draft animals, and it also meant soil compaction and erosion. Not keeping draft animals meant not needing to plant pasturage, and not receiving the soil nutritional benefits of recycled animal waste as fertilizer. Fields historically rotated with pasturage thus became available for continuous commercial crop production, increasing gross marketable production and net physical productivity of land and labor in the hopes of maintaining (or increasing) net profits, despite exacerbating already saturated market conditions.

The Agricultural Depression from 1919 to 1941 effectively ended—as did the Great Depression—with U.S. entry into World War II. With the national demands for food and fiber for the military, and later for global reconstruction in the context of the Cold War, robust agricultural markets returned. At the same time, institutional, mechanical, and chemical developments associated with Depression-era political restructuring, scientific and technological research within the land grant university complex, and the war effort laid the groundwork for the Fordist revolution in southwestern Michigan's agriculture.

Agricultural Fordism, 1941–1973

Agricultural Fordism represents two basic processes: one in production, the other in consumption. In terms of production, Fordism represents what Goodman, Sorj, and Wilkinson term *appropriationism* (Goodman et al., 1987)—the increased penetration of agriculture by capital goods (e.g., tractors, hybrid seeds, pesticides) that have the effect of increasing the commoditization of agricultural labor processes (i.e., the farm operator increasingly becomes a labor unit in the mass production of food and fiber). Processes that had been endogenous to agriculture (e.g., supplying the energy for draught power with crops raised on the farm, selecting and saving seed to maximize desirable attributes, endemic predators of pests) were moved off the farm and into the realms of industrial, commercial, and financial capital (e.g., machines that relied on petrochemical fuels, commercially bred seeds, synthetic pesticides distributed by national and transnational firms). In terms of consumption, Fordism intensified the capacity, desire, and need of farm families to increase their consumption of market goods—particularly mass-produced consumer goods and "labor-saving devices." Thus, for farm people, Fordist consumption is associated with (1) a deepening orientation to consumerism and away from even partial self-provisioning of household food and fuel, and, as a consequence of this, (2) a deepening of farmer commitments to either monocropping or very simple rotations for the purpose of productivity. The relationship between Fordist consumption and Fordist production is mutually reinforcing such that both encourage the intensification of agriculture including monocropping, very simple rotations, and cultural commitment to little else than increasing productivity. The production part of the appropriation process goes faster sooner; the consumption part of Fordist appropriationism initially proceeds slowly and then goes faster later.

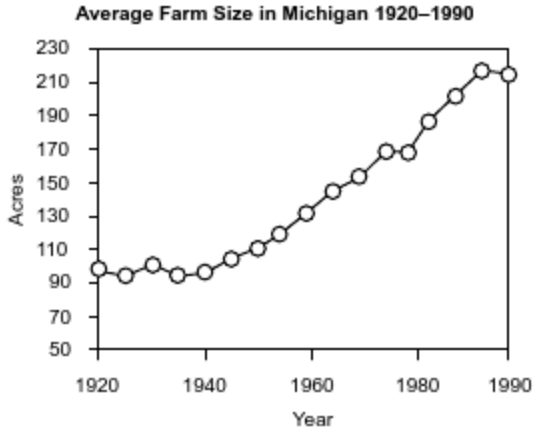

Figure 5.7 Average farm size in Michigan, 1920–1990.

Simultaneously with the promotion of mass-market commodities, however, and in a pattern more like its distant cousin, California, than its near relatives Ohio, Indiana, and Illinois, Michigan agriculture maintained and increased its agricultural diversity after World War II. Although states more central to the Corn Belt broadly reduced their crop diversity to a limited range of grains (corn, wheat, and soy predominant among them), increased the presence of feedlot livestock, and in both respects increased the size of agricultural units, southwestern Michigan's units of production remained fairly small and its agricultural diversity fairly complex, including both crops and animals. Land concentration was limited during this period, although average unit size did grow slightly and middle-range farmers declined over time in the face of larger numbers of large and small farms (Fig. 5.7).

To understand why farmland concentration in southwest Michigan was limited during this period, it helps to view the social process related to agricultural land concentration as consisting generally of two subprocesses. One subprocess makes farmland available; this may happen as current farmers and/or their heirs sell their land, as large operations downsize, or as new land is brought into farming (draining, clearing). This first process is fostered by the aging of the farm population, decreasing commodity prices, increasing tax burdens, and the current and speculative demand for land for exurban residences, as noted earlier. The second subprocess takes this available farmland into farming operations via purchase, rental, or partnership. This second subprocess is fostered by government commodity programs based on acreage, and by the increasing scale of farm machinery. Among the constraints on land concentration in southwest Michigan are (1) the different ethnic/cultural commitments to farming that keep some farmers from exiting farming and keep other farmers from increasing the scale of their operations (Salamon, 1980; Salamon and Davis-Brown, 1986; Salamon and Keim, 1979); (2) opportunities for full-time industrial work off the farm that generate income

to sustain the household and to subsidize the farm operations, thus diminishing movement out of agriculture; (3) opportunities for part-time industrial, retail, and tourism work off the farm that siphon off the supply of labor that would be needed for farm expansion (Cantrell and Lively, 2002); and (4) increased productivity and/or profitability associated with new inputs, new cultural practices, new high-value crops, and on-farm value-added crop processing.

How these two subprocesses operate determines the outcome for concentration. To return to the four constraints just mentioned, the increased productivity made possible by new inputs and practices diminishes the need to get larger. Relatively small farms can be highly productive, economies of scale in production may level off at a relatively small size, and opportunities for work off the farm decrease the incentive to get larger. As important, however, is the preexisting agricultural diversity. Southwestern Michigan has rarely experienced saturated markets in grains, livestock, fruits, vegetables, and hay simultaneously, and the region has a fairly long history of moving land in and out of production, and/or from one form of cropping to another—most often, particularly in the western counties, moving between grain and fruit production.

Agroecological and Profitability Crisis, 1974–1989

The combination of the OPEC oil embargo and the associated period of economic stagflation during the 1970s provides the beginning conditions for the end of agricultural Fordism in southwestern Michigan. In addition to increasing costs of direct (e.g., fuel) and indirect (e.g., agrichemicals) petrochemical inputs to agriculture, and increasing costs associated with state and federal environmental regulatory regimes, the 1970s also seriously damaged the Michigan automobile industry and Michigan's industrial sector generally, diminishing opportunities for off-farm employment and supplemental income. This state-level economic downturn was then exacerbated by the decision of USDA officials in the Reagan administration to call in the many agricultural loans extended during the "fencerow-to-fencerow" planting strategies promoted by the Carter administration in the face of the Soviet grain deals.

These changes to the industrial and agricultural foundations of southwestern Michigan were happening at the same time that new, more ecologically oriented and input cost-reducing production practices were introduced: integrated pest management (IPM), corn–soy–wheat rotations, minimum tillage, and intensive rotational grazing. Although the costs of some inputs (e.g., lime, nitrogen fertilizer, sulfur pesticide) decreased, at least in real terms, the costs of other input factors (e.g., tractor fuel, propane for grain drying) increased, more than offsetting the potential cost savings. At the same time, real prices for agricultural commodities continued their long-term downward trend, and farm operators were squeezed between the rising costs and the falling prices. This cost–price squeeze was relieved to some extent by federal government payments. By the 1990s, federal payments constituted more than half of net farm income.

At the same time that more and more farm households were developing pluriactive strategies for staying on the land (and choosing production patterns,

cropping systems, and niche crop varieties that fit with the demands of these multiple-income strategies), science, technology, and markets generated opportunities for alternative forms of value-added production and/or regional crop diversification. During the 1980s and 1990s, food consumption in the United States became more diverse, and demand grew for a wider variety of fruits, vegetables, and meats at the same time that consumers sought "healthy" options associated with polyunsaturated oils, organic production, and vegetarian diets.

Southwest Michigan's historical agricultural diversity has allowed the industry to foster some of these new consumer demands and respond to some of the market signals generated by these new consumer desires. In particular, alternative marketing systems, from farmers' markets (Bingen, 2005) to Community Supported Agriculture (DeLind, 1999), have emerged within the region's still-dominant production of corn, soy, and wheat. This has been possible because apples, grapes, and blueberries provide both industrial commodities for mass marketing and processing, and specialty crops for niche marketing and value-added processing. The intricate and uneven dynamics of the relationships between these new and changing land management styles, changing consumer dietary demand, changing agricultural land-use patterns, and changing rural development trajectories are intimately bound up with one another and engender complex and uneven consequences for social relations, ecological conditions, and rural conservation practices all around.

Globalization, 1990 to Present

Most archaeologists agree that the agricultural revolution occurred in one or more locations during a period of a few thousand years starting roughly 11,000 years ago. To self-provisioning patterns that relied on gathering, hunting, and fishing, agriculture added the cultivation of crops and the domestication of animals. These agricultural adaptations remained relatively local in scope until technological and social developments supported trading and raiding at an increasing geographical scale during a period about 5,000 years ago (Hall, 2000). These patterns of exchange remained relatively regional in scope until technological and social developments supported a shift to a global scale during a period beginning about 600 years ago (Wallerstein, 1974). What began as a contest between monarchies for global power by the middle of the 1800s had become a system of nation states, and large, private capitalist corporations operating internationally but usually based in dominant nation states (Friedmann and McMichael, 1989). During the next 100-plus years, the organization of power gradually shifted in favor of the transnational corporation as opposed to the nation state, with only rudimentary development of a transnational state that might exert countervailing power against the transnational corporation (Friedland, 2001; Friedland and Boden, 1994). By the last two decades of the 20th century, transnational corporations were able to access and move raw materials, finished goods, and financial and human capital anywhere on the surface of the globe with almost no regard for the well-being of the communities or nation states involved (Gereffi and Korzeniewycz, 1994).

Thus, by the late 1900s, agrifood systems were increasingly global in scope and local in consequences (Hecht, 1985)—hence Swyngedouw's (1997) felicitous term *glocalization*. Working at the interface of Smith's arguments about the inherent and simultaneous homogenization and differentiation of social ecological landscapes under capitalist development (Smith, 1984, 1989; Smith and Dennis, 1987), and the geographical literature on the de-/reterritorialization processes of globalization (whether global warming or free trade), Swyngedouw (1997) argues that the scalar dynamics of social and ecological processes are shifting. Glocalization represents the simultaneous homogenization and differentiation of social ecological landscapes, particularly with respect to the transformation of local processes in the context of globalization. In terms of agrifood systems, this means that the relatively stable national dynamics of Fordist agricultural markets, policy, and research have been destabilized—with direct consequences for local and regional agroecological conditions. It also means that relations between agricultural production, distribution, markets, and consumption are being restructured as the relations between these entities and the patterns and governance of rural/urban development, environmental standards, and agrifood regulation are transformed by globalization.

For southwest Michigan, this means that historical rural/agricultural and urban/industrial dynamics are shifting rapidly. This raises questions about the extent to which and the ways in which agroecological land use and conservation measures can adapt at a similar pace. The promotion of and struggles over the social and ecological consequences of seven major developments—(1) alternative agriculture; (2) genetically modified crops; (3) niche or specialty crop production; (4) value-added agritainment, craft production, and rural vacationing; (5) exurban sprawl; (6) the environmental and human health implications of agrichemical use generally and pest management particularly; and (7) industrial animal farming—are all developing along international and regional lines, with widely diverse consequences for different localities in the glocalization of southwest Michigan.

We noted at the outset of this chapter that the distinguishing characteristic of the agriculture in the southwest Michigan region is its diversity. Our job in the wider study for which this chapter is a start is to explore the historical (amount, composition) and spatial (location, patchiness) patterns of this agricultural diversity as well as its sociocultural and ecological influences and consequences. These days in southwest Michigan, farms are increasingly growing houses where they used to grow grains, fruits, and vegetables. Increasingly, the use of the land is changing from farming to low-density residences, strip malls, light industry, government facilities, and highways. Whereas during the Fordist epoch suburbanization was broadly associated with expansion at the boundary between the urban core and the suburban ring, these days urban expansion is associated with spotty and noncontiguous exurban development, whether as medium-density prefabricated housing developments or low-density megahome construction. How this set of social transitions of the agricultural landscape is playing itself out in relation to new cropping systems and forms of animal agriculture—and how each is

affecting the environment—will be central to our developing understanding of southwest Michigan's contemporary agricultural transformations.

Grain Commodities

Nineteenth-Century Extensive Development, 1837–1898

Grain production in the region expanded rapidly as more and more land was cleared and drained. Between 1854 and 1904, the acreage planted to wheat and corn increased more than 150% from 452,595 to 1,153,512 acres (U.S. Department of Commerce, *Census of agriculture*). Wheat, planted on 22% of improved acreage in 1884, and corn, planted on 12% of improved acreage, were major parts of the agroecosystem during this period. Minor grains such as oats, barley, buckwheat, and rye were planted on approximately 7% of improved acreage in 1884, meaning that these six grains covered 40% of the improved landscape. Forty percent is more significant than it might seem, because all farms had to maintain extensive acreages rotating as pasturage.

Despite the development of rail transport and the concentration of midwestern grain marketing and processing in Chicago, practically all the wheat that was produced in Michigan during the 19th century was milled within the state. Milling centers of southwest Michigan were Grand Rapids, Alma, Coldwater, Lansing, and Jackson (Wood, 1914). Presumably this flour was consumed by growing urban populations in Michigan. The Civil War also had a significant impact on grain production as serendipitously timed bumper crops were sent to feed Union armies (Dunbar and May, 1995).

The Golden Age, 1899–1919

By the end of the 19th century, wheat production had already spread into the Great Plains (Brigham, 1910), and Michigan farmers now had to compete with other regions in a context of declining prices. For this reason, the expansion of grain production in the region slowed decidedly compared with the previous 50 years. In fact, although acreage in grain grew slightly from 1,702,481 to 1,758,372 acres between 1884 and 1904, acreage in grain as a percentage of improved land actually declined slightly from 41% to 39%.

From 1898 to 1919, agricultural expansion was starting to level off. Although the change in grain acreage was relatively small, the composition of the grain that was being produced continued to change. Most notably, there was a movement away from wheat production, and toward corn and other grains. Corn was often preferred by farmers because they could sell it when corn prices were high or use it as feed for hogs or cattle grown on the farm (Hart, 1986).

Many farmers, in fact, preferred to feed their corn to livestock because livestock production allowed for productive use of labor during winter months (Hart, 1986). Approximately two thirds of corn was used as livestock feed (Dunbar and

May, 1995). Equally important, alcohol consumption, and corn whiskey in particular, was also starting to increase during this period, providing new outlets for excess production of corn (Pollan, 2003).

The Agricultural Depression and the Great Depression, 1920–1940

The decrease in grain prices made cash grain farming extremely unprofitable, and many areas of grain farming were simply taken out of production as farmers across southwest Michigan were unable to pay taxes (Barnes, 1929). Farmers were also faced with declining relative income compared with manufacturing jobs (Alstou and Hatton, 1991). These conditions were exacerbated by the arrival of the industrial and financial depression in 1929.

The mechanical intensification of agriculture during the Depression era affected the environment by increasing soil erosion in many areas. Furthermore, the intensification of modern, monocultured grain crops—corn in particular—created new opportunities for agricultural insect pests. The European corn borer, introduced into North America around 1910, spread quickly across Canada and entered Michigan in the early 1920s (Larrimer, 1928). In response to the threat of the corn borer, in the spring of 1927, Congress passed a $10,000,000 corn borer cleanup campaign. Within Michigan, this campaign was largely an educational movement stemming from the agricultural section of the Cooperative Extension Service (Dibble, 1936; Musselman, 1928) that sought to reduce the amount of crop residue left on farm fields. The campaign largely failed to control the corn borer. However, the corn borer did represent, at least to some entomologists at the time, a larger structural problem. Dr. Charles Brues, a Harvard professor, suggested that increasing farm size and concentration of farmland was the source of increasing insect pest problems because large, reliable sources of food were allowing pest populations to grow (Anonymous, 1929). He also argued that a reduction in farm size would be the only way to control pest populations.

The combination of local environmental degradation, increased pest infestation, and national and global depression had a significant impact on both the amount and composition of grain production. As noted earlier, declining prices and decreased grain productivity drove many farmers out of business as their main cash crop became increasingly unprofitable. To maintain their farms, many farmers shifted out of grain production, and, from 1904 to 1940, the amount of farmland used for grain production declined from 1,314,259 acres to 948,614 acres, and grain's share of cropland declined from around 40% to less than 25%. This drastic decline was the result both of taking land out of production and of diversifying production into crops other than grains.

By the end of the 1930s, new opportunities for grain production began to emerge with the development of soybeans as a potential crop that could be rotated with corn and wheat as a means to reduce soil exhaustion, control pest infestations, and take advantage of new market demand for soy oil and soy meal. Although even as late as 1940 the fraction of farm acreage used for soybean production in the region was less than 1%, there were indications that soybeans would become critical for

southwest Michigan agriculture. Significant changes took place first technologically in 1934, when the hydrogenation of soybean oil became possible on an industrial scale; and then politically in 1935, when margarine manufacturers decided to use only domestically produced oils and fats (Berlan, 1991). These key decisions, buoyed by the discovery that soy meal could be used as a high-protein animal feed, opened the door for the expansion of soybean production in the coming decades.

Agricultural Fordism, 1941–1973

In the 1940s, the face of grain production in southwest Michigan changed drastically. First, grain production, which had declined significantly during the previous era, found new opportunities in markets in post–World War II Europe. Stimulated by new demand both internationally and nationally, grain farmers in southwest Michigan responded by increasing the amount of farmland used for grain production. In this era, however, corn and not wheat was the dominant grain produced. In part because of the Agricultural Depression, farm ownership became markedly more concentrated and farm size increased, whereas the diversity of grains produced declined. In 1974, the amount of soybeans planted was only 5% of total farm acreage; however, it increased rapidly through the next time period. Although there continued to be some farming of field crops other than corn, wheat, and soybeans during the early part of this era, by the 1970s it was clear that other grains were of relatively little importance. By 1974, less than 3% of farmland in the southwest Michigan region that was planted in grain or legume crops, was planted in crops other than corn, soy, or wheat.

Equally important, grain production in this period was defined by new mechanical and chemical developments that increased productivity and provided new positive economies of scale. Although tractors were available prior to World War II, they were not produced in sufficient quantities to meet demand, and many farmers in the region continued to rely on animal traction throughout the war years (see Animal Commodities, below). After World War II, as industrial production reoriented to include nonmilitary as well as military uses, fossil-fuel-driven farm machinery quickly became the norm for grain production. Within the entire state, the number of corn pickers alone more than doubled—from 10,681 to 23,514 from 1950 to 1954. By 1969, there were 13,053 self-propelled grain and bean combines and more than 70,000 tractors. The replacement of horses and the few other draft animals by self-propelled farm machines did not represent simply a labor-saving development. It altered the landscape by facilitating the further specialization of farms and by increasing the separation of animal systems from grain production. Farmers no longer had to feed and house animals, but at the same time the agricultural fields of farmers who had no other animal enterprises no longer benefited from the animal manure.

When livestock was removed from the grain production system, it was essential that new sources of fertilizer be found. Around World War I, two German scientists developed a way of synthesizing ammonia through the Haber-Bosch process. This meant that nitrogen fertilizer could be produced industrially, rather then relying on Chilean guano sources. The industrial production of ammonia

was further expanded within the United States during World War II because it was an essential part of munitions production. In 1930, 140,082 tons of commercial fertilizer was applied in Michigan. By 1964, this quantity had reached 679,519 tons.

The use of industrially produced agricultural chemicals was not without a cost, but neither did it lead to a wholesale domination of the landscape. This was particularly evident with regard to pesticides. In the case of the corn borer, the use of pesticide as a management technique proved to be extremely limited, because pesticide had to be applied when corn was nearly full grown, which made scouting and spraying for pests time-consuming and physically inconvenient. On the other hand, management of pests such as the western corn rootworm, which entered Michigan during this period already resistant to organochlorine pesticides, was initially successful through second-generation, organophosphate-based soil insecticides. Inevitably, however, the rampant use of pesticides developed during this era began to affect nontarget species and degrade agricultural and nonagricultural environments alike. Insecticides such as dichlorodiphenyltrichloroethane (DDT) had serious and lasting impacts on avian, aquatic, and terrestrial wildlife populations (Frank at al., 1981; Heinz et al., 1985, 1994).

The new tractor-driven, monocropped, chemically intensive, densely planted system could not have succeeded without structurally homogenous crops that were able to utilize high nutrient levels. Hybrid corn fit the bill. Although research into hybrid corn had begun in the 1930s, it was not until this period that its commercial use expanded. By 1940, more than 10% of corn acreage in southwest Michigan had been planted in hybrid corn (Griliches, 1960). By 1959, 90% to 100% of all corn varieties planted were hybrids. However, the spread of hybrid corn did not have an equitable effect on all agricultural operations. Rather, the yield improvements disproportionately benefited those who had large, relatively successful farms (Griliches, 1960). Larger farms not only had greater capital to buy the new hybrid seeds, but they could also purchase the host of chemicals and machines that worked in tandem with the hybrid crops to make production so high.

Agroecological and Profitability Crisis, 1974–1989

Through the post-Fordist era, from 1974 to 1989, the composition of grain production continued along similar trajectories as the previous era. Grain as a percentage of farmland continued to increase. Wheat acreage declined, whereas land planted to corn and soybeans increased. The factors driving these trends, however, were beginning to change. As a result of the homogenization of grain landscapes in previous eras, new environmental problems were being encountered. The homogenization of landscapes and the development of pesticide resistance led to increased pest infestations. Application of highly concentrated synthetic fertilizer began to pollute water sources; mechanization made possible increased tillage, which fostered soil erosion. Confronted with heightened public awareness of environmental issues and new federal regulations, farmers had to seek new ways to manage their fields.

Although serious grain pests, such as the western corn rootworm, were initially managed with soil insecticides, the rapid spread of resistance was making chemical management increasingly ineffective. At the same time, the homogenized landscape was providing pest populations with a large area of highly concentrated, high-quality food to support their populations. The solution to managing the corn rootworm in southwest Michigan was to rotate field crops to disrupt the lifecycle of the pest. This strategy not only was an effective means of pest management, but also allowed farmers to take advantage of the growing market for soybeans, and also had a further benefit in that it fixed nitrogen in the soil. The continued expansion of soybeans throughout this era is a testament to their use by farmers as a strategy for pest management, economic diversification, and nutrient management.

The problem of soil erosion was addressed through the expansion of no- and low-till farming. As with the expansion of soybeans, the benefits to grain farmers were multifaceted. Not only did the reduced disruption of the soil reduce the amount of wind and water erosion, but it also reduced the amount of labor time and fuel that were necessary to work the soil. Unfortunately, the concomitant effect of no-till farming was that it required more herbicide use to control weeds and maintain the clean, untainted fields that had become the cultural norm for southwest Michigan. Especially on the sandier soils and during the spring planting season, the herbicides leached into the groundwater. Ironically, no-till farming necessitated that farmers unlearn the lesson of eliminating crop residue that had been taught during the corn borer cleanup campaign in the 1920s (above).

Farmland concentration accelerated throughout this era, so fewer farmers were working larger tracts of land. Farm machinery itself became larger so that corn pickers that once picked a single row could now pick five or more rows simultaneously. Economic pressure resulting from low grain prices forced many farmers to "get big or get out." Farmland that had been in families for generations became available as a result of death or retirement, and was sold to settle the estate or rented out to provide a pension for the surviving spouse. In most cases, land that was rented was used for grain crops because of the quick return and low labor requirement compared with fruit or vegetable production.

Globalization, 1990 to Present

If grain production from 1940 to 1973 was defined by technology, and grain production from 1974 to 1989 was defined by environmental degradation, the final era of grain production, from 1990 to the present, is defined by globalization and increasing conflicts with nonagricultural populations. During this era, the forces driving grain production have shifted away from local or regional conditions and toward global-level influences. Certainly, extraregional factors have always had an impact on southwest Michigan grain production, from competition with wheat-producing states in the Great Plains and the West to the decline in prices of the Depression to new markets opened by World War II. However, in many ways, grain and legume production in this era is driven by the global supply of (e.g., from Brazil), and global demand for (e.g., by Mexico), cash grains and legumes

in ways that had not previously been the case. The market is not only affected directly by global supply and demand; in addition, grain and legume production is indirectly affected by markets for nontraditional uses (e.g., sweeteners, fuel alcohols, starch utensils, biodiesel fuels), and thus by the global supply of and demand for crops and other commodities that historically had not been seen as fungible and thus competitive with grains and legumes (e.g., cane and beet sugar, fossil fuels, wood pulp).

By 1997, the grain–legume landscape in southwest Michigan was dominated by corn and soybeans. Soybeans represented almost 20% of all farm acres planted, and corn was planted on 28% of all farmland. Wheat had decreased to only 5%. Despite the continued homogenization in the types of grains produced, there has been, at least to a limited extent, a diversification in the varieties of those types of grains that are produced (e.g., high-lysine corn, high-oil soybeans), and in the ways in which these grains are produced (e.g., genetically modified crops, organic crops).

Biotechnology has had a significant impact on grain production during this period. By 2003, an estimated 73% of soybean acreage and 35% of corn acreage was planted in genetically modified crops. For corn, the dominant genetically modified variety incorporated a plant-expressed insecticide (the *Bt* toxin) that controlled the European corn borer. Since the entry of the corn borer to the region nearly 100 years earlier, *Bt* corn represented the first highly effective control. Genetically modified soybeans consisted of a variety resistant to the Roundup herbicide. This allowed for easy weed control of soybean fields. Interestingly, however, despite the claims of the biotechnology industry, neither of these varieties contributed to a reduction in chemical application in the region.

Although transgenically modified crops (GMOs) were beneficial to farmers in that they reduced crop loss and made weed management easier, they were not without problems. With the expansion of international trade, international markets have become increasingly important to grain production in the region. Resistance to transgenically modified crops in countries in Europe and elsewhere has barred some southwest Michigan grain from some markets. In addition, some authors (e.g., Rissler and Mellon, 1996) have expressed concern that the constant and universal expression of the *Bt* toxin in corn will rapidly lead to resistance (loss of susceptibility) in the pest species. Other authors have suggested that the increased use of glyphosate (Roundup) will lead to resistance in the weed species, and/or that the herbicide tolerance genetic construct may be transmitted to weed species and may become incorporated in one or more weed genomes, creating so-called superweeds—weeds that are resistant to one of the major herbicides. Although there is no indication that any of these outcomes has occurred yet in southwest Michigan, the potential exists for these major environmental impacts.

In contrast to transgenically modified crops, organic production represents a relatively small part of southwest Michigan agriculture. Statewide slightly more than 40,000 acres, less than 1% of the total farmland in the state, were in organic production in 2001. However, organic production has grown rapidly in Michigan during the past 10 years, increasing more than 280% between 1997 and 2001. Furthermore, the 2002 adoption of national organic standards and the growth of

organic production nationally speak to its future potential. The exact amount of organic production in southwest Michigan is unknown; however, one extension agent stated that the majority of organic production in the region is in soybeans. The production of organic soybeans has been stimulated in part by the demand for edible organic soybeans in international markets. Organic production techniques emphasize the use of naturally occurring fertilizers that release nutrients more slowly than synthetic fertilizers; thus, less nutrient is available for leaching and erosion. Organic farming emphasizes the use of "naturally occurring" substances for pest management, such as sulfur and toxins produced by the *Bt* bacterium; thus, there is expected to be less impact on nontarget species. It seems likely that as organic production continues to expand, organic production of soybeans, as well as other crops, will likely increase in southwest Michigan in the future.

In addition to changes in technology and international trade, the expansion of residential developments into rural areas in the region is having an impact on how grain is produced. During the past two decades, movement into rural southwest Michigan has increased, as urbanites from as far away as Chicago have taken advantage of low land prices to build vacation homes or year-round houses in the country. Small "hobby farms," bed and breakfasts, and other tourist ventures now dot the landscape, seeking to take advantage of the pastoral ideal of country living. The implications of these residential developments for grain farming have been significant. First, to reduce complaints, grain farmers must now take into account adjacent nonfarm residences when timing the application of manure or pesticides. Furthermore, surveillance of the environmental impacts of agricultural practices has increased as the new exurban residents bring with them nonfarm aesthetics, environmentalist perspectives, and affiliation with environmental organizations. One of the reasons the production of wheat has decreased in the southwest region is the increased difficulty of the aerial application of pesticides and fertilizers that had been common.

Despite the increased social contention surrounding grain production in southwest Michigan, in some areas grain production has increased to provide a sink for manure from ever-larger and more concentrated animal operations. In general, grain land remains an important sink for the manure that livestock operations produce, at the same time that manuring remains an important mechanism for recycling many of the nutrients back to the land in a form that releases them relatively slowly. Of course, because of the high water content of manure, transportation costs for distant disposal are very high, and manure must be disposed of locally. As farmland has been taken over by residential areas, as animal production has become more concentrated spatially and organizationally, and as legislation has been put in place regulating manure application, there has developed a shortage of land on which to apply manure. It is this dynamic that has led to the bringing of new land into grain production to serve as a sink for manure. At the same time, grain production in the region continues to be an important source for animal feed in the region. Although livestock and grain production have become more separated and specialized at the level of the farm, they remain closely integrated at the regional level.

Fruit Commodities

Nineteenth-Century Extensive Development, 1837–1898

Eastern North American and European varieties of apple, peach, and pear seedlings were brought to southwest Michigan by early settlers and planted in fencerow corners. Some growers grafted these varieties onto wild plum stocks to speed fruiting. They also gathered indigenous small fruits from wild species such as the pawpaw (Armstrong, 1993). Blueberries were one of the few indigenous fruit species that became a commercial fruit crop (Kessler, 1971). Early economic successes encouraged growers widely to begin construction of formal peach orchards typically intercropped with staple crops like potatoes. A series of severe frosts killed large numbers of young trees in the 1840s and set into motion both on-farm research and demands by local horticultural societies that the state help to determine how best to cultivate fruit in the region. In this context, fruit growers were involved in the initial negotiations with the state legislature to open an agricultural college, culminating in the establishment of the Michigan Agricultural College in 1855, and in the negotiations to establish a department of horticulture at the college, finally realized in 1883.

By the mid 1800s, several of the biogeophysical conditions (e.g., sandy loam soils, seasonal variation in temperatures) that make the region suitable for fruit were formally identified and widely promoted (e.g., Winchell, 1865). One key feature is Lake Michigan. It was found to extend the growing season along the coast by cooling the air in the spring and summer, which delays budding and moderates the hottest days, and by warming the air in the fall and winter, which delays autumn frosts and creates heavy, insulating snows (Hill, 1939). Those counties that benefit most from the lake's moderating effects—Berrien, Van Buren, Allegan, Ottawa, and Kent—were identified as composing the Fruit Belt (Winchell, 1866). In addition, Lake Michigan provided the moisture necessary for production. Unlike some of the major fruit-growing regions of California (Stoll, 1998), Michigan growers did not require the development of extensive irrigation systems. In fact, research on fruit irrigation did not begin for another 100 years.

Fruit was initially grown for friends and family. Early commercial growers typically had small orchards on mixed farms (Kessler, 1971). In 1853, the Detroit and Milwaukee Railroad linked Grand Rapids and Detroit, which was significant for the development of the northern portion of the southwest Michigan fruit-growing region. Equally important events for the fruit industry were the opening of the Benton Harbor Fruit Market in 1860 and the subsequent completion of the Chicago–Lake Michigan Shore rail line in 1871 (Kessler, 1971). By the end of the 19th century, southwest Michigan was an established fruit-growing region, serving several significant markets (primarily Chicago, and secondarily Detroit, Milwaukee, and Grand Rapids), and famous for its peaches but anchored by its other crops, especially apples. In 1884, there were 173,251 acres of apples, peaches, and grapes being grown, which represents 4.12% of the improved farmland in southwest Michigan.

As increasing numbers of formal peach, apple, and pear orchards came into production, and the production of fruit expanded, it caused significant changes in the biophysical environment of the region. The varieties of apples and peaches and grapes that were planted were European and eastern North American varieties, exotic to the region. Although none escaped from cultivation to become an invasive nuisance, they did replace a significant percentage of the native vegetation. The sizeable and concentrated planting of these varieties made it possible for native and introduced insect and microbial pest species to increase to the point of being significant problems.

As the fruit landscape became more homogeneous, widespread damage became apparent as the transmission of diseases and the rapid spread of damaging insect pests increased. For instance, the Peach Yellows virus, first found in Michigan in 1866 in Berrien County, in combination with the severe winters of 1873 and 1879 severely damaged the peach industry. Yellows causes premature ripening and red spots from the skin through the flesh. Although the cause of Peach Yellows was not understood during this period, it was believed that it was contagious and that the only preventative measure was to remove and burn affected trees immediately (Wilcox and Smith, 1911). Control of Yellows was so critical that it prompted the passing of the Insect and Plant Disease Act of 1875, the first state legislation in the nation with the objective of controlling a plant disease (Kessler, 1971).

A central consequence of the problems fruit growers had with frosts and freezes, pests and diseases was a concentration of fruit acreage in the southwest Fruit Belt counties along Lake Michigan. Seventy-five percent of the 94,000-acre increase in fruit acreage between 1874 and 1904 was in these five counties. The other 13 counties in the region together lost more than 7% of their fruit acreage.

The Golden Age, 1899–1919

Despite the fact that the total acreage of fruit crops in southwest Michigan reached its all-time peak, 213,993 acres, in 1904, the Golden Age of Agriculture was not the golden age of fruit in southwest Michigan. Nevertheless, fruit plantings, especially along Lake Michigan, were used as an economic development tool to promote regional tourism during the early years of the 20th century (State of Michigan, Public Domain Commission and Immigration Commission, 1914).

Enormous economic successes in commercial production had encouraged a "peach-planting frenzy between 1884 and 1906" (Armstrong, 1993, p. 16). Yet, a particularly devastating storm on October 10, 1906, killed 73% of the peach trees across the region. This freeze devastated the industry, which never fully recovered. Although peaches were still planted across southwest Michigan, they became spatially concentrated in the southernmost county (Berrien) where the lake effect is strongest and the growing season is 20 days longer than in the rest of the region (Schaetzl, n.d.). Apples, a comparatively hardy crop, continue to be planted across the region to this day, whereas grapes and cherries are far more concentrated because of their greater need for specific ecological conditions. By 1904, more than 9% of the improved land in the southwest Fruit Belt was planted in apples, peaches, and grapes; and secondarily, strawberries, pears, plums, and cherries.

Additionally, during this period Michigan fruit producers had to respond to increasingly tough competition from producers in the Pacific Coast states. Extending the Progressive concern with productive efficiency, the development of the Farm Bureau and Cooperative Extension offices intensified the already tight relationship between fruit producers and land grant university scientists at Michigan State College, as it was then called. Thus, attention was turned toward alternative strategies, including new markets such as processed foods and beverages (Kessler, 1971), increasing yield and efficiency, decreasing production costs, and improving cosmetic appearance.

In response to quality concerns, Michigan State College focused its efforts on developing scientific, rational, and profitable agricultural techniques, using the newly established Cooperative Extension Service to reach the farmers whom the university agents believed most likely to adopt new technologies and techniques (Rosenberg, 1997). By this time, entomologists had already introduced chemistry to the orchard (Houck, 1954). Agrichemicals (e.g., lead, arsenic, sulfur) were in full use by 1900. When, early during the 20th century, the plum industry nearly succumbed to the plum curculio, one of the major insect pests of tree fruits, the industry was rescued by the introduction of lead arsenate paste (Kessler, 1971). In addition, variety testing and long-range breeding programs began to be developed and supported at several new regional experiment stations (Kessler, 1971).

During this period, the fruit industry began to learn how to control and adapt to nature—the nature of the biophysical environment as well as the nature of sociopolitical and economic conditions—each of which influenced the distribution of fruits across the landscape.

The Agricultural and Great Depressions, 1920–1940

Between the height of the Golden Age (1904) and the end of the Agricultural Depression era (1940), southwest Michigan lost nearly 63,000 acres of fruit, approximately 29.2% of its acreage. This overall decline was largely the result of two countervailing trends. First, fruit production shifted out of the areas that were not prime fruit land. Although fruit acreage in the Fruit Belt declined only 6.2%, fruit acreage inland declined by 67.1%. Second, there was an increase in berry acreage between 1929 and 1940 across southwest Michigan of almost 5,000 acres; 72% of this change was in the southwest Fruit Belt. During the Depression era, overproduction, increased competition, and decreased market prices challenged the southwest Michigan fruit industry. Members of the industry—growers, government agencies, land grant university, processors—collaborated on several on-farm strategies to mitigate these challenges, and to keep both the growers farming and the land in production.

1. *Increase quality.* Continuing from the previous era, the fruit industry concentrated on increasing quality as a way to preserve market share, which often meant increasing applications of heavy metal pesticides. State and federal grades and standards were enacted to force growers to "protect" crops in particular ways. Cherry growers, for instance, were required to

spray their orchards, on particular dates, with lead arsenate to control cherry fruit fly. In 1921, efforts were also put into enforcing the Insect and Plant Disease Act of 1875 by expanding the role of the Plant Industry Division in the Michigan Department of Agriculture, which was charged with inspecting nurseries, and later with removal of "nuisance" fruit plants (Kessler, 1971). Nevertheless, some crops such as pears rapidly declined during this era because of the difficulty controlling fire blight (a bacterial disease) and psylla (an insect pest) (Kessler, 1971).

2. *Grow for the market.* As a result of high market prices, grape planting between 1918 and 1920 markedly increased. Kessler (1971, p. 145) states that "the sale of grapes for home wine making, because of Prohibition, caused additional planting." During the same time, a major juice processor moved into the area. At the market level, at least two approaches were used to increase quality. First, there were organized efforts, beginning in 1923, to keep immature fruit out of the market (Kessler, 1971). Second, a shift in varieties grown was encouraged. For instance, the primary plum grown in the 1920s (the Damson) was so tart that it was suitable only for processing into jams and jellies. In 1926, the Stanley prune plum was introduced and soon became the dominant variety. At the same time, consumer interest in maraschino cherries during the 1930s made it profitable to try growing sweet cherries, even though sweets are susceptible to frost damage and to cracking from excessive moisture.
3. *Increase use of technoscience.* Although some commodities (e.g., grains) became highly mechanized during earlier eras, many fruits were found to be too fragile; hand harvesting was required to maintain quality. Furthermore, growers had a readily available supply of cheap labor. Thus, technological developments consisted primarily of tractors, sprayers, and new pesticides. In addition, existing breeding programs were expanded and many new ones developed. The Bluehaven blueberry, for instance, was a mid-size bush developed specifically for southwest Michigan that was easier to pick. The first commercial planting of blueberries was established in 1928, "demonstrating that blueberries are well adapted to thousands of acres of sandy, acid soil, which had until then been considered wasteland" (Kessler, 1971, p. 146). Today, competition from residential uses increasingly compromises access to this previously undesirable land.
4. *Elevate efficiency in the orchard.* At the beginning of the 20th century it was common practice for orchards to have multiple fruit varieties, but it was argued that efficient orchards require monoculture plantings (e.g., so they ripen at the same time). By the early 1930s, the Montmorency variety of tart cherries (i.e., one variety of one cultivar) was grown almost exclusively. Historically, peaches were typically interplanted with apples, but during this period, as the peach trees aged and became unproductive, they were pushed out and replaced by apples. In addition, the number of apple varieties grown was reduced from nearly two dozen to only a few. Thus, harvest became easier to time and to manage.

In addition to the production strategies just described, industry efforts were focused on marketing moreso than in any previous period. Marketing had several effects on the landscape, including the planting of new fruit cultivars, changing cultivar varieties, and the homogenization and standardization of fruit land. At the same time, the pressures of competition from other regions pushed fruit out of less productive areas and into the Fruit Belt counties. In addition, pressures of insect and disease pests forced greater concentration on those fruits for which the region had a comparative advantage—apples, blueberries, grapes, and cherries.

Agricultural Fordism, 1941–1973

Up to the 1940s, increasing fruit production was primarily based on extensive cultivation. After World War II, the application of capital and technology allowed the industry to use the natural environment maximally (Stoll, 1998), with little concern about the impacts of agroindustrialization on the rural countryside. These new practices had several effects on the land. On the one hand, they created a visually stunning, uniform landscape, especially around bloom and at harvest. On the other hand, industrialization of the landscape also meant the loss of biodiversity, increased pest problems, and a continuous need for new pesticides and pest control technologies. These conditions developed as a result of design strategies, pest management practices, and new forms of mechanization.

1. *Design.* Growers changed the landscape with changes in cultivars and cultivation techniques. For instance, commercial blueberry cultivation became important during this period. They were initially gathered from the wild; now, most Michigan blueberry acres are cultivated in the southwest Fruit Belt counties. During the Fordist period, orchard plantings also came to be "designed," their space calculated, and trees planted for efficiency, technological compatibility, and maximum yield. Research on size controlling rootstocks began in 1937; by the mid to late 1960s they were used on approximately 60% of new trees (Kessler, 1971). By 1974, dwarfing and semidwarfing apple trees allowed growers to increase density from 33 trees/acre during the Golden Age to 109 trees/acre during the Fordist era—an increase of 232%.
2. *Pest management.* After World War II, DDT, as well as other broad-spectrum pesticides (e.g., organophosphates), became widely available to fruit growers. They were immediately accepted and their value and effectiveness were not questioned (Russell, 1996). With growers following the spray calendar (e.g., Mitchell et al., 1953) and directions from other "experts" (e.g., chemical company representatives), pest control became a routinized process; pesticides were applied on a regular schedule, regardless of whether pests were present (Perkins, 1982). At the same time, both state and federal agencies codified grades and standards for quality. For example, formal rules about tart cherries established what were the minimum grades of fruit that processors (i.e., pitters) could receive, purchase, sell (Michigan Department of Agriculture, 1953), can, and/or preserve

(Michigan Department of Agriculture, 1962), as well as the specifications for the products that have been pitted (U.S. Department of Agriculture, 1946 [1941]), canned (U.S. Department of Agriculture, 1949a), and/or frozen (U.S. Department of Agriculture, 1949b). Over time, wholesalers and retailers reinforced these standards through their preferences for cosmetic appearance and by promoting the idea that consumers will tolerate nothing less than perfection (Pimentel et al., 1993). The point is that these grades and standards left growers with little choice but to attempt to grow perfect fruit with the only means available—agrichemicals (Worosz, 2006).

3. *Mechanization.* For several fruit crops, one of the most significant changes was the development and introduction of harvesting equipment. The mechanical cherry harvester (shaker), for instance, was promoted as the "solution" to the labor "problem." However, its use required extensive orchard modification—wider tree rows, special pruning, and leveling of the ground (Childers, 1975). It also became necessary to alter the character of the fruit with growth regulators so that they would be ready for simultaneous harvesting. Additional agrichemical applications were necessary to care for the cherries that were inevitably left on the trees, as well as to care for the tree itself.

Whereas trends in fruit land use during previous time periods focused on industry development (1852–1898), extensive cultivation (1899–1919), and marketing concerns (1920–1940), what stands out in the Fordist period (1941–1973) is the increasing intensity with which the land was used. Industrial, commercial fruit production is synonymous with increasing calculation and control. In fact, contemporary southwest Michigan Fruit Belt growers recount a time in which pests were controlled to the extent that nothing was alive in their orchards—no bugs, no birds, and no grass—just rows and rows of trees on barren soil. By the 1950s, the wide-scale use of synthetic, broad-spectrum agrichemicals began to raise concerns on numerous bases, including pest resistance and secondary outbreaks (Pickett, 1949).

Agroecological and Profitability Crisis, 1974–1989

Although the fruit growers in the southwest region had their crisis of profitability at the end of the Fordist era, from the 1970s to the present the cost/price squeeze and increasing land values throughout the Fruit Belt counties in southwest Michigan have continued to contribute to the overall loss of fruit farm acreage. High capital investment, and delayed return on investment, meant that orchard lands could not be rapidly shifted either between different enterprises or in and out of production. Fruit growers who continued to farm used several strategies directly related to land use, including enterprise selection, pest management, and risk reduction.

1. *Changing crops and/or varieties.* Some fruit commodities (e.g., pears) that once were strong faded almost entirely from the landscape during this period. In the case of grapes, however, some growers chose to develop

new vineyards and/or to change grape varieties. Although they were well adapted to the biophysical environment, native grapes (e.g., concords) are valued "about one-fifth that of Vinifera and one-third of French-American varieties" (Baxevanis, 1992, p. 203). During the 1980s and early 1990s, Vinifera acreage increased more than 26% statewide (Michigan Department of Agriculture, 1995).

2. *Reducing pest management costs and/or impacts.* During the early 1970s, many southwest Michigan apple growers were introduced to IPM by the State Cooperative Extension Service and by private crop consultants. The goal was to promote biologically based timing of agrichemical applications that would minimize unnecessary use and maximize effectiveness, thus minimizing environmental burden and maximizing efficiency. Other fruit crops were perceived to be too difficult to manage with alternative techniques; for example, federal regulations imposed zero tolerance for fruit fly damage in cherries (see earlier mention). Thus, most growers continued to rely on a "conventional," routinized program of pest control. Although the official IPM program succumbed to a lack of institutional support in the mid 1980s, most growers continued to attempt to reduce numbers and rates of pesticide applications, and some growers continued to practice scouting for pests (Harris and Worosz, 1998).

   Pesticides were once applied by hand, a tree/bush/vine at a time. After World War II, sprayers were automated, but their application was less exact, emitting the same quantity regardless of plant size or presence. During the 1970s and 1980s, multiple developments in sprayer technology (e.g., electronic eye) greatly increased precision. This precision meant that less product was lost to the air and/or soil. In addition, broad-spectrum pesticides were increasingly replaced with pest-specific substances. Growers interviewed during the 1990s remarked that there were more living organisms on their farms at that time than they had ever seen in their lifetime.
3. *Reducing risks from "natural" hazards.* Prior to the post-Fordist era, the biophysical environment was highly managed and manipulated. Practices such as windrows, tile drainage, smudge pots, and wind machines were already in use by the 1970s. However, cultural practices such as fertilization, tree bark painting (to reflect winter sun away from tree trunks), and slope alteration (e.g., to increase growing season sun exposure and/or air drainage) continued to increase the intensity with which the land was used. For example, up until this period, all plant material was removed from the orchard/vineyard/field floor to reduce competition for water and/or nutrients. For most crops, this practice ended when the use of herbicides and irrigation became feasible. Today, various grasses are typically used to cover the soil between the rows, both to conserve moisture and to provide habitat for pest predators. From 1974 to 1997, the acreage of fruit land in the southwest Michigan region under irrigation increased 44.2%, from 6,462 to 9,318 acres.

Globalization, 1990 to Present

During the current epoch, land in fruit production has continued to decline across the region; 17% of the land in fruit production in southwest Michigan was converted to nonfruit agriculture or to nonagricultural uses between 1974 and 1997. The spatial distribution of this decrease in fruit acreage further concentrated fruit production in the Fruit Belt counties. Since 1940, the non–Fruit Belt counties in southwest Michigan have lost more than 91% of their fruit farm land, whereas the Fruit Belt counties in the southwest region have lost only 43% of their fruit acreage. These two components imply that fruit acreage in the region as a whole declined 61% from 1974 to 1997. Today, the region has approximately 94,000 fruit acres, which is most highly concentrated in Berrien (19,768 acres) and Van Buren (22,259 acres) counties (Michigan Agricultural Statistics Service, 2001). To continue production, growers are, again, faced with increasing size and/or efficiency, changing crops, and/or finding niches. The competition for land in fruit production is particularly fierce because the same attributes that make land good for fruit production (i.e., slope, proximity to Lake Michigan) also mean that the land offers scenic vistas that are highly desired for exurban residences. Anecdotal evidence suggests that in response to these pressures, some growers have reoriented their production away from commodities for processing and toward the higher value fresh market. Therefore, requirements for cosmetic appearance, and hence for pest management, are intensified.

1. *Pest management.* Nearly every grower in the region is believed to use at least some aspect of IPM currently, but the extent to which growers have adopted IM techniques is unclear. Furthermore, the adoption of IPM has in some cases meant the application of additional pesticides. Several growers stated that monitoring and scouting found previously unobserved pests that required treatment. Furthermore, alternative methods are incompatible with some practices and their pest issues. For instance, as noted during the Fordist period mentioned earlier, apple density increased from approximately 32 trees/acre in the 1880s to 140 trees/acre in the 1990s, with the highest density orchards having more than 500 trees/acre. As density increases, pests spread more rapidly and are more difficult to treat. In 2000, the fireblight bacterium (*Erwinia amylovora*) killed nearly 400,000 trees in southwest Michigan (Longstroth, 2002). Control was compromised both by planting dwarfing varieties that are more susceptible and by planting them closer together, which decreased spray penetration and facilitated the rapid spread of the disease (Fig. 5.8).
2. *Population and sprawl.* Regional newcomers are especially concerned about pesticide residues and environmental contamination; their concerns are heightened by the federally mandated roadside warning signs that indicate the location of recent agrichemical applications. At the same time, it should be noted that these concerns are not unwarranted. Contaminated soils from heavy metal use (e.g., lead, arsenic) have been found in similar regions across the country (Jones and Patterson, 2003). The rapid

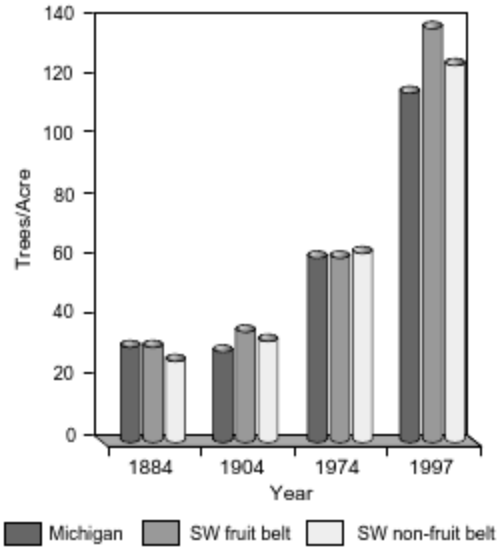

Figure 5.8 Apple orchard density in Michigan, 1884–1997. SW, southwest.

expansion of the urban, suburban, and exurban populations during this period exacerbated conflicts. Because good fruit land is attractive for rural residences for the reasons noted earlier, the population in southwest Michigan Fruit Belt counties increased 27% between 1980 and 2000, in contrast to an 8% increase in the non–Fruit Belt counties in the region. The proximity of these new rural residents to the agricultural operations, the traffic congestion, and new community mandates have altered the rural social landscape. Long-term residents, both farm and nonfarm families, perceive increasing tourism and urban sprawl as the most problematic land-use changes. They feel that these newcomers, who are unfamiliar with typical farming practices, change the tone of local politics and increase conflict (e.g., over zoning rules). Nevertheless, the visual imagery of the landscape has had and does have an impact on tourism and responses to sprawl (i.e., farmland conservation and preservation). At the state level, Michigan allows farmland owners to place their farmland in a program that indemnifies them against property tax increases for as many as 20 years. Although it has not yet happened in the southwest region, several counties near the region have implemented programs to purchase development rights from farmland owners. Both of these efforts have the effect of freezing in place a particular relationship between land in farms and the off-farm biophysical environment.

The state has also attempted to interpose its authority between farm operators and nonfarm rural residents in conflicts over the off-farm impacts of farming practices. For each major agricultural enterprise in Michigan, the state government has established Generally Acceptable

Agricultural Management Practices (GAAMPS), which establish minimal standards that farming practices must meet or exceed in order not to be considered an actionable nuisance under law. The establishment of GAAMPS has made it difficult for rural residents to seek redress for pesticide spray drift or odors from animal operations (the two most frequent complaints) (Gunter et al., 1999). Again, the GAAMPS program has had the effect of cementing in place a particular relationship between agriculture and the surrounding biophysical environment.

3. *"Nature" and "ruralness."* The viewscape is how the new residents come to know the agroecological environment, and it is reflected in their values and attitudes (Redclift and Woodgate, 1994). Their notions of agriculture paradoxically tend to center around an image of "nature" that is constructed as rolling hills with blooming fruit trees. The fruit itself has been iconized into a symbol of agriculture (Worosz, 2006), and fruit production is the definition of "ruralness." Thus, land use is built on a socially constructed definition of "nature" that does not include the messiness of industrialized agriculture. On the one hand, new rural residents construct nature as "agriculture"; on the other hand, they construct agriculture as "nature"—thus the paradox. In essence, both the "natural" environment and farming become little more than illusions, and the legacy of what was agriculture is preserved in the names of roads, subdivisions, and shopping centers (Thompson, 2000), while seasonal events become nothing more than an economic development tool for the nonagricultural community (Aronoff, 1993). For example, blossom festivals were initially used to request divine intervention (e.g., prevent pest damage, ensure yield), but are now agritainment (e.g., parades, carnival rides) complete with the naming of queens, courts, and king's men (Worosz, 2006).

   At the same time, these notions are reinforced by the fruit industry itself and are codified by government agencies. The biophysical characteristics of the landscape, for instance, are used to promote local products to tourists, such as wine labeled "Lake Michigan Shore." The Michigan wine industry has come to rely heavily on tourists; they account for up to 95% of the overall business, and much of the tourist trade is repeat customers.

4. *Niche markets.* In addition to reorienting production, some growers have also sought to capture niche markets—agritainment (e.g., u-pick, corn mazes, hayrides), value-added (e.g., branded pies and jams), and direct sales (e.g., farmers' markets, roadside stands) (Cantrell and Lively, 2002). The presence of consumers in and around their orchards/vineyards/fields, again, increases concentration on the appearance not only of the fruit, but also of the farm (Busch and Tanaka, 1996). For example, the planting of seasonal grasses in orchards that was recommended during the 1980s and 1990s as a technique to manage pests is discontinued so that consumers can see a pristine orchard. Thus, orchard-level pest/predator manipulation is sacrificed for "beauty."

Animal Commodities

Nineteenth-Century Extensive Development, 1837–1898

Draft animals provided the principal source of traction on the farms in the region during this period, and a significant portion of transportation of commodities and goods, both in rural and in urban areas. During this period, the number of horses on farms in the region increased from 23,000 to 221,000. The breeding of horses was important, both to replenish the farm stock and to supply nonfarm uses. The increasing production of small grains and hay, noted earlier, fed both the farm animals and the nonfarm animals.

During this period the number of hogs quintupled, as the farms of the region supplied fresh pork, cured ham and bacon, and lard for baking to a growing urban population. Initially, hogs were allowed to graze freely in the woodlands, and later they were allowed to root freely in fields of root crops planted for that purpose. Slaughter and curing were done either on the farm or by commercial butchers.

The number of milk cows quadrupled during this period, as the farms of the region supplied dairy products to a growing urban population. Milk was sold raw, and butter and cheese were produced on the farms. The growth in other cattle tracked the number of milk cows almost perfectly as male calves were raised for beef. Slaughtering was done locally, either on the farm or by commercial butchers, and hides were processed into leather. Cattle were fed largely on pasture and with hay during the winter.

During this period, the number of sheep on farms in the region almost quadrupled, but the number of farms on which sheep were raised increased only slightly. Sheep were raised both for wool, which was spun in the household, and for meat, which was slaughtered on the farm. Sheep grazed either on pasture or on unimproved land, and were fed hay during the winter.

Poultry (chickens, ducks, geese, and turkeys) provided both eggs and meat for farm consumption, and for sale in the rural towns and the urban centers. Although most poultry ranged freely in the barnyard and farm pond, the food they could obtain on their own was supplemented with various grain mixtures.

The animal agriculture of this period in southwest Michigan could be characterized as petty commodity production—a balanced mixture of self-provisioning and production for largely local markets, relying primarily on family/household labor with perhaps some small amount of full-time, long-term hired labor. The animals and animal products that were sold supplied the nonfarm residents of towns and cities in the region.

As noted earlier, horses, milk and beef cows, and sheep all relied on extensive areas of grass pasture for grazing, and extensive areas of hay for additional feeding. This area supported populations of arthropods, birds, and small and medium mammals. At the same time, the grazing animals deposited manure in the fields very slowly and gradually, plop by plop, in a highly dispersed pattern. In addition, horses and poultry consumed corn and small grains. These amber waves of grain supported bird populations much larger than had existed before the clearing and planting of the land (Neumann, 1985). The manure from poultry, from swine

when they were penned, and from horses and cattle when they were kept near the barn in the winter was spread on the croplands to replenish the fertility of the soil. Because all the animals' feed had come from the cropland, this did not cause problems of excessive phosphorus or nitrogen.

The Golden Age, 1899–1919

Although draft animals continued to be the principal source of traction on farms during this period, the number of horses on farms reached its peak in 1890, and declined slowly during the next 30 years as steam tractors become more prevalent. Off the farm, horses remained important for the transportation of people and goods. Thus, farms in southwest Michigan continued to produce hay and grain to feed draft animals both on and off the farm. As a result of hunting and other efforts, the large mobile flocks of birds that had threatened grain yield in the past were beginning to decline during this period.

As the urban population in Michigan and the three nearby states (Illinois, Indiana, and Ohio) continued to increase, the market for eggs and poultry meat grew apace. In this period the number of poultry on southwest Michigan farms increased by 48.7%, with chickens constituting 95.3% of those flocks. Ration for poultry continued to be largely produced on the farm. Poultry was mostly sent to market live. Like the birds themselves, eggs produced increased 47.4%. Anecdotal evidence suggests that eggs provided "pin money" for farm wives and perhaps younger farm children.

It was in 1916 that Carl Sandburg (Sandburg, 1916, p. 1) described Chicago as the "hog butcher for the world," and we would suggest that many of those hogs came from southwest Michigan, transported by rail to the stockyards in less than 24 hours. Hog production was a petty commodity enterprise for many farms. During this period the number of swine on southwest Michigan farms increased by only 13.6%, roughly the same relative increase as the number of farms in the region. Swine continued to receive a variety of roots and greens produced on the farms as their feed.

The production of milk remained important during this period. The number of milk cows in the region increased by 53.1%. In 1910, farms still sold milk and cream separately, and also sold butter and cheese. During this period, the number of other cattle continued to be about the same as the number of milk cows. This would suggest that these were largely integrated farm operations, breeding the mature cows, and raising the calves either for beef or for milk production. The production of beef cattle in the region supplied both local slaughterhouses and the Chicago meatpackers. Feed for cattle was still mostly pasture and hay, with some movement toward more specialized forages and hays during this period.

Because of the reliance on grazing for a significant portion of the year, much of the cattle manure was deposited directly on the land in the pastures. Manure that was collected from the barnyards and animal buildings was simply piled up to await spreading in late winter or fall, after which it would be tilled into the soil. The relatively low density of animals per unit of land in farms in the region diminished the potential negative environmental impacts of this practice, and

recycled nutrients from the animal waste back into the soil in a form that could be gradually converted into nutrients that the next year's crop could take up.

The Agricultural and Great Depressions, 1920–1940

The number of horses on farms in the region decreased by 48.2% during this period. Many farms gave up at least some of their horses and purchased internal combustion engine tractors. During the first two decades of this period, farm people left farming and shifted to industrial employment. This decreased the amount of internal and local labor available for farms, and contributed to the shift to more powerful self-propelled farm machinery. At the same time, the reliance on horses for transportation and draft power in the nonagricultural sectors of society greatly decreased, so raising draft horses was no longer a profitable enterprise. Because the average farm had about three horses, and each horse ate the grain from about 10 acres, giving up the horses meant that 30 acres of small grains and pasture could be converted to other uses. Although the demand for barley for beer was increasing, the demand for small grains (especially oats and rye) for food manufacturing was decreasing, so generally the cropland was allocated to some other enterprise; in some cases, the number of other animals was increased. The decrease in small-grain acreage doubtless further decreased the graminivorous bird populations in the region.

During this period, the production of chickens increased by more than one third (from 1920 to 1940, the increase was 33.0%), and became more concentrated. From 1925 to 1940, the number of chickens produced on farms producing chickens increased by 48.1%. In contrast, the number of eggs produced increased 28.9% from 1910 to 1940, while the number of eggs produced on farms producing eggs increased by 26.7% from 1925 to 1940, so concentration was not happening as much in egg production as it was in poultry meat production.

The years around 1910 represent an initial peak in hog production in the southwest region. During this period, the number of swine in the region decreased by 56.0%, and did not regain a comparable level until the late 1970s. It would appear that this decrease was only partly the result of farmers dropping swine from their mix of enterprises; from 1925 to 1940, the number of farms with swine decreased by only 9.7%. However this appearance may be misleading. In fact, probably three trends were occurring. First, farms were tending to drop swine from their mix of commercial enterprises, and some of these farms gave up swine altogether. Second, some of the farms that dropped commercial swine continued to raise a few hogs for self-provisioning and extended family support. Thus, the number of swine on farms with any swine reaches its lowest value (6.7) in 1935. Although some of the selling down may have been a response to the lack of markets during the depths of the Depression, this would be all the more reason for a farm to continue to feed the number of hogs that the resident and extended family members could consume. Third, some of the farms that stayed in commercial swine expanded their hog operations. The number of hogs on farms with hogs almost doubled every decade after 1935.

Although the size of the dairy herd continued to grow during this period, the latter part of the 1930s and the first part of the 1940s were the peak of dairy

farming in southwest Michigan. Since the mid 1940s, the number of dairy cows in the region has declined continuously up to the present. In fact, the decline had its origins during this period. From 1925 to 1940, the number of farms with dairy cattle decreased by 12.0%. Although the number of dairy cows per farm with dairy cows increased by 25.6% from 1925 to 1940, the mean number of dairy cattle per farm was still less than six. Because one or two cows would have supplied the dairy needs of the farm family, it would appear that a significant amount of petty commodity production was still occurring. Butter was still being produced on the farm for sale, and cream was still being separated from the milk and sold separately.

Although 1910 continued the previous pattern of equal numbers of dairy and nondairy cattle, from 1920 on, the number of nondairy cattle in the region was consistently less than the number of dairy cattle by about a third. This would suggest that female cattle were being kept because dairy production was profitable, whereas young male cattle were being sold for slaughter or for finishing operations elsewhere.

Agricultural Fordism, 1941–1973

The number of horses on farms continued to decline during the first part of this period, reaching a low point in the late 1950s or early 1960s. In 1954, most of the farms that had horses had only one horse. Although some of these animals would still have been workhorses, presumably most of them were being kept for pleasure riding. At the same time that horses were being eliminated from crop farms, the late 1950s also saw the return and increasing development of horses as a farm enterprise. By 1969, the number of horses in the region had increased 66.6% from the low point in 1959, and the average number of horses on farms with horses had increased from slightly more than one in 1954 to almost four in 1969. These horse farms would have maintained some acreage for pasture, some acreage for hay, and presumably some acreage for riding trails.

It was during this period that the poultry sector became highly concentrated. On the one hand, the number of chickens raised increased by about 100%. At the same time, the number of farms raising chickens decreased by approximately 90%. Although the average number of birds raised per chicken farm increased about 20-fold to 3,000, the average broiler operation was raising 7,000 birds per year. Similarly, the number of eggs produced increased by 60.3% from 1940 to 1964, while the number of farms producing eggs in southwest Michigan declined by 89.9%. Not only was egg production concentrated on fewer farms, it was also spatially concentrated. One county, Allegan, produced 12% of all the eggs produced in Michigan. Because the population of Michigan increased 69.0% from 1940 to 1970, the increase in egg production barely kept pace with the increased population. This reflects the long-term decline in egg consumption that began during this period. From its peak in 1945, per-capita egg consumption in the United States had decreased 26.7% by 1970 as consumers shifted away from cholesterol, and food manufacturers found substitutes for eggs.

It was also during this period that the raising of turkeys shifted from small-scale petty commodity production to industrial-scale operations. Although the number of farms raising turkeys decreased by 97%, the number of turkeys produced increased by more than ninefold (938%). Half the farms and four fifths of the production were in one county (Ottawa). The increase in turkey production reflected an increase in turkey consumption in the United States. During this 30-year period per capita consumption increased from its long-term average of less than 2 lb. to 6.6 lb., as consumers sought to avoid beef and pork because of their image of high fat and cholesterol. For these large, concentrated poultry operations, the disposal of manure began to be a problem.

The number of hogs and pigs on southwest Michigan farms continued to increase slowly during this period, growing 79.9% from 1940 to 1969. The number of farms with swine continued to decrease during these years, from 30,848 to 5,661 (81.6%). Thus the average number of pigs and hogs on a swine farm increased by 878% during this period. Because the land area of these hog farms did not increase to that extent, the disposal of hog manure was an increasing problem.

The number of dairy cattle in the region started its long-term decline during this period, decreasing by 46.0% from 1940 to 1969. Because the number of farms with dairy cattle declined even more precipitously during these years, by 88.1%, the average number of dairy cattle on dairy farms increased from 5.79 to 26.2. In 1970 the conventional wisdom was that one adult farm operator could manage about 80 cows, so these farms were probably a mixture of small-scale petty commodity production and commercial dairy farms. Concomitant with the decline in dairy cattle and dairy farms, the number of nondairy cattle increased by 89.8%, and the number of farms with nondairy cattle was at least double the number of farms with dairy cattle. So while the beef sector was beginning to emerge in 1969, the average head per farm was still less than 50, and manure management was not yet a problem.

Agroecological and Profitability Crisis, 1974–1989

Although the number of horses in southwest Michigan increased slightly during this period, the number of farms with horses declined by about a third. The average number of 6.1 horses on a horse farm reflects the increasing specialization of horse farming in breeding and raising horses for racing and recreation.

The shift to horse farming for racing and recreation is symptomatic of the general withdrawal of southwest Michigan from traditional agriculture during this period. From a high point of slightly over a million birds in 1969, production fell 35% by 1987. This occurred despite the increase in per capita consumption of turkey meat in the United States during that period from 6.6 lb. to 11.6 lb. Similarly, chicken sales from southwest Michigan decreased by 2.5% during this period, despite the 50% increase in per capita consumption of chicken meat in the United States from 26.3 lb. to 39.4 lb. At the same time, the number of poultry farms in the region decreased by about 75%, so the remaining production was concentrated on a much smaller number of farms. Although the Census of Agriculture stopped collecting data on egg production and sales after 1969, information from extension agents and specialists suggests that the region also gradually withdrew

from egg production. This pattern of withdrawal is probably the result, at least in part, of the difficulty of disposing of the manure being generated by large-scale, concentrated poultry operations.

This same pattern of withdrawal occurred in dairy and beef cattle during this period. Reduction in the dairy herd in the region was fostered both by the federal dairy buyout program in 1980, and the introduction of synthetic bovine growth hormone that increased milk production per cow by about 10%. In contrast, swine production in the region increased by almost 100%, stimulated by a state policy favoring concentrated hog-feeding operations ("hog hotels"). Although these operations were being discouraged in other states where environmental problems had occurred (e.g., North Carolina), Michigan was welcoming them with financial and legal (permitting) assistance.

Globalization, 1990 to Present

During the last decade of the 20th century and the first decade of the 21st century, the previous trends in animal agriculture in southwest Michigan continued. The number of horses in the region increased by 73.9%, and the number of farms with horses increased by 55.9% to 5,488. Thus, more than a quarter (28.4%) of southwest Michigan's farms had horses, and the average horse farm had almost seven horses.

The number of milk cows in the region continued to decline slowly (about 1% per year), but the number of dairy farms declined by more than 50% as the consequences of the dairy buyout, the use of bovine growth hormone, and economies of scale were felt. Thus, the average dairy herd more than doubled, from 58 in 1987 to 126 in 2002. Because the land operated by dairy farms did not increase that much, disposal of local concentrations of manure became more of a problem.

In contrast to the slow decline in dairy cattle, the numbers of nondairy cattle in the region plummeted during this period, decreasing by 70.5% between 1987 and 2002. Since the number of nondairy cattle farms only decreased by about 25% during this period, manure management is not the increasing problem that it is for dairy operations.

Whereas hogs show the general pattern of withdrawal from traditional animal agriculture, they also show the increasing intensity of dairy. While the number of hogs in the southwest region declined by 18.7% from 1987 to 2002, the number of hog farms declined by 68.4% to 879. Thus the average number of hogs per farm increased by 157% to more than 800, and disposal of local concentrations of manure was an increasing environmental and social problem.

Commodity Summary

The Agricultural and Great Depressions, 1920–1940

During this period, the steep decline in the use of animals for draught power led to declines in the use of farmland for pasture and hay and small grains. These

land uses were replaced by annual crops, especially corn and incipiently soybeans. These changes in land use implied more tillage (for annual crops) and more cultivation (for row crops), and thus more compaction of the soil and soil erosion. The shift to cultivated annual crops meant that less carbon was being sequestered by agriculture, and that greenhouse gases were increasing. The greater use of tractors and combines meant that more greenhouse gases were being produced because internal combustion engines have greater flatulence than horses and other beasts of burden. The shift to combines for harvesting meant that less grain was being scattered in the fields for birds and other animals. The increasing spatial concentration of monocultures of grain and fruit led to more problems with insect and disease pests. The increased importance of cosmetic standards and legal regulations led to more spraying of heavy metal pesticides. At the same time, mechanical sprayers caused greater off-target deposition, and thus greater impacts on off-target species.

Agricultural Fordism, 1941–1973

More than any other, the post–World War II period marks the industrialization of southwest Michigan agriculture. By the end of this period, animal draught power was almost entirely gone, replaced by internal combustion engines. Tillage and cultivation were intensively practiced, leading to soil compaction and soil erosion. Fewer than half the farms in the region included animal enterprises, so fertilization was increasingly in the form of synthetic nitrogen and mineral phosphates and potash, which resulted in increased runoff to surface waters and leaching to groundwater. These, in turn, increased the eutrophication of lakes and rivers in the region. Pest management relied on persistent, broad-spectrum insecticides that generated pest resistance and secondary outbreaks, and that negatively affected nontarget species of birds and fish. These various negative impacts set the stage for the environmental backlash against agriculture in the following period.

Conclusion

Since settlement, grain production has been one of the most significant parts of agriculture in southwest Michigan. During the first era, the ecological suitability of the region resulting from the ease of transportation and the availability of small, open prairies helped to draw settlers and to orient them to grain production. As agriculture expanded, settlers altered the landscape by cutting down trees and draining wetlands. Expanding national (new uses) and international (new users) demand led to increasing intensification of production until finally soil erosion, pest infestations, aquifer reduction, and other environmental limits were felt. Technological and institutional developments overcame some of these environmental limits as grain production became defined by machines, chemicals, and hybrids. Again, however, environmental degradation resulted from these new technologies and farmers were forced to alter production practices to incorporate practices such as crop rotation and reduced tillage. Finally, encroachment

at a global scale through technologies such as biotechnology and locally through exurbanization has once again altered grain production. This tension has both created new opportunities for grain production and placed new constraints on decision making by farmers. Inevitably, these new opportunities and constraints have once again altered and recreated the ecological landscape on which the corn, wheat, soybeans, and other crops are grown.

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