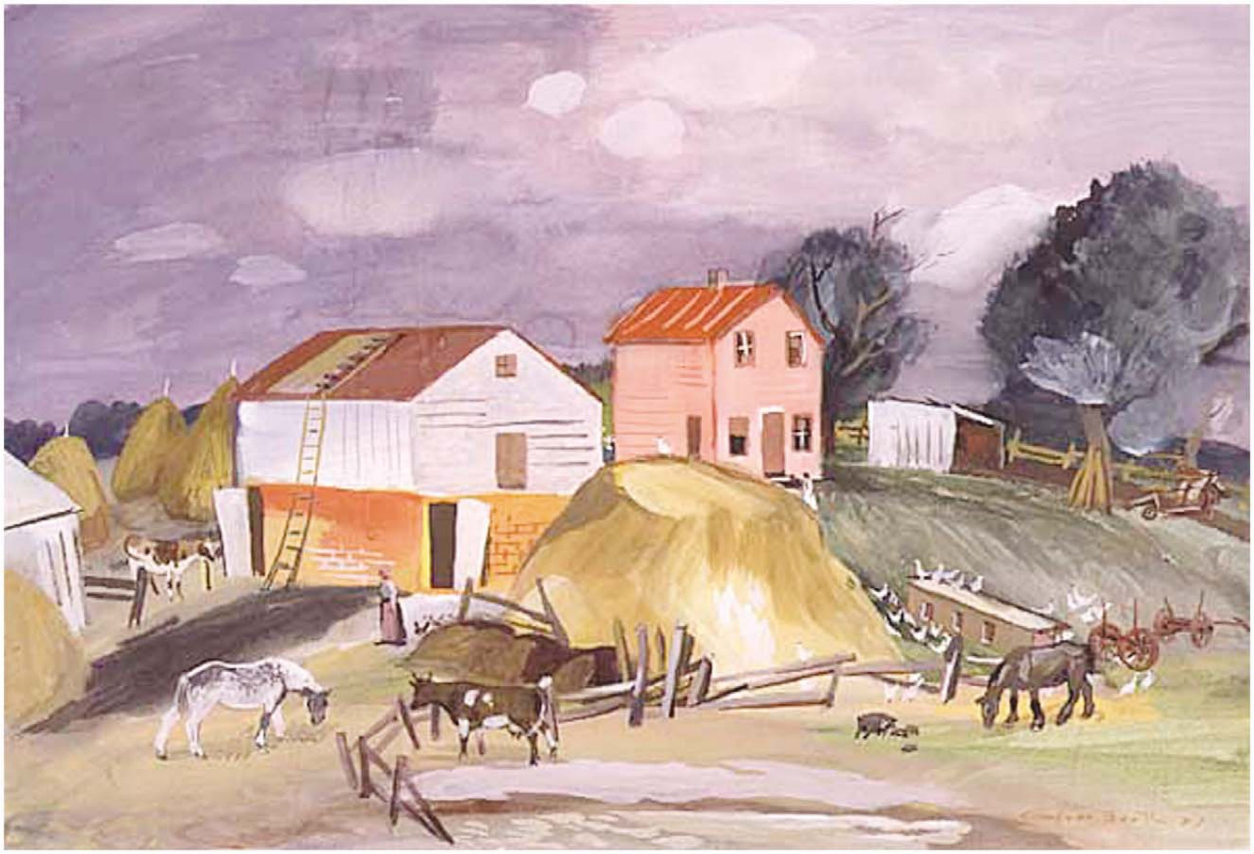
HISTORIC CONTEXT STUDY OF MINNESOTA FARMS, 1820-1960

Vol 3



prepared for the
Minnesota Dept of Transportation

Susan Granger and Scott Kelly
Gemini Research   June 2005

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On the cover: *Juke's Farm* by Cameron Booth, gouache, 1937 (MHS art collection)

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▪ SILOS

- Silos were ideally strong and airtight
- Minnesota's first silos appeared in the late 1880s; many were built in 1900-1920
- Silos transformed the profitability of dairy farming and led to the spread of dairying throughout Minnesota
- Nearly all dairy farmers had a silo, but silage was also fed to beef cattle, sheep, and draft horses
- Silos could be horizontal or vertical, permanent or temporary, above or below ground
- Materials included wood, stone, brick, reinforced concrete, concrete block, cement stave, clay tile, galvanized metal, asbestos, and glass-lined steel

Silos were storage containers in which chopped corn stalks, grasses, legumes, sorghum, sunflowers, and other green fodder could be preserved through the winter months while maintaining its high nutritional value. The silage fermented until all air was used from the silo, and then reached a stable state that preserved it. Vertical silos did not necessarily need roofs because the weight of material helped keep air from reaching the silage at the lower levels (Lindor 2004).

Minnesota farmers fed silage to dairy cows, beef cattle, sheep, draft horses, and, very rarely, hogs and poultry. In 1937 most Minnesota corn was being grown for silage except in the southernmost "Corn Belt" counties where it was fed to livestock as grain.

Silos were particularly useful in northern climates where a short growing season didn't support cultivating more profitable cash crops. In northern and central Minnesota, silos could preserve field corn that didn't always fully ripen by the end of the season. Silos also enabled farmers to use stalks, roughage, and other crop by-products. In the 1950s, Minnesota farmers also began to ensile shelled corn to make concentrate livestock feed.

Silos and the rise in Minnesota's dairy industry went hand in hand. Dairy cattle only gave milk from spring to fall when they were fed on green pastures. Limited to this schedule, farmers were unable to participate in higher-priced winter markets for milk. The silo transformed dairy farming by allowing animals to be fed green fodder year- round, which encouraged cows to give milk through the winter. According to geographer Allen G. Noble, this was especially advantageous to farmers near large urban areas: "Urban dwellers constituted a steadily growing market for milk, a market that existed throughout the year despite fluid milk's seasonal availability" (Noble 1984: 72). With a silo, a farm could also feed more dairy cattle and feed them better-quality winter rations. In fact, a silo increased the stock-carrying capacity of a farm by more than one-fourth (Wayne 1977: 30-37). Farmers also found that dairy cows required less water in the winter if fed silage (Noble 1984: 72).

In 1911 C. R. Barns of the University of Minnesota wrote, "The owner of a dairy herd of more than ten or a dozen cows, who has failed to erect a silo, is now to be regarded as 'behind the age.' The gains from its use are so manifest, that the number of silos being erected in Minnesota grows with

See also

Dairy Barns
Beef Barns
Hay Barns
Diversification & Rise of Dairy, 1875-1900
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a rapidity that is at once a tribute to the intelligence of our dairy farmers and a prophecy of still further advances in animal husbandry" (Barns "Corn" 1911: 117).

Cornell University's G. F. Warren wrote in 1916, "The most striking change in the dairy industry in the last century has come in connection with the use of the silo" (Eckles and Warren 1916, rpt. 1921: 221).

And University of Minnesota dairy expert R. M. Washburn wrote in 1931, "No dairy or general livestock farm is properly equipped for economical production until a silo of some sort is provided" (Washburn 1931: 240).

EARLY DEVELOPMENT

According to Noble, ensiling fodder was a centuries-old practice. In modern times, experiments with ensiling – especially corn that had not ripened – were conducted in Europe beginning in the 1860s and in the U.S. around 1875. Innovators in Maryland, New Jersey, and Illinois apparently built the first silos in the late 1870s. In 1882 the USDA counted 91 silos on U.S. farms, most of them in New England, although others probably existed (Noble 1984: 70-71).

Noble explained that silos were only slowly adopted by average-sized farms beginning in the 1880s, and that "as late as 1910 articles still implored the conservative farmers not to continue to look upon a solo 'as an extravagance'" (Noble 1984: 72).

In 1895 there were more than 50,000 silos in the U.S. and by 1903 there were an estimated 300,000 to 500,000. Eckles wrote in 1950 that many of the silos in the Midwest were built between 1910 and 1925 (Eckles 1950: 486). In 1924 Wisconsin was the state with the most silos (100,000), followed by New York (which had half as many), followed by Michigan and Ohio (Noble 1984: 72).

In Minnesota the first experiments with the use of silos began in the 1880s. According to Vogeler, "By 1880, silos had appeared in Wisconsin; by 1882, in Michigan; and by 1884, in Minnesota" (Vogeler 1995: 108). By 1889 the *Minnesota Farmers' Institutes Annual* had published an article on building a square silo in a basement barn.

The University of Minnesota's C. H. Eckles wrote in 1950, "Some interest in silos [in Minnesota] was aroused between 1885 and 1895 as the result of experimental work," suggesting that silos built before the mid- to late-1890s were in the vanguard of the movement (Eckles 1950: 486).

Silos proliferated slowly in the state but were built more rapidly around 1910 as farmers continued to diversify and as silo designs were improved. The importance of having a silo became obvious to many Minnesota farmers around 1914 when the corn crop in most counties did not ripen. Farms with silos were able to store the yet-green crop and feed their animals over the winter (Gould 1889; "The Beneficent Silo" 1915: 270).

The University of Minnesota reported that Minnesota had 36,278 silos in 1927, or about one silo for every five farms (Schwantes and Torrance 1937: 2). Brinkman wrote that in Stearns County alone there were 1,200 silos in 1922 (Brinkman 1988: 18). In the mid-20th century, average Minnesota farms had one silo, but those with larger herds might have two or three (Lindor 2004).

OVERVIEW OF SILO FORMS

Silos were built in two general forms, vertical (sometimes called "tower") and horizontal.

The first modern silos, dating from the mid- to late-1870s and horizontal in form, were "pit" silos or fully- or partly-excavated holes lined with straw, stone, or another material. Wisconsin's first silo, built in 1877, was a pit silo.

The earliest vertical silos were square structures usually built of wood or stone. Farmers found, however, that the square shape bowed outward and led to air pockets in the corners. This caused silage to rot despite attempts to make the silos taller so the heavy silage would settle into the pockets. Subsequent octagonal and round forms worked better, and square silos were rarely built after 1900 (Beedle 2001: 3-4; Noble 1984: 74).

The first successful round vertical silo was developed by F. H. King of Wisconsin's state agricultural experiment station in the early 1890s. The King or Wisconsin silo was made of two layers of horizontally-placed wood boards (Noble 1984: 74).

Wooden silos were prone to deterioration from the acidic silage and were not very strong, especially when empty. Some farmers continued to build stone silos and, beginning in the mid- to late-1890s, also used brick and concrete. In the early 20th century, improved silos of reinforced concrete, concrete block, structural clay tile, cement staves, and galvanized metal were built.

Temporary silos were useful when a crop failed unexpectedly, and were used to serve a recently-enlarged herd, to meet wartime production increases, or when money or building materials were scarce. Many were made of straw bales, inexpensive boards, wood fencing, or plywood, or were simply below-ground pits or trenches. Some renters built temporary silos so they could take them along when they moved from farm to farm.

BUILDERS

Farmers often made their own silos, especially before 1920. Technical help was available from county agents, farmers' groups, and agricultural schools and experiment stations. Forms or molds for poured concrete silos could often be rented. By 1915, however, many experts were recommending that farmers seek professional help for silo construction, unless a lower-cost or temporary model was being built.

A large number of companies offered commercially-made silos. The 1909-1914 issues of the *Minnesota Farmers Institutes Annual*, for example, contain numerous advertisements for silos of wood, poured concrete, clay tile, cement stave, and metal. A 1919 University of Minnesota author indicated that most silos at that time were commercially-made (Wilson 1919: 6). Cement staves and other materials were heavy to ship and were usually sold by dealers who worked in small local territories. These dealers often built the silo for the farmer (Lindor 2004).

LOCATION AND SIZE

While some vertical silos were incorporated within the massing of a barn, most were built outside so that barn floor space would be spared. The silo was connected to the barn via a small passageway, room, or chute. While experts noted that the south or east sides of the barn protected the silo from wind, and exposed it to the sun which helped silage stay unfrozen, many agreed that good accessibility for filling and unloading was the most important factor in determining location. In the 1970s Noble studied the siting of silos in Ohio and found the most popular location to be at the gable end of a barn. He found detached silos – unconnected to any building – to be uncommon (Noble 1984: 73; Wilson 1911: 66; Louden 1923: 5).

The size or capacity of the silo helped determine the size of the farm's dairy herd. The diameter of a silo was determined largely by the amount of silage one man could unload each day. Silage was removed from the top surface, and taking an even amount was important to minimize silage decay. It became standard to remove a 2″ to 4″ per day – just enough to keep up with the rate of spoilage. The height of the silo helped determine capacity, but, in the days before mechanical unloaders, overall size was limited by the effort to unload the silo (Wilson 1911: 66; Lindor 2004).

Before World War II most silos were 12′ to 14′ in diameter and about 35′ to 40′ tall, which was about the height of a barn roof. A silo 12′ x 38′ or 14′ x 30′ could provide winter feed for about 25 cows in an average situation, but could feed many more sheep, calves, feeder cattle, or draft horses. One 1920 source indicated it was not cost-effective to build a silo for fewer than 10 cows. When mechanical unloaders became popular after World War II, silos grew taller and wider. In the 1960s they averaged about 20′ in diameter and about 60′ high (Beedle 2001: 12, 15; Carter and Foster 1941: 253-254; Moore et al 1920: 532).

BASIC PARTS OF A VERTICAL SILO

The foundation and floor of a vertical silo were placed below grade and were almost always concrete. By about 1910 floor level was standardized at 4′ to 6′ below the level of the barn floor. The foundation, or lower portion of the silo walls, needed to be very strong to withstand the force of the wind and the pressure of the silage. Below-grade walls were commonly 10″ thick. The foundation sometimes extended above grade for extra strength and durability (Beedle 2001: 12).

The upper walls of a vertical silo needed to be sturdy enough to withstand the considerable outward pressure of the contents when full, and were generally 6″-8″ thick. It was important for interior walls to be smooth so that, as the silage settled, it would not stick to the walls and form air pockets that spoiled surrounding silage. The inside walls of wooden silos were usually treated with oil or creosote, and masonry walls were typically coated with cement, all in an effort to help silage settle and keep the corrosive silage from coming in contact with the wood or mortar.

Silo roofs, according to Noble, followed a chronological progression through gabled, conical, hipped conical (some with flared eaves), low dome, and hemispherical forms (Noble 1984: 77). Roofs were first made of wood, and later of metal. About 10 to 15 percent of Minnesota silos had no roofs (Lindor 2004).

Silo door openings were usually vertically aligned up the silo, and integrated with a ladder. The door openings and ladder were often covered by (i.e., contained within) a long vertical chute of wood or metal. The silo chute was usually about 30″ in diameter. The silo door openings, often 20″ x 30″, were covered by door panels made of double-layered wood. As the silage level decreased from the top down, the farmer removed each door panel and successively hooked it into the opening above.

Most silos were filled through a door in the roof with a mechanical silo filler, which was a two- to three-day job. The first silo filler was developed around 1926, and by the mid-1930s they were fairly common in Minnesota. Silo fillers had a powerful fan that forced air and chopped silage up a long tube (Schwantes and Torrance 1937). Some groups of farmers cooperatively owned a silo filler and formed a silo filling "ring". In the years before mechanical fillers were used, silos were often filled with a sling suspended on a boom (Lindor 2004).

Vertical silos were unloaded from the top until the development of the glass-lined silo, which was generally unloaded from the bottom.

Most silos were emptied by hand until after World War II. The farmer ascended the ladder (up inside the chute), climbed into the silo, stood on the silage, and loosened 2"-4" of the material with a pitchfork, chopping it away from the walls if it was frozen. The loose silage was then pitched down the chute. Although engineers began to experiment with silo unloaders immediately after World War II, it wasn't until the late 1950s and early 1960s that automatic unloaders were widely used.

By 1960 there were two principal types of unloaders for vertical silos. The surface or top unloader either rested on top of the silage or was suspended from the roof. As the silage level lowered, so did the unloader. The unloader spit silage out through the silo door and the material dropped down the chute. The second type, called the bottom unloader, was developed first for glass-lined silos. It was generally an auger attached to the inside of the silo near the floor. While silage unloaders could be successfully used when the silage was fresh and loose, frozen silage was troublesome and had to be chipped into smaller pieces for an unloader to have enough power to move it (Lindor 2004).

VERTICAL SILOS: WOODEN, BUILT 1890s-ca. 1950

Wooden silos were used in Minnesota from the 1890s to about 1950. They were often made of cypress, fir, redwood, or white pine (which was less desirable). The wood was frequently treated with a chemical preservative such as creosote. Wooden silos were also coated with boiled linseed oil on the inside, and oiled or painted on the outside. Like all silos, they had to be well-anchored to their foundation. While long-lasting, wooden silos were at times tricky to build and maintain, and were usually lost if a barn burned. Wooden silos took several forms, described below:

1. **Horizontal Wooden Silos**. Some wooden silos were made of boards installed horizontally after being soaked and bent into circular shapes. The wood was often tongue-and-grooved like flooring. The popular King or Wisconsin silo, which originated in Wisconsin in the 1890s, had horizontal boards and double-wall construction. Wooden silos made of horizontal boards were sometimes hard to build and the boards could spring or warp.

2. **Wooden Panel Silos**. An improved version of the horizontal wooden silo was called a wood panel silo. On the outside of the horizontal boards was a set of vertical boards, evenly spaced around the silo, that extended from top to bottom. Around the vertical boards was yet another layer of reinforcement in the form of metal bands or hoops.

3. **Wooden Hoop Silos**. Wooden hoop silos consisted of round wooden hoops – spaced about 3' apart – onto which two complete layers of vertically-aligned tongue-and-groove flooring

were nailed, one inside the hoops and one on the exterior. Occasionally the outside layer was omitted.

4. **Wooden Stave Silos**. Wooden stave silos were built of wood that ran vertically like the staves of a barrel. The wood was commonly 2″ x 6″ tongue-and-groove. The staves were reinforced with bands or hoops, first made of wood and later of iron or steel. The bands were usually closer together toward the bottom of the silo where the pressure was greatest. Turnbuckles on the bands had to be adjusted periodically, and were sometimes troublesome. Sources in both 1920 and 1950 reported the wooden stave silo to be the most common silo in the U.S. (Moore et al 1920; Eckles 1950: 490). Farmers were advised to buy a manufactured stave silo rather than try to fashion their own. Wooden stave silos could be disassembled and rebuilt and were therefore considered somewhat movable.

5. **Wooden Stud and Sheathing Silos**. Often homemade, wooden stud and sheathing silos were low-cost silos built of two layers of horizontal sheathing nailed on the inside of vertically-aligned studs, with acid-proof paper between the layers. Plywood sheathing and dimensional lumber studding were sometimes used. No steel reinforcement was generally required. A variation, the Gurler or plastered silo, was sometimes covered on the outside with asphalt roofing, and then plastered inside. Wire fencing was sometimes placed around the bottom of the silo for more strength. Wood stud and sheathing silos were somewhat common during and immediately after World War II when farm production was up and building materials were limited.

6. **Timber Crib Silos**. A timber crib silo was made of 2″ x 4″ or 2″ x 6″ boards laid in an octagon footprint with overlapping end joints to form a strong structure. A 12′-diameter silo required 7′-long boards. The inside of the silo could be surfaced with tongue-and-groove flooring or cement plaster. The outer surface could be covered with plaster or rolled asphalt roofing. In the 1920s the timber crib silo was recommended as an inexpensive, easily-built silo for Minnesota's northeastern cutover counties where wood was plentiful.

Commercially-made wooden silos were offered to Minnesota farmers by a number of companies. In 1912, for example, the Kretchmer Manufacturing Company of Council Bluffs, Iowa, was advertising the Great Western Fir Stave Silo. In 1914 the Welles-Thompson Company of Minneapolis was making the Arctic Silo, a wooden structure built with "interlocking horizontal staves" of Washington fir. The name "Arctic" probably refers to claims that wooden silos were less likely to freeze than those of stone, brick, or concrete (Welles 1914).

VERTICAL SILOS: STONE, BUILT ca. 1890-1910s

Beginning around 1890, stone silos – both square and round – were being built in Wisconsin. No references to stone silos in Minnesota were encountered during this context study, and they are presumed to be very rare (Beedle 2001: 8).

VERTICAL SILOS: BRICK, BUILT ca. 1895-ca. 1920

Brick silos were built in Minnesota beginning in the mid-1890s, but were not as common as most other types described herein. A proponent of brick silos for Minnesota wrote in 1909, "A brick silo properly constructed is not only the very best silo made, but will last a lifetime without that constant attention that must be given the [wooden] stave silo which at the best will in time rot out" (Henry 1909: 220).

Most brick silos were double-walled with an insulating 2" air space between the layers to help keep silage from freezing. The majority had embedded reinforcing bands, rods, or wire linking the courses. It was important that the inner wall be laid as smoothly as possible so the silage would settle evenly rather than forming air pockets that would cause spoilage. Brick silos were then coated with an interior wash of cement to make the interior smoother, and to keep the acidic silage from deteriorating the mortar. Some brick silos were built with decorative brick patterns near the top.

VERTICAL SILOS: REINFORCED CONCRETE, BUILT ca. 1890s-PRESENT

The phrase "concrete" silo often refers to silos built of monolithic, reinforced concrete. Vogeler writes that Wisconsin had circular concrete silos by the late 1880s, suggesting that Minnesota had concrete silos by the 1890s (Vogeler 1995: 108). These silos were made by pouring concrete into wooden forms (about 3' tall) that were successively moved upward after the mixture cured. Reinforcing rods within the walls could include metal strips, wires, iron hoops from old wooden silos, old steam pipes, and wire fencing (Wilson 1911: 68).

Forms for reinforced concrete silos could be rented from agricultural experiment stations and some farmers' organizations, and were also owned by building contractors. In 1920 a poured concrete silo cost more than a wooden stave silo but less than silos of structural clay tile, concrete block, or brick. Reinforced concrete silos were considered the most durable type by one source in 1920. In general, reinforced concrete silos were less prevalent than concrete stave silos (Moore et al 1920: 527, 532; Lindor 2004).

VERTICAL SILOS: CONCRETE BLOCK, BUILT ca. 1905-ca. 1960s

Silos made of curved concrete blocks, introduced around 1900, were more expensive than reinforced concrete silos and not as strong. Concrete block silos were not as popular as either reinforced concrete or cement stave silos (Beedle 2001: 9).

Some farmers chose to make their own concrete blocks on the farm, which could lower the cost. Typical blocks were 8" x 8" x 16". Strength was added with metal reinforcing rods. When building a silo with concrete blocks, it was important that the blocks be well-laid so that the interior of the silo was smooth. The inside was then plastered or coated with cement to smooth it further and protect the mortar from silage acid.

VERTICAL SILOS: CEMENT STAVE, BUILT 1905-PRESENT

Cement stave silos were one of the most common silo types in Minnesota. Cement staves were masonry units that hooked together with interlocking edges. (They were often called "cement" staves, although "concrete" would be more accurate.) The units were about 30" long, 10" wide, and 2.5" thick.

Cement staves were invented in 1905 by the S. T. Playford Company of Elgin, Illinois. The first cement stave structure was a circular stock tank built in 1905 in Michigan, and silos were built soon thereafter. Some cement stave silos were constructed with mortar between the joints. Most, but not all, had exterior steel bands or rods to stabilize the silo against outward pressure. The inside wall of the silo was sealed with a thin concrete mixture.

Cement stave silos were promoted as being permanent, durable, and resistant to fire. They were cheaper than silos of brick and clay tile, and no special masonry skills were needed. They were more durable than concrete block silos and did not need the forms used in monolithic concrete. The reinforcing hoops or bands tended to deteriorate through time, however. Stave grain bins were similar to stave silos but had more reinforcing hoops because of greater outward pressure (Kaiser 1919: 8-10).

There were more than one dozen major manufacturers of staves in the Midwest in 1919. Construction companies often held exclusive cement stave silo dearlerships. Among Minnesota's many cement stave companies were the Minnesota Silo Company of Willmar, the Minnesota Cement Construction Company of Fergus Falls, Norling Brothers Silo Company of Svea, and the Minnesota Keystone Silo Company, location unknown. Several Minnesota companies were long-lived and some are still in operation including the Hanson Companies of Lake Lillian, established in 1916 (Kaiser 1919: 41). One 1980 source indicated that cement stave silo manufacturers could be identified by unique decorative designs (e.g., checkerboard patterns) made with staves near the silo top (*Minnesota Farmscape* 1980). This context study was not able to corroborate that information.

VERTICAL SILOS: STRUCTURAL CLAY TILE, BUILT 1908-ca. 1960

The first round silo of structural clay tile was built in 1908 at Iowa State College in Ames. In 1950 Eckles wrote that the tile silo "has become popular in recent years" (Eckles 1950: 491). Clay silo tiles were generally about 12" x 8" x 4". The silos' 8"-thick walls were reinforced with twisted wire or rods placed in the mortar at predetermined intervals, often connected to the door frame. Experts cautioned that the tiles should be laid evenly so the silo had a smooth interior surface. It was recommended that the inside then be plastered to create walls that were smoother and more watertight (Structural Clay 1941: 9).

Clay tile was also molded into interlocking staves and used to build stave silos. One 1940 source indicates that clay stave tiles were relatively new and were advantageous because they needed no mortar (Fox 1940: 53). Such silos were not widely built and are apparently rare (Beedle 2001: 10).

Many companies sold clay tile silos to Minnesota farmers. They included the Minnesota Farmers' Brick and Tile Company of Austin, the Zumbrota Clay Manufacturing Company of Zumbrota, the A. C. Ochs Brick and Tile Company of Springfield, and the Mason City Brick and Tile Company of Mason City, Iowa.

VERTICAL SILOS: GALVANIZED METAL, BUILT ca. 1910-ca. 1960s

Galvanized metal silos became available in the early 20th century and were made of riveted or bolted sheets of metal. The metal was sometimes corrugated. Exterior bands or hoops often provided additional support. Like wooden silos, steel silos needed to be firmly anchored to their poured concrete foundations. A 1940 source indicates this type of silo was numerous in some areas of the Midwest (Fox 1940: 53). During World War II, an "experimental site-welded silo," and a steel dairy barn and milk house, were built in Madison by the University of Wisconsin in cooperation with Carnegie-Illinois Steel Corporation (Witzel 1945: 415).

Most metal silos were made by commercial companies such as the Butler Manufacturing Company of Kansas City and Minneapolis, which in 1914 was advertising the Butler Special Metal Silo. Another company, the Kretchmer Manufacturing Company of Council Bluffs, Iowa, made a galvanized silo with a cypress lining that was being advertised in 1912.

VERTICAL SILOS: GLASS-LINED METAL, BUILT 1947-PRESENT

The glass-lined silo was introduced in 1947 in Wisconsin. These silos had an enameled steel exterior to which a glass liner was fused. Brands included the dark blue Harvestore, the light blue Sealstore, and the dark green Cropstore.

Also called oxygen-limiting silos, glass-lined silos were airtight and therefore preserved silage and "haylage" (silage made from hay that could be stored without drying) with less spoiling. Most glass-lined silos were taller than earlier silos and were unloaded at the bottom, rather than from the top. They were considerably more expensive then conventional silos. Glass-lined silos resisted corrosion from silage acids and supposedly did not freeze, although early Harvestores often froze in practice (Lindor 2004).

According to Noble, the first glass-lined silo, the Harvestore, first received notice in 1948 "when it was exhibited at the centennial Wisconsin State Fair, although manufacture of units was subsequently delayed by steel shortages in 1949 and 1950. After 1950, the conspicuous Harvestore silo with its brilliant metallic blue color . . . has increasingly come to be the mark of a commercially successful farmer. During the 1960s, the cost of a Harvestore silo was more than twice that of a concrete-stave silo, so that normally only the most efficient farmers operating on the largest scale could afford the investment" (Noble 1984: 78-79. For a farmer's-eye view of the Harvestore, see Hoffbeck's *The Haymakers* (2000)).

Vogeler indicated in 1995 that Harvestore silos were most common in the states of Wisconsin, Minnesota, and the southern half of Michigan (Vogeler 1995: 109). In Minnesota more Harvestore-type silos were built in central and southern Minnesota where the largest and most successful dairy and livestock farms were concentrated.

VERTICAL SILOS: ASBESTOS, BUILT ca. 1945-ca. 1960

Some silos of asbestos were made during World War II (Beedle 2001: 15). It is presumed they are rare in Minnesota.

VERTICAL SILOS: FENCING, BUILT ca. 1930-ca. 1960s

"Fencing", "pen", or "paper bag" silos were built of fencing lined with sisal or craft paper. Several types of fencing were commonly used including "crib" fencing (also called "snow" fencing), picket fencing, and woven-wire fencing. These silos were generally temporary. They were used to supplement an existing silo, take care of a crop that was damaged or failed to ripen, or fill an emergency need. The silos were usually 8' to 15' tall and made of two to six overlapping layers of fencing. If the height exceeded the diameter, the silo needed to be reinforced with vertical poles. While termed temporary, they could last for several years with some repair.

HORIZONTAL SILOS: PIT, BUILT ca. 1870s-ca. 1960s

Pit silos were the first type of silos developed; they date in the U.S. from the 1870s. Pit silos were also used in the 20th century when a farmer needed a silo quickly, or when building resources were scarce.

A common pit silo from the 1920s used a 10'-deep cylindrical pit. The pit was dug in stages with the walls of the first stage given two to five coats of plaster before the silo was deepened. The structure was often reinforced with a circular poured concrete collar that extended from below the frost line to a point 1' above the ground. If the herd was small, the silage was usually removed with a pulley, rope, and basket. If the herd was large, a windlass and wooden box was used (Moore et al 1920: 530-532; Carter and Foster 1941: 265).

Pit silos were relatively cheap to build and kept the silage unfrozen. However, pit silos were hard to keep waterproof unless built in very well-drained soil or in a location where the water table was low.

HORIZONTAL SILOS: TRENCH, BUILT ca. 1880s-PRESENT

Like pit silos, trench silos were developed early in the silo's evolution and then called upon again in times of financial hardship, war, or emergency because they could be built quickly and were inexpensive. In the 1920s, for example, farmers in northwestern Minnesota built trench silos to salvage what was left of their crops after the region was hit by early frost. Built at agricultural experiment stations during many decades, trench silos were also promoted in the 1950s during times of high crop production (Lindor 2004). They could be built without special skills and didn't need a blower to fill. However the walls of trench silos tended to collapse if not well-planned, the spoilage rate was high, and the silos were hard to keep waterproof. Some trench silos were used for haylage.

A 10'- or 12'-wide oblong trench silo might be 8' deep. Some were unlined, but more permanent trench silos were lined with stone, brick, poured concrete, wood, or several layers of plaster. The trench was then filled with fodder and topped with straw, chaff, and dirt. Some had a wooden gabled roof. Silage usually had to be removed from a trench silo more rapidly than from a vertical silo since it spoiled at a faster rate. Sometimes the trench was built near a cattle feeding yard.

Modern trench silos are sometimes lined with treated wood. They are usually found on farms that feed cattle and where the silage is used fairly quickly.

HORIZONTAL SILOS: BUNKER, BUILT ca. 1955-PRESENT

Bunker silos were like trench silos, but were generally built above-grade. They were made with three low walls, usually of reinforced concrete, and were filled and emptied with a tractor-loader. In 1955 the Minnesota Agricultural Experiment Station tested the technology by building two experimental bunker silos at the North Central Experiment Station in Grand Rapids. Each silo was 16' x 62' with a capacity of 120 tons. The more successful of the two designs was built with cantilevered poles set into a concrete floor to support the timber plank walls. The other design, with poles held up by exterior angled braces, collapsed during the second season. The silage was covered with sawdust during the first two seasons and, in 1957, plastic film (Briggs et al 1958). In the late 1950s bunker silos were one-half to three-quarters the price of a conventional vertical silo. They were easy to build but the silage in them spoiled quickly. Like trench silos and silage bags, bunker silos were often built near the cattle yard to save labor. They were used for dairy and beef herds, and sometimes arranged for self-feeding. Some bunker and trench silos were used for haylage rather than traditional silage.

Bunker silos are still widely built in Minnesota and are often covered with sheets of black plastic held down with worn tractor tires.

HORIZONTAL SILOS: SILAGE BAGS, BUILT ca. 1950s-PRESENT

Silage bags are long, narrow, airtight plastic bags in which fodder ensiles. *Agricultural Engineering* reported in 1956 that research was being conducted using tubular 50- to 70-ton plastic bags, and that the experiments were largely successful. The journal indicated that plastic bags were also being used inside the top of vertical silos to reduce spoilage (Staff 1956: 742).

Today silage bags are common in Minnesota. They are relatively inexpensive and can be placed near the feeding cattle, although they can be torn if not handled carefully. The bags are filled with a silage blower and unloaded with a tractor-loader.

PREVALENCE

It is believed that cement stave silos were the most common type of silo built in Minnesota and that more cement stave silos survive than any other type. Wooden, square, stone, and structural clay tile stave silos are rare in the state. Those built of structural clay tile, brick, metal, pre-1945 concrete block, and pre-1945 poured concrete are believed to be uncommon. The remnants of pit and trench silos may be encountered, especially examples in cutover counties and examples built after World War II. Silos built before 1900 should be considered to be in the forefront of the movement in the state.

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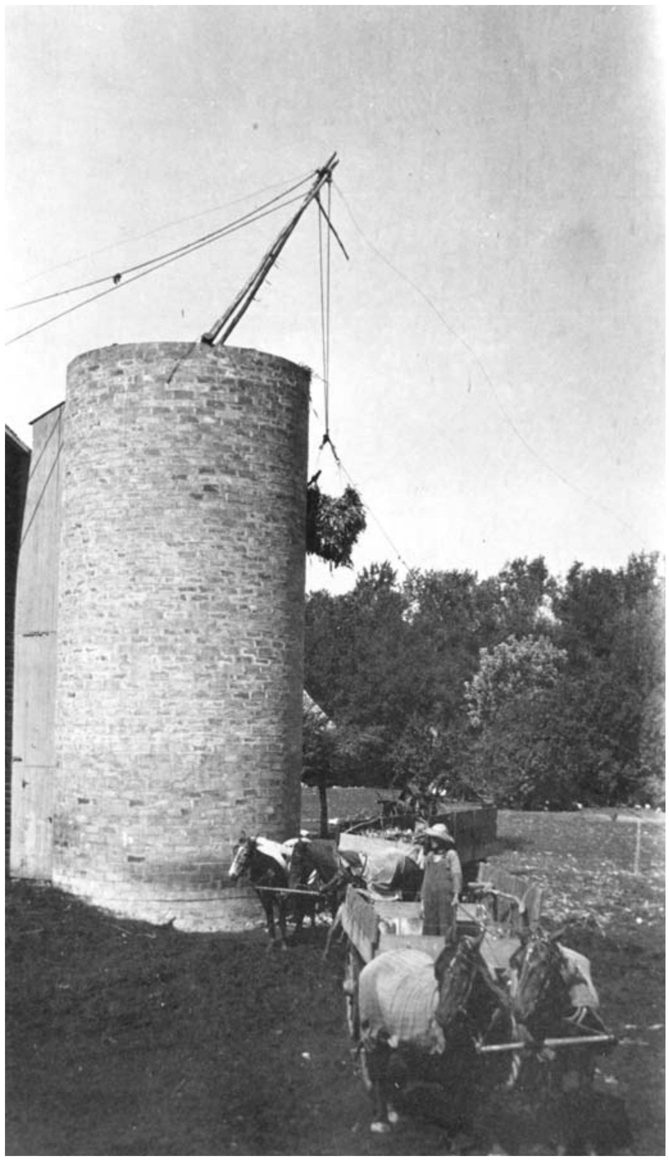


Silos were becoming common in Minnesota around 1910, and by 1927 the state had one silo for every five farms. The farmers in this photo are filling a silo with a sling system. Ronning Farm, Lac qui Parle County, circa 1915. (MHS photo)

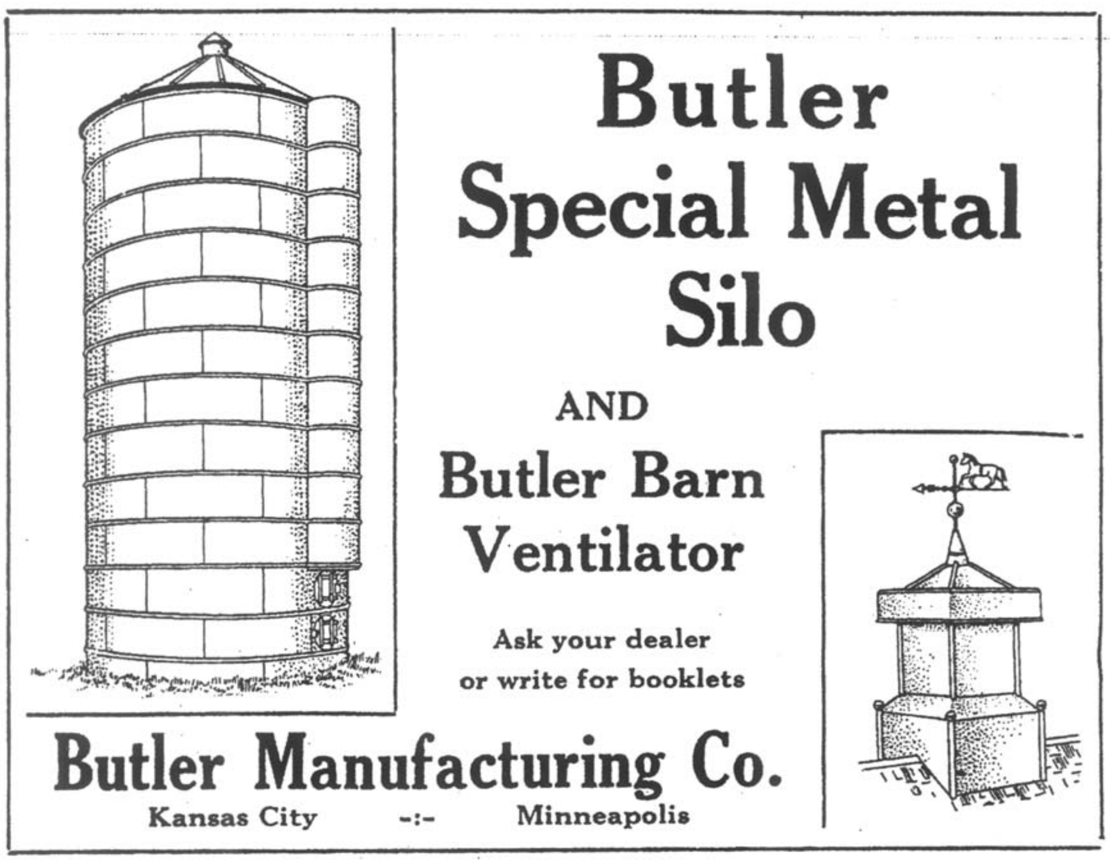
Some horizontal wooden silos were reinforced with vertical boards and then a set of iron bands. This silo, which had both vertical boards and bands, was under construction. Blackinere Farm near Albert Lea, circa 1910. (MHS photo by Harry Darius Ayer)

Vertical stave silos, first built in the 1890s, were easier to construct than those of horizontal wood and became more popular. The tongue-and-groove staves were reinforced with iron bands whose turnbuckles were periodically tightened. Note the belt-operated silo filler and the lightning rod on the silo roof. Location unknown, circa 1910. (MHS photo by Harry Darius Ayer)

Brick silos were first built around the turn of the century. They were expensive to construct and, like all silos built of masonry units, had to be lined with a coating of concrete to protect the mortar from the corrosive silage. Henry Farm, location unknown, circa 1910. (MHS photo by Harry Darius Ayer)

Reinforced concrete silos were built in layers by moving the forms successively upward. Like most silos, this one was attached to the barn. Location unknown, circa 1910. (MHS photo by Harry Darius Ayer)

Cement stave silos were introduced in 1905. The staves were assembled either dry or with mortar. The silo interior was usually plastered with a thin layer of concrete to make it waterproof. Most cement stave silos had reinforcing hoops, which could be either flat bands or round rods. In the mid-20th century, cement stave silos were probably the most common type of silo being built in Minnesota. Elfstrom Farm, Traverse County, 1983. (MHS photo)



Galvanized steel silos were built by companies like Butler Manufacturing, which still makes steel buildings today. Some metal silos were lined with cypress. Until about 1950, silos were unloaded by the farmer who climbed up the ladder (often inside a chute) and into the silo. The farmer pitched a 2"-4" layer of silage down the chute. It fell into a cart and was hauled to the cows. Advertisement from a 1914 issue of the *Minnesota Farmers' Institutes Annual*.

▪ SMOKEHOUSES

- Small buildings used to preserve meat, particularly before refrigeration
- Often doubled as storage sheds when not used for smoking
- Built on many Minnesota farms beginning in the mid- to late-19th century

Smoking meat, like canning meat, was an important method of preserving food on Minnesota farms before refrigerators and freezers became widespread. Smoking also imparted extra flavor (which occurred when the meat became exposed to the creosote from the fire). According to geographer Allen Noble, many farms smoked in the late fall and early winter when the butchering was done. Animals were commonly butchered in the fall when seasonal grasses went dormant, in part to reduce the number of animals that needed to fed over the winter (Noble 1984: 89).

Brinkman and Morgan encountered smokehouses made of logs, milled lumber, and chamfered concrete blocks in their early 1980s study of farm architecture in central Minnesota. Many of the German Catholic families that settled in central Minnesota butchered all of their own meat in the years before 1960, and smoked much of it. Butchering six hogs and a cow at one time was not uncommon, and neighbors sometimes gathered to collectively butcher and smoke (Brinkman and Morgan 1982).

Scholar LaVern J. Rippley wrote in 1981 that the smokehouse was an outbuilding that "almost universally stood on the German farmstead in Minnesota" (Rippley 1981: 61). In the same anthology, anthropologist Gary W. Stanton wrote that smokehouses were ubiquitous on farms in particular regions of the U.S., and that they were likely associated with a variety of cultural groups including Germans (Stanton 1981: 77).

Smokehouses were built in Minnesota beginning in the mid- to late-19th century. By 1910 many types were in use "ranging from simple contrivances, that are more or less on the makeshift order, to well-built permanent smoke-houses" (Paterson 1914: 191-192).

Despite this variation in types, four factors were common to a well-functioning smokehouse: it needed to be fireproof, have a good ventilation system so the temperature could be controlled, hold the meat high enough so that it would be smoked rather than cooked, and be insect free.

The smokehouse was usually built in a location convenient enough to allow it to be constantly monitored while in use, but far enough away from other structures to pose no fire risk.

A small quantity of meat could be smoked in a wooden box or barrel. A 6' x 6' smokehouse was typical for an average size farm. A height of 10' to 12' kept the meat high enough above the fire so that it wouldn't overcook. If the smokehouse was also used as a storage shed or tool house, its footprint was often bigger (Paterson 1914).

See also
Farmyards

Smokehouses were generally windowless and had only one door so that they were as airtight as possible. If the door was wood, it could be lined on the inside with a sheet of metal to prevent fires. While the floor could be of dirt, more substantial smokehouses had concrete floors.

While fireproof materials such as brick, stone, concrete block, and hollow tile were recommended, many farmers built smokehouses of logs or dimensional lumber with the fire pit located in the center of the floor well away from the walls.

Farm experts, on the other hand, recommended that, if a wood structure was used, the fire pit not be located within it, but in a separate unit outside of the main structure. A stove pipe or vent was used to draw the smoke from the firebox into the smokehouse. It is not known how many farmers used this more complex design (National Plan Service ca. 1950).

A smokehouse roof could be either flat or gabled, but accommodated a vent system to draw the smoke "freely over the meat and out of the house" (Moore et al 1920: 1167). Some smokehouses had vents on the roof and in the eaves.

Some interior fireboxes were made of poured cement. The Midwest Plan Service indicated in 1937 that some fire pits in smokehouses were also used for "making soap, rending lard, or heating water for butchering" (Midwest Farm 1937).

PREVALENCE

Smokehouses were widely built throughout Minnesota, but their use declined with the proliferation of on-farm refrigerators and freezers. It is anticipated that some smokehouses may be standing, and a few may still be used for their original purpose.

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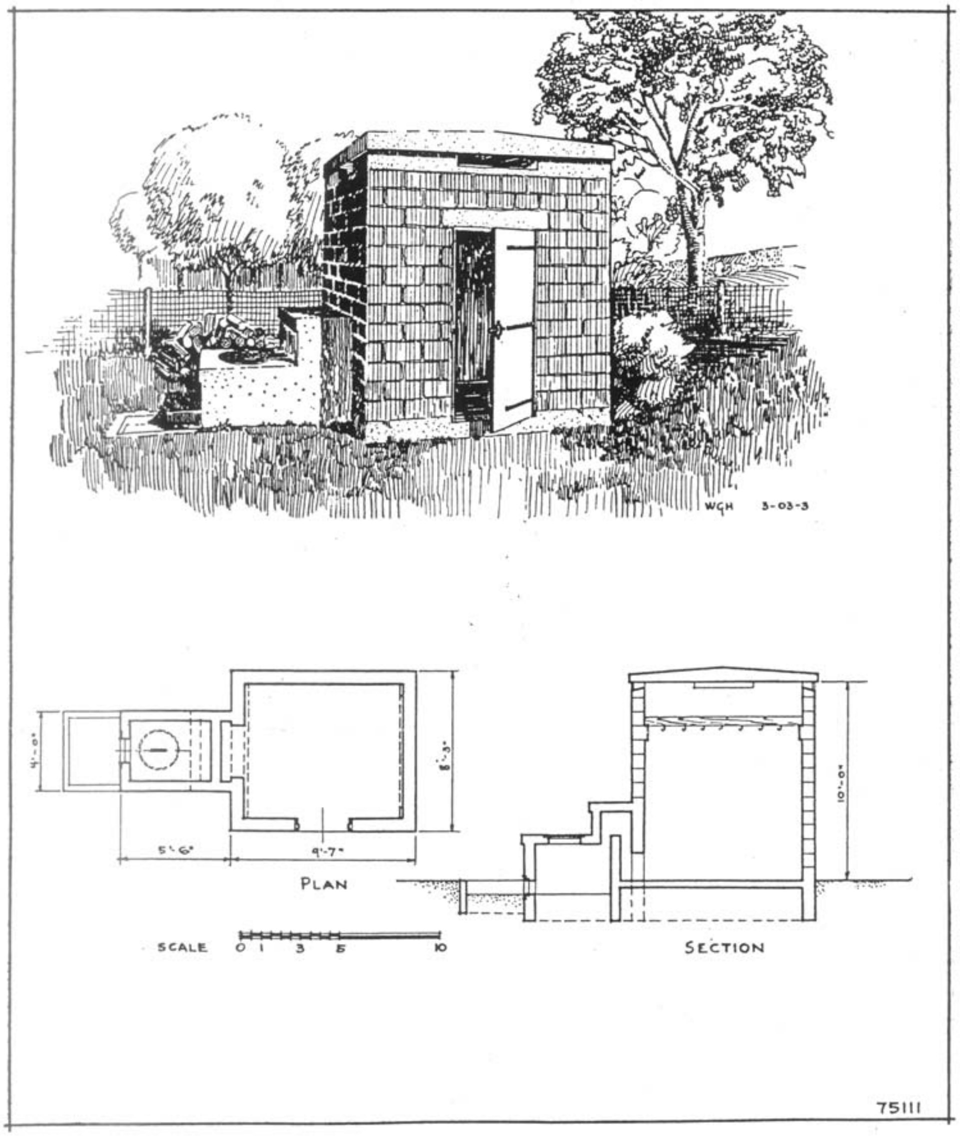

Designed by agricultural engineers for a plan catalog published in 1937, this smokehouse could be built of hollow tile or concrete block. Its floor, roof, and firebox were poured concrete. The 10'-tall smoke room measured about 8' x 9', while the firebox extension was about 4' x 5'6". From Midwest Farm Building Plan Service catalog of plans (1937).

■ SPRINGHOUSES AND SPRINGBOXES

- Located on farms with natural springs, generally in hilly areas
- Used to both protect the quality of drinking water and to cool products like milk and eggs
- Used for passive gravity separation of milk before centrifugal separators
- Superseded by milk houses and mechanical refrigerators

Minnesota farm families have used natural springs for both drinking water and cooling since the early settlement era. Springhouses were built to keep animals, plants, and surface run-off away from springs, and to provide a cool place to store food, particularly dairy products and eggs that needed to be cooled and stored. Before mechanical cream separators came into widespread use in the 1890s, springhouses were used to passively separate milk and cream. The whole milk was poured into a bowl, which was placed in cold, shallow springhouse water, and the cream separated from the milk as it cooled. Some springhouses also served as washhouses where dairy equipment and other items were washed (Scharf 2004).

Merill E. Jarchow wrote about Minnesota's pre-1885 farms, "Preserving foods was not easy. . . . Smoking and salting generally insured meat against spoiling, but milk and butter were not so easily kept fresh. . . . Springhouses or cellars were almost necessities on the farm, and it was a good idea for the farmer to spend part of the winter putting up ice for the next summer" (Jarchow 1949: 87).

Jaakkola and Frericks quote Minnesota food historian Marjorie Kreidberg, who explained:

> To early Minnesota settlers lucky enough to have a spring-fed pond or stream on their property, the springhouse was indispensable. The water provided a measure of cooling that was increased by the protective insulation of the structure's walls. Within the springhouse cans of milk, jars of cream, tubs of butter, and possibly some cheese could be kept for short periods of time even in warm weather (quoted in Jaakkola and Frericks 1996: 28).

Springhouses were built beginning in the early settlement era. They were usually small rectangular or square structures with gabled or hipped roofs. They were built of logs, milled lumber, stone, brick, concrete blocks, and poured concrete. The lowest part of the building was often built of masonry for durability.

Springhouses were generally located at the base of a slope where the natural spring emerged from the ground. They were often dug into the hillside. Springhouses were sometimes fenced to keep livestock away, and shallow trenches were sometimes dug above the springhouse to divert contaminated surface water away from the spring (Brooks and Jacon 1994: 70).

Inside, springhouses often had a trough in which the water collected. Butter, cream, and eggs were stored in crocks that were placed in the cold flowing water. Both dairy products and eggs had to

See also

Milk Houses
Root Cellars
Icehouses

be quickly cooled and stored in cold conditions. Properly stored, products like butter, eggs, and cheese could be kept for many weeks.

As dairying advanced, many farmers built milk houses in which milk and separated cream was cooled in metal cans standing in water-filled cooling tanks. (See "Milk Houses," another individual farm elements section.) Springhouses were also superseded by mechanical refrigeration, usually made possible by the electrification of farms.

The springbox – a variation on the springhouse – was a primarily underground structure for collecting and protecting spring water. They were usually made of brick or concrete, and were at least 4' deep and 3' wide, and extended at least 1' above the ground (Brooks and Jacon 1994: 70).

PREVALENCE

In Minnesota, springhouses and springboxes were built primarily in hilly areas where natural springs were found. Some are likely to be extant, with the earliest examples being the most rare.

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This fieldstone springhouse was standing in Mille Lacs County in the early 1980s. It was built into the side of a slope, which was typical. From Brinkman and Morgan's *Light from the Hearth: Central Minnesota Pioneers and Early Architecture* (1982).

■ STOCK TANKS

- stock tanks held water for livestock to drink
- tanks of sheet steel were manufactured by at least 1901
- wood, poured concrete, and cement staves were also used

Stock tanks, also called watering troughs, were circular, oval, or rectangular tanks that held drinking water for livestock. They could be located near a barn or stockyard, or in a more remote pasture, as long as a source of water was available. Supplying water to valuable livestock was important to keeping them healthy and productive. Dairy cows, for example, gave more milk if they were given sufficient water. Some farmers filled their stock tanks with rainwater captured in a cistern.

Many of the earliest tanks dating from the mid-19th century consisted of, and were modeled after, wooden barrels cut in half. More durable tanks were usually made of reinforced concrete or galvanized metal and were perhaps 4′ wide and 8′ to 12′ long. Steel stock tanks were available by at least 1901, the year Butler Manufacturing Company was founded and began producing them. Concrete tanks sometimes had an apron of pavement extending around the base. Tank walls were low to allow livestock to freely drink. The inside walls were often sloped to allow ice to rise as the water froze. Round stock tanks were sometimes made with commercial silo forms. Most tanks were fed from the farm water system via metal pipes (*Farm Building Plans* 1953).

A University of Minnesota Experiment Station bulletin explained in 1934: "The water supply is always a problem on any livestock farm. . . . A large supply tank . . . should be located on ground high enough so that water can be piped from it to automatic waterers regulated by float valves. These waterers, carrying a small supply of water, will be refilled as the water is consumed. They may be kept from freezing by kerosene lamps. The drinking tank is best located out-of-doors but in a place protected from the wind. The supply tank may be filled as needed by a windmill, gasoline engine, or electric-powered pump" (Crickman et al. 1934: 56-58).

PREVALENCE

Pre-1960 stock tanks may still be fairly common on Minnesota farms, particularly if they were built of poured concrete.

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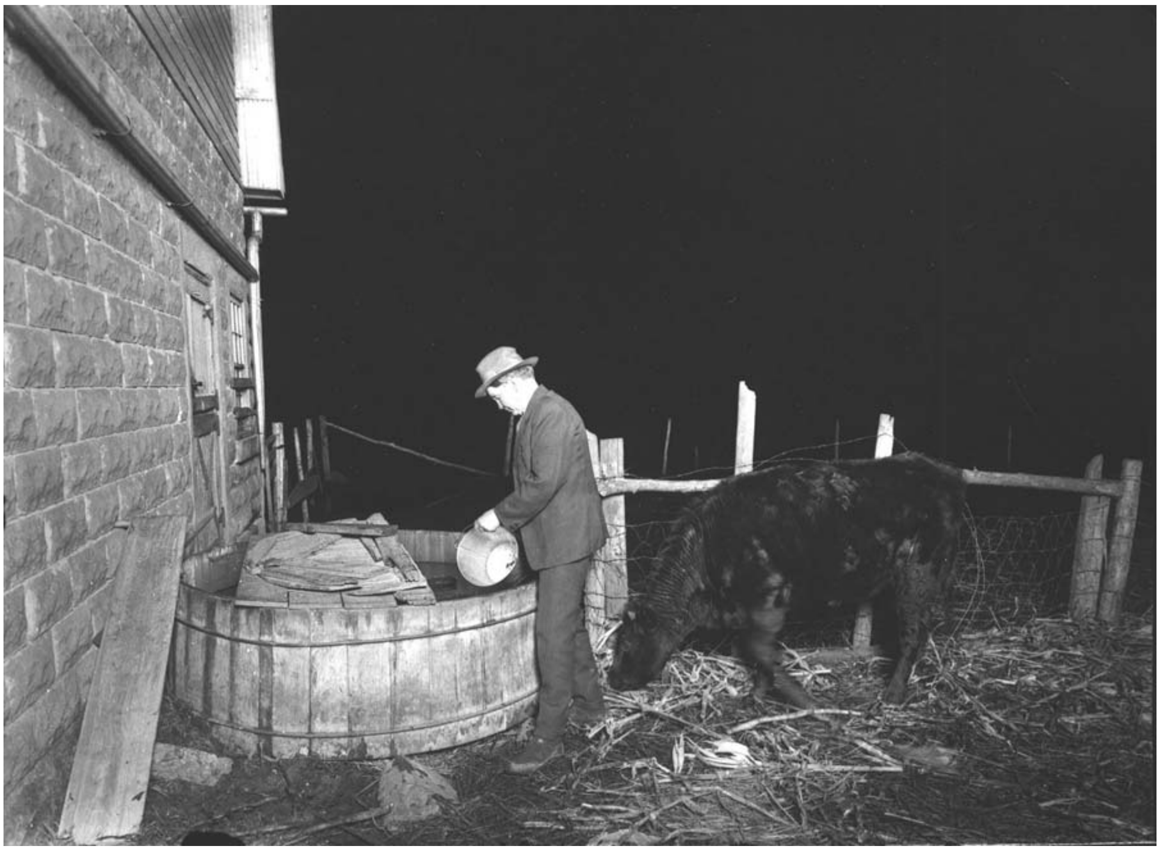
See also

Stockyards
Fields and Pastures



The earliest stock tanks were wooden. This tank stood on a farm near Lake Lillian, Kandiyohi County. Circa 1920. (MHS photo)

Most stock tanks were made of poured concrete like this one, or of galvanized metal. Location unknown, 1911. (MHS photo by Harry Darius Ayer)

This concrete stock tank stands in permanent pasture, away from the farmstead. Nearby are a well and a wooden chute for restraining stock. Pope County, 2004. (Gemini Research photo)

■ STOCKYARDS

- Fenced enclosures for livestock, usually near the barn(s)
- Often located south or east of barns for shelter from northwesterly winds
- Usually unpaved; hog yards and feeding areas for other stock eventually paved for cleaning

Stockyards – also called cattle yards, barnyards, feedlots, pens, or paddocks – were sturdy, fenced livestock enclosures, usually located adjacent to the barns. Built since the early settlement period, they were often enclosed with wooden fences. Stockyards were usually located fairly close to the house and principal barn so farmers could keep an eye on the livestock. They were often placed south or east of the barns for maximum sun, warmth, and protection from winter winds.

Stockyards usually contained feeding structures like troughs, racks, and bunks; stock tanks for water; manure piles or pits; hog wallows and sheep dips; and livestock chutes.

Grass was maintained in some stockyards, while others were grazed and trampled so that little vegetation grew. By the 1940s many yards, especially for hogs and dairy cows, were paved with concrete to facilitate cleaning. The University of Wisconsin tested gravel for a dairy yard in the early 1940s but found it to be too impermanent. University of Minnesota staff were discussing "blacktop" or bituminous paving for yards in the mid-1950s (Witzel and Derber 1952: 638; Neubauer and Walker 1961: 66).

Separate stockyards were usually created for pigs, cattle and horses, and poultry. It was desirable for cattle yards to adjoin the main fields, and for hog yards to adjoin smaller fields, so the animals could be easily turned out to eat crop residue. Stockyards on farms that specialized in livestock were usually larger than those on diversified farms.

Farmers often divided stockyards – either temporarily or permanently – into smaller pens to facilitate sorting the animals by age or sex, rounding them up for veterinary treatment, or loading them for shipment. Pens for cattle, which get nervous when confined, needed to be very sturdy, and it was not uncommon for farmers to have to repair their bull pen weekly. Pens were often made of strong boards nailed to massive posts or old railroad ties (Hart 1998: 181; Kable 1936: 471).

In 1960 some U.S. dairy farmers were experimenting with a circular configuration in which pie-shaped, fenced yards radiated from central milking and storage facilities (Cleaver 1960).

PREVALENCE

Stockyards were built on virtually all Minnesota farms that cared for livestock. Many were fairly small and located adjacent to barns. It is expected that many stockyards were dismantled after

See also

Fences
Stock Tanks
Beef Barns
Sheep Barns
Appendix: Focus on Minn Livestock

1960 as Minnesota farms phased out of livestock. Fences were removed and yards converted to grass or gravel surfacing. Farmsteads with intact sets of fenced stockyards may be somewhat rare.

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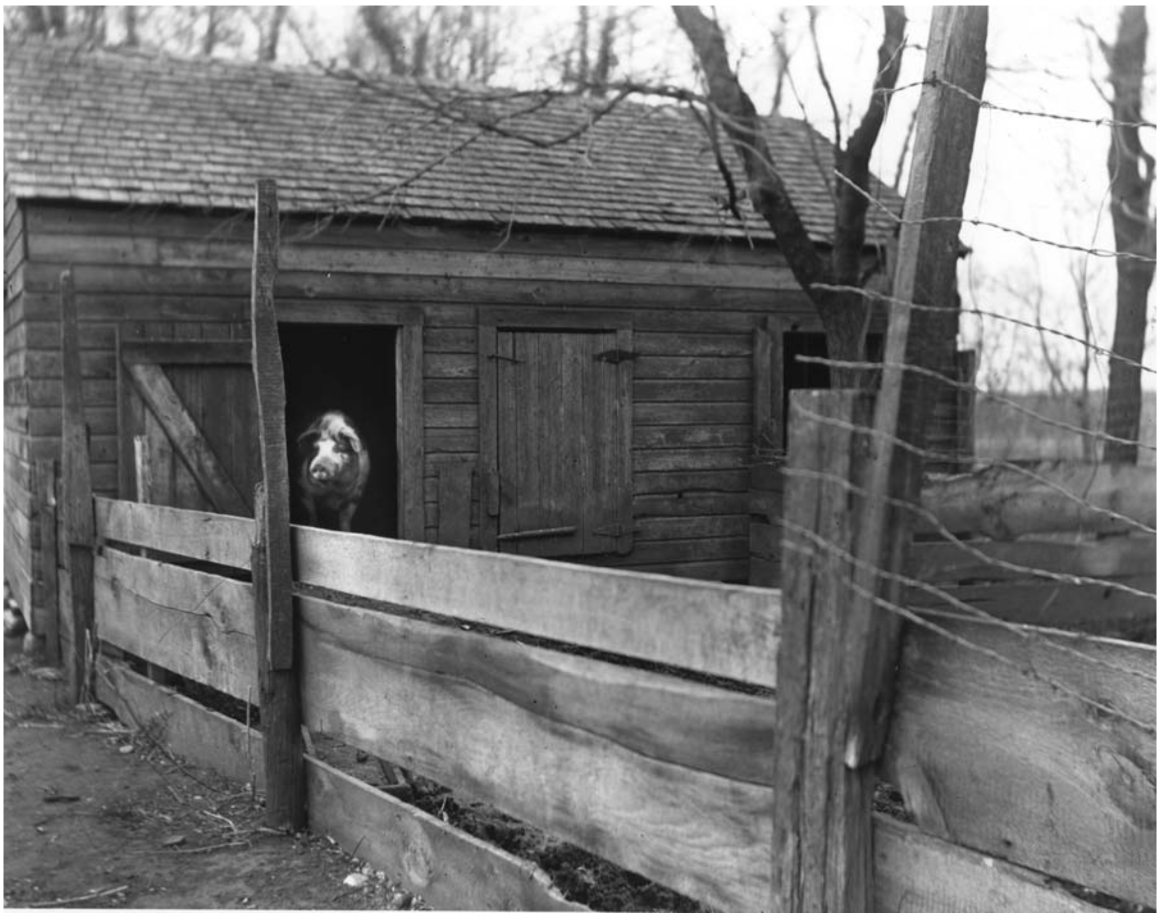
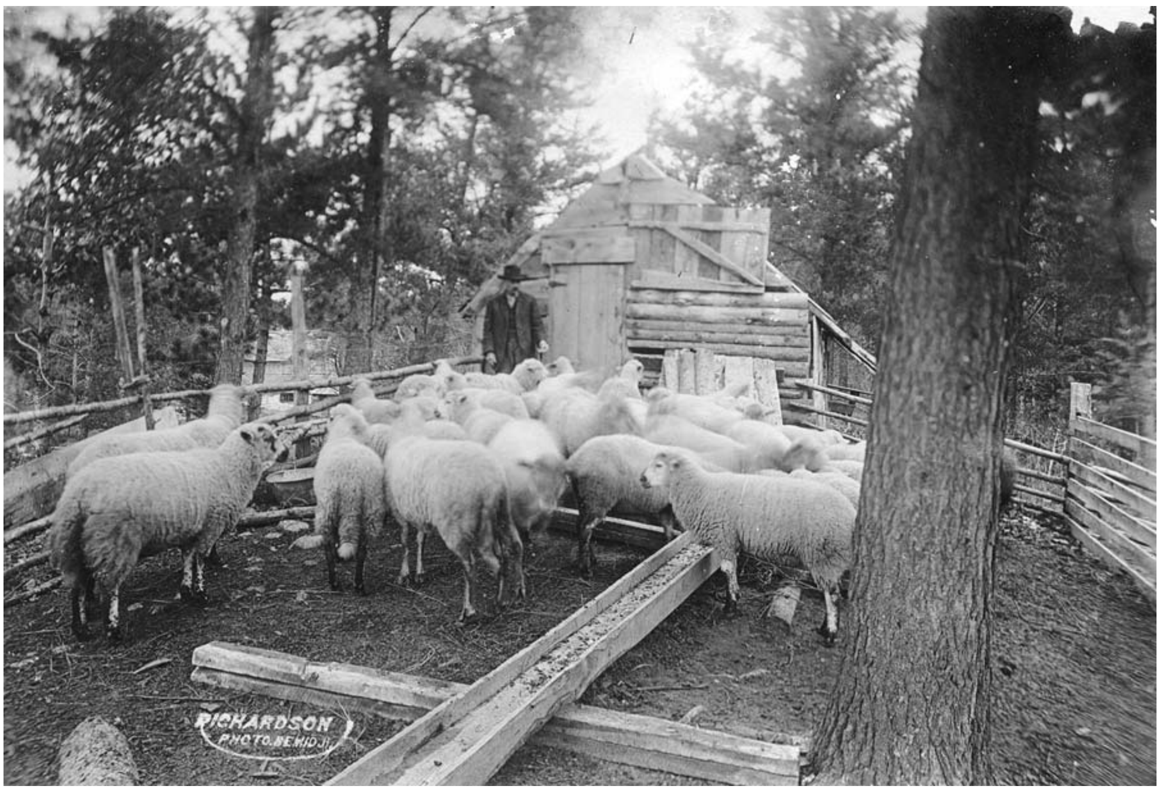
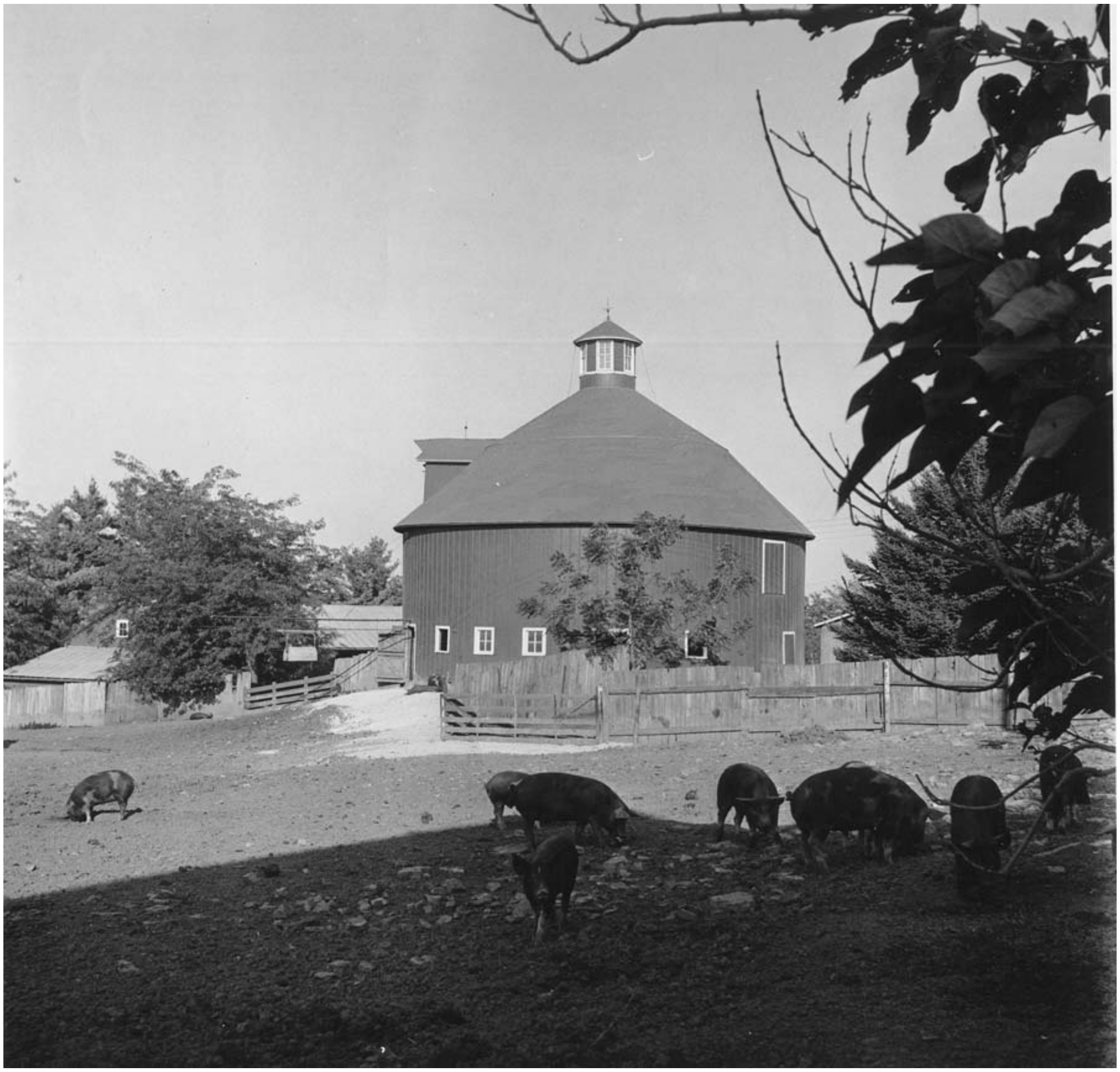


Stockyard adjacent to a hog barn. Location unknown, circa 1915. (MHS photo by Louis Enstrom)

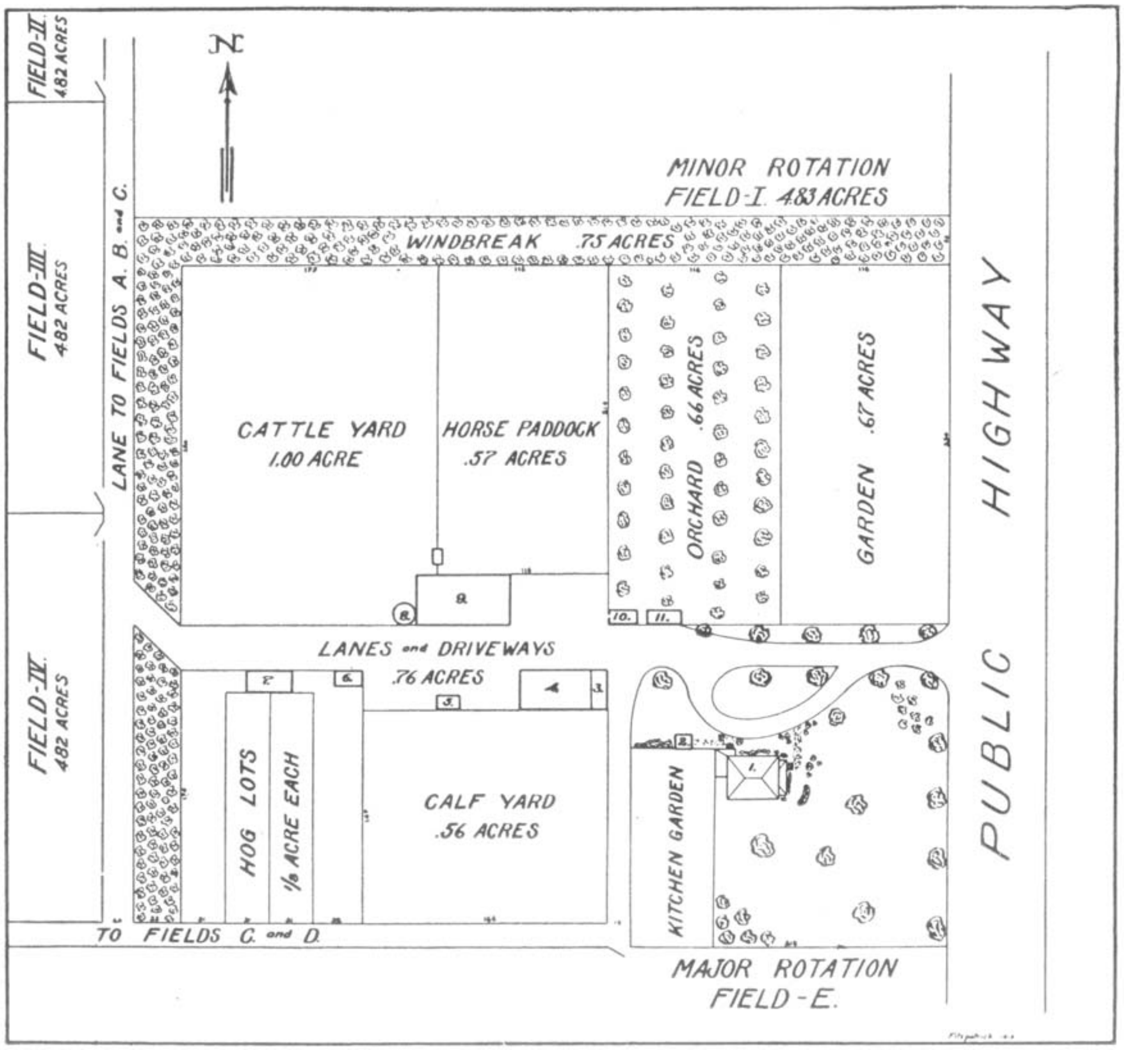
Sows and their litters in a yard in Washington County, photographed in 1913. (MHS photo by Runk)



A small yard for sheep. Cutover farms raised an average of 24 ewes per farm in 1939. Hubbard County, circa 1915. (MHS photo)



A large stockyard with its necessary sturdy wood fence. Meyer Farm, near Potsdam, Olmsted County, 1959. (MHS photo by Eugene Debs Becker)



The 1914 book *Farm Management* by Minnesotan Andrew Boss illustrated a typical diversified farm with separate yards for cattle, horses, calves, and hogs. Each yard was located adjacent to the appropriate barn (Boss 1914).

A hog farm with extensive stockyards and nearby fenced fields. Location unknown, circa 1910. (MHS photo by Harry Darius Ayer)

▪ SUGARHOUSES

- Processing maple sap into syrup and sugar was traditional among Native Americans and adopted by Euro-American farmers
- Sap was processed in the sugarhouse, usually built in a "sugarbush" or grove of sugar maple trees

Native Americans were processing maple sap into syrup and sugar long before the first European explorers arrived, making those two products "among the oldest agricultural commodities" in the nation (Vogue 1994). For Euro-Americans who adopted the practice, maple syrup and sugar were "strictly a sideline farm crop" although occasionally the production expanded into a commercial operation (Vogue 1994). Most sugarhouses in Minnesota probably predate 1940.

Minnesotans, particularly in central and northern counties, usually tapped maple trees in February and March. Geographer Allen Noble explained that the "traditional production" of maple syrup and sugar involved "boring holes into the maple trees, placing a tube called a spile in the hole, and allowing sap to drip into covered pails or buckets hung from the spile" (Noble 1984: 99). The sap was collected and brought to the sugarhouse, which was usually standing in the grove of sugar maple trees.

Sugarhouses were often built in a "sugarbush," or grove of sugar maple trees, some distance from other farm buildings. Sugarhouses varied from one-room buildings measuring about 10′ x 18′ to larger two-room houses that might be 16′ x 36′ in size. The single-room structures housed "the firebox, also called the arch, a chimney pipe, the long shallow metal evaporator pan, and various jugs, bottles, and other miscellaneous equipment." Larger houses separated the "syrup boiling and sugar making operations" (Noble 1984: 99).

Within the well-ventilated house, the sap was boiled in large kettles over open fires. The wood was stacked inside the sugarhouse, outside in a neat pile, "or in an open-sided lean-to addition to one of the gables" of the house (Noble 1984: 99). Open fires were eventually replaced by shallow-pan evaporators. It took about 43 gallons of the watery sap to produce one gallon of syrup (Vogue 1994).

In 1941-1950, maple sugar harvesters in 11 states produced about 166 tons of sugar and 1.977 million gallons of maple syrup each year (Roberts et al 1956: 198).

Small maple syrup producers still collect the sap in buckets or plastic bags and carry it to the sugarhouse. Some larger operations skip the buckets and use tubing to carry the sap all the way to the sugarhouse, which is ideally located "at the foot of a bank or small slope" (Noble 1984: 99).

See also
Developing the Cutover, 1900-1940

PREVALENCE

Sugarhouses were often built in central and northern Minnesota where native sugar maple trees grow. It is not known how many pre-1960 sugarhouses are still standing. Some may have been converted to other uses such as storage.

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It took about 43 gallons of maple sap to produce one gallon of syrup. This sugarhouse was photographed circa 1905 near Long Lake in Hennepin County. (MHS photo by Sweet)

▪ SUMMER KITCHENS

- Usually located near the rear of the farmhouse and close to the pump and garden
- Often a small, free-standing, gable-roofed structure
- Often converted to other uses when farms were electrified

Used in Minnesota since the last quarter of the 19th century, summer kitchens were auxiliary cooking structures that were usually detached buildings. For convenience, they were usually located a few feet behind the farmhouse and close to a source of water and the vegetable garden. While they were often detached for fire safety, summer kitchens were sometimes connected to the main house via an enclosed passage. Sometimes summer kitchens were shed-roofed additions built onto the farmhouse (Peterson 1992: 99, 160; Noble 1984: 97).

According to geographers Noble and Cleek, who surveyed farm structures nationwide, "Detached summer kitchens are associated with settlements of Pennsylvania Germans, Hungarians, French-Canadians, Belgians, Russian-Germans, and Finns. Most immigrants from the British Isles did not build summer kitchens" (Noble and Cleek 1995: 146).

The earliest summer kitchens were furnished with fireplaces, and later structures had stoves with stove pipes. In summer months these kitchens were used for cooking, baking, canning, and other hot chores to keep the main house from getting too warm. Noble noted an added benefit: "The mess associated with the greatly augmented scale of summer cooking, when additional hired hands and helpers had to be fed, was removed from the dwelling," as were flies and other pests (Noble 1984: 97; Noble and Cleek 1995: 146). During the winter, after the cooking was moved back into the house to help heat it, the summer kitchen was often used for storage of freezable items. Sometimes the summer kitchen was used during the late fall and early spring for farm chores that required an enclosed sheltered area.

Historian Christopher Bobbitt, who studied summer kitchens in Harrison County, Indiana, wrote in 1989, "For nearly five months out of the year, [the] summer kitchen served as the center of all the family's activities except sleeping and entertaining company; the main house could thereby be kept clean and cool." He also wrote (with perhaps some conjecture): "The yearly move to and from the summer kitchen was a major but welcome event, a ritual marking of the seasons" (Bobbitt 1989: 228).

Bobbitt indicated that some of the summer kitchens he studied were specifically designed for the purpose, while others were small buildings that had served as the family's first home, or a springhouse or smokehouse. Those Bobbitt studied were "remarkably consistent in size and proportion," often with footprints of 12′ to 14′ by 20′ to 22′. Noble indicated 16′ x 20′ was a common size. Many summer kitchens had windows and doors on opposing walls for cross-ventilation (Bobbitt 1989: 228-229).

See also

Farmhouses
Smokehouses
Farmyards

The summer kitchens Bobbitt studied were often divided into two rooms with a temporary or permanent partition. They sometimes had a loft used for storage or for sleeping quarters for hired help. They were used for eating meals, as well as for cooking. Many summer kitchens Bobbitt studied were used through the 1930s and still extant in 1989 (Bobbitt 1989: 230).

Many farms stopped using summer kitchens for cooking when electricity was installed and modern cooking ranges were purchased in the 1930s-1950s. Many then began new lives as farm workshops, sheds, bunkhouses, or smokehouses (Bobbitt 1989: 235-236; Noble 1984: 98).

PREVALENCE

It is believed that summer kitchens were widely built on Minnesota farms. After they were no longer used for that purpose, many were converted to farmhouse entry rooms, bunkhouses for hired help, storage sheds, smokehouses, and similar uses. Many are likely to be still standing, although intact examples, especially with original chimneys, windows, etc., are assumed to be fairly rare.

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This summer kitchen may date from about 1930. It had a simple design with three windows for ventilation. A stove (removed) stood against the rear wall (opposite the door), with the stove pipe projecting through the roof. Anderson Farm, Stevens County, 2005. (Gemini Research photo)

▪ THRESHING BARNS

- Threshing barns were built in Minnesota between the 1850s and the time of farm diversification, which began in the 1870s in southeastern Minnesota
- Most threshing barns were timber frame, three-bay structures with a central drive
- After diversification, the three-bay form persisted, often as a raised three-bay barn
- Most were built in southeastern Minnesota

Wheat was first raised commercially in Minnesota beginning around 1858. The farms were concentrated in southeastern Minnesota, which is where most of the state's threshing barns were built. By 1869 wheat occupied 62 percent of the state's cultivated fields, and in 1870 the leading wheat growing areas were Olmsted, Goodhue, Fillmore, Wabasha, Dakota, and Winona – all southeastern counties. By 1880 wheat was grown on nearly 70 percent of all tilled acreage in Minnesota. By this time, however, wheat yields were declining and land prices in southeastern Minnesota were rising. These factors helped shift wheat farming to the edge of the settlement frontier in western Minnesota and the Red River Valley where land prices were lower. By the time the wheat frontier moved to the Red River Valley, threshing had been mechanized, farms were raising more livestock, and commercial pre-cut lumber was becoming available – all factors that favored new barn forms over the threshing barn, especially in western Minnesota. However, the three-bay threshing barn form persisted as farms diversified, and some farms built "raised" three-bay barns on basements (or raised an existing threshing barn onto a basement) to accommodate livestock.

See also this context study's "Planning and Building Farm Structures: Barn Forms and Terminology" for a discussion of barn forms including three-bay barns and raised three-bay barns.

The threshing barn originated in Europe and was a single-function structure, according to barn historians Calkins and Perkins, with its purpose being the threshing and storage of grain. Livestock were generally not housed in a threshing barn (Calkins and Perkins 1995: 40).

In the U.S. threshing barns were commonly known as English barns, but also called New England, Connecticut, or Yankee barns. They were brought to the Midwest by Yankee or old-stock American settlers. Among the barn's ethnic variations was a type of threshing barn called a "Scheune," built by German immigrants to the Midwest. It was similar to the English threshing barn but usually built of fachwerk or half-timbering (Calkins and Perkins 1995: 45).

In a study of Midwestern threshing barns Calkins and Perkins have written, "As long as wheat was grown, a continuing need existed for the function provided by the three-bay threshing barn. The barn's diffusion westward [to the Midwest] went hand-in-hand with the crops it served" (Calkins and Perkins 1995: 40). The authors explained that in some parts of Wisconsin the threshing barn was the primary barn form prior to the introduction of commercial dairying around 1875 (Calkins and Perkins 1995: 44). The same was likely true in Minnesota. After diversifying, farmers tended to

See also

Granaries, Elevators, Bins, Dryers
Develop of Wheat Mono, 1860-1885
Appendix: Focus on Minnesota Crops
Barn Forms and Terminology

build general purpose barns (or dairy barns) that were better suited to animal husbandry (Ennals 1972). Some of these barns were three-bay barns identical to threshing barns, but built on basements

Strictly-defined threshing barns (those built before mechanized threshing) were generally one-story, gable-roofed rectangular buildings. They were usually timber-framed, with four bents (e.g., about 16′ apart) creating evenly-sized three bays. The central or threshing bay was accessed by a double door on each of the longitudinal (i.e., eave) sides. The central bay was often used as a driveway and historically – before threshing was mechanized in the 1850s and 1860s – as a threshing floor.

Calkins and Perkins explain, "The [double] door openings were large enough to allow a fully loaded wagon, pulled by a team, to enter and exit the central bay. Besides serving as a sheltered location to unload the harvest, the drive-through bay also was the surface upon which the grain crop was threshed or separated" (Calkins and Perkins 1995: 55). The two sets of doors were adjusted to "regulate the draft needed to carry the winnowed chaff from the threshing floor" (Calkins and Perkins 1995: 51). In the 1850s and 1860s farmers increasingly used mechanical threshers that also did the winnowing, reducing the need for air flow.

One of the flanking bays was usually used to store grain sheaves waiting to be threshed, while the other stored threshed grain to be used for feed, as well as the grain straw, which was used for livestock bedding.

Threshing barns often measured 24′ to 40′ wide by 48′ to 60′ long. Some were up to 80′ long, in which case they had more than three bays. Steep gabled roofs were common. The barns usually had vertical siding with the planks spaced about 1″ apart to provide the ventilation needed to dry and safely store the grain.

Threshing barns rarely had windows other than a small window in the peak of a gable end and a row of small transom windows above the door openings (Calkins and Perkins 1995: 51).

Threshing barns were often built of local timber. Some were built of brick or stone rubble. The barns often had foundations of stone or brick, and wooden floors. The flooring of the central bay was often reinforced to support the weight of loaded wagons (Calkins and Perkins 1995: 45, 48).

Hand-threshing in threshing barns was eventually replaced by mechanical processes that were much more efficient. Horse-powered threshing machines were available by the 1850s and 1860s, and steam-powered threshers in the 1880s. Threshers were large machines into which grain sheaves were fed. They were often owned by a commercial thresher who moved the rig from farm to farm. Itinerant crews or groups of farmers and neighbors provided the labor. Smaller tractor-drawn threshers became affordable for Minnesota farmers in the mid-1930s.

As Minnesota agriculture diversified, the three-bay form persisted but the barns were no longer used as "threshing barns." Some farmers built three-bay barns on top of basements, creating a "raised three-bay barn." Livestock were housed in the basement and hay and feed on the floor above. Platform lofts above the outer bays could store more hay.

Some threshing barns were modified to house livestock and hay in one of the flanking bays. The livestock bay was often fitted with a door in the gable end, plus a window (Calkins and Perkins

1995: 51). Threshing barns were frequently enlarged with extra bays built onto the gable ends, with shed-roofed additions, or with an upper story added. Some farmers converted their threshing barn into an implement shed or similar structure after building a new dairy or general purpose barn.

According to Calkins and Perkins, "The three-bay threshing barn not only is a reminder of an earlier emphasis on wheat that originally dominated Midwestern agriculture, but also represents the early settlement period when timber-frame barns were the dominant structures of the Midwestern landscape" (Calkins and Perkins 1995: 59).

PREVALENCE

It is expected that intact strictly-defined threshing barns (those built before mechanical threshing) will be rare in Minnesota. More prevalent will be threshing barns modified to shelter livestock or built after mechanized threshing as general purpose barns, usually on basements. Threshing barns will be most likely found in southeastern Minnesota where wheat growing was concentrated in the era before farms mechanized.

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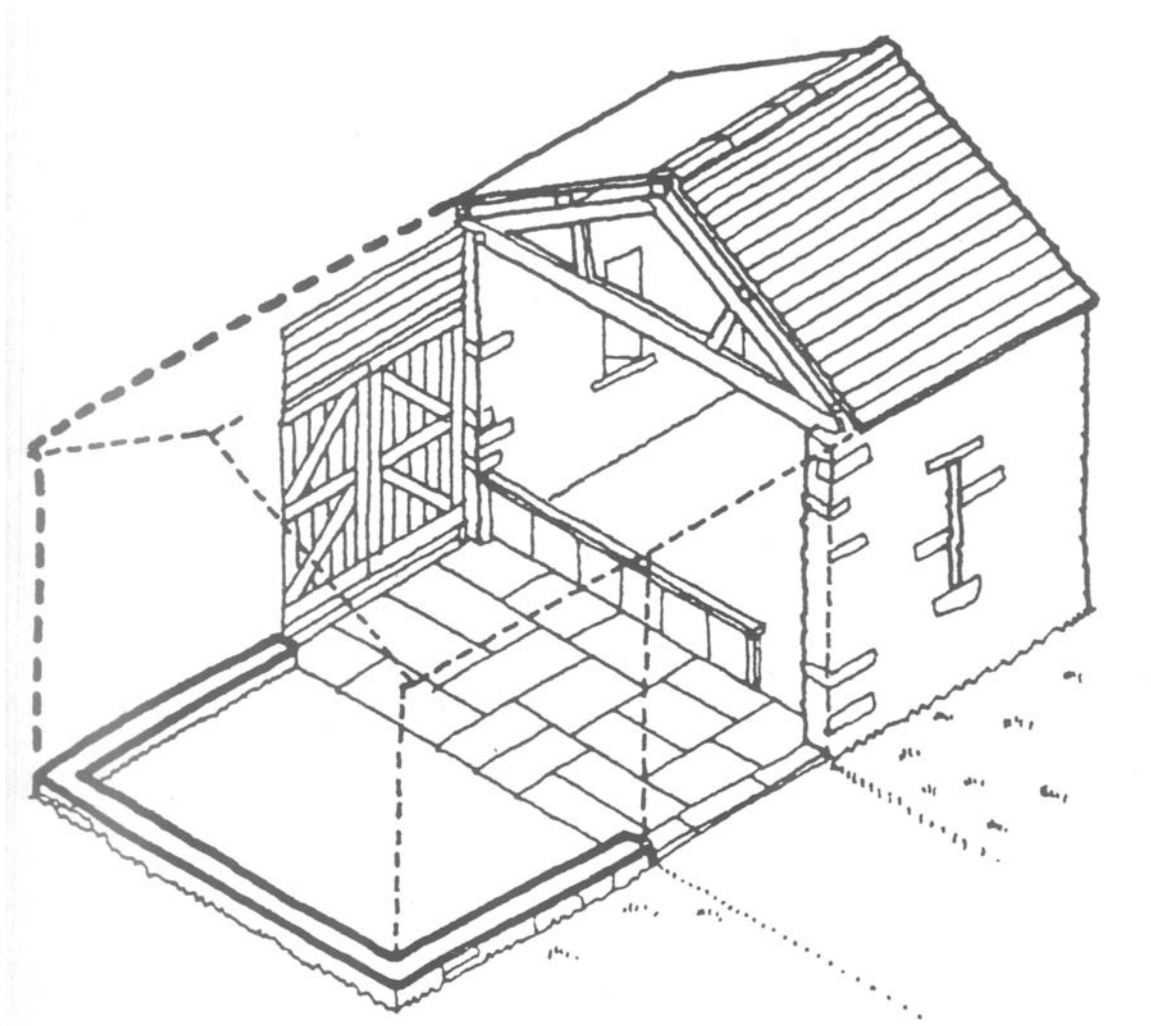

The anatomy of a three-bay threshing barn, which was usually supported by four bents. The central drive doubled as the threshing floor. Stored in one flanking bay were grain sheaves waiting to be threshed. Stored in the other bay were the products of threshing – the grain and the wheat straw. Animals were usually not housed in a threshing barn, and they did not have basements. From Calkins and Perkins, "The Three-Bay Threshing Barn" (1995).

This threshing barn was apparently built in 1855 on the Childs Farm in Waseca County. After the farm diversified, the barn was altered to support animal husbandry. Wilton Township, Waseca County, 1938. (MHS photo by Lewis)

■ TOBACCO BARNS

- Gable-roofed sheds with good air circulation for drying tobacco
- Built largely in central Minnesota; survivors are likely rare today

Tobacco barns or sheds were built in Minnesota at least as early as the 1910s. They were considered important for serious commercial growers because tobacco needed to be handled carefully to bring the highest prices.

Tobacco barns were gable-roofed woodframe buildings – usually somewhat long and narrow – with provisions for good air circulation. Vertical openings along sidewalls and roof-top cupolas or metal ventilators were common. Many tobacco sheds had vertical siding, and hinged or sliding vehicle doors (Vogeler and Dockendorff 1978: 78-81). It is likely that tobacco barns were used for other purposes during months when the crop was not being stored.

In a study of tobacco barns in central Minnesota, geographers Ingolf Vogeler and Thomas Dockendorff wrote in 1978, "Lack of a tobacco shed, for whatever reason, requires either renting a neighbor's shed and increasing production costs or curing tobacco in a barn or tool shed and lowering the quality of the tobacco. Large acreage and long-time commitment to growing tobacco made it feasible to build a specialized tobacco shed. . . . Tobacco sheds seem to have been constructed only after several years of tobacco cultivation, but only if the acreage planted warranted a shed" (Vogeler and Dockendorff 1978: 79).

Tobacco growing peaked in Minnesota in the 1920s and was concentrated in central counties such as Morrison, Benton, Sherburne, Meeker, Stearns, and Mille Lacs. Farmers eventually moved to other cash crops that were more profitable and required less labor and expertise.

PREVALENCE

According to Vogeler and Dockendorff, the only tobacco barns standing in central Minnesota in 1978 were located in Stearns and Meeker counties. (The authors provided some location details.) Most tobacco barns surviving in 1978 had been converted to livestock barns or sheds for storing implements or crops (Vogeler and Dockendorff 1978: 80-82). In general, they will be rare in the state.

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See also
Other Crop Husbandry Elements

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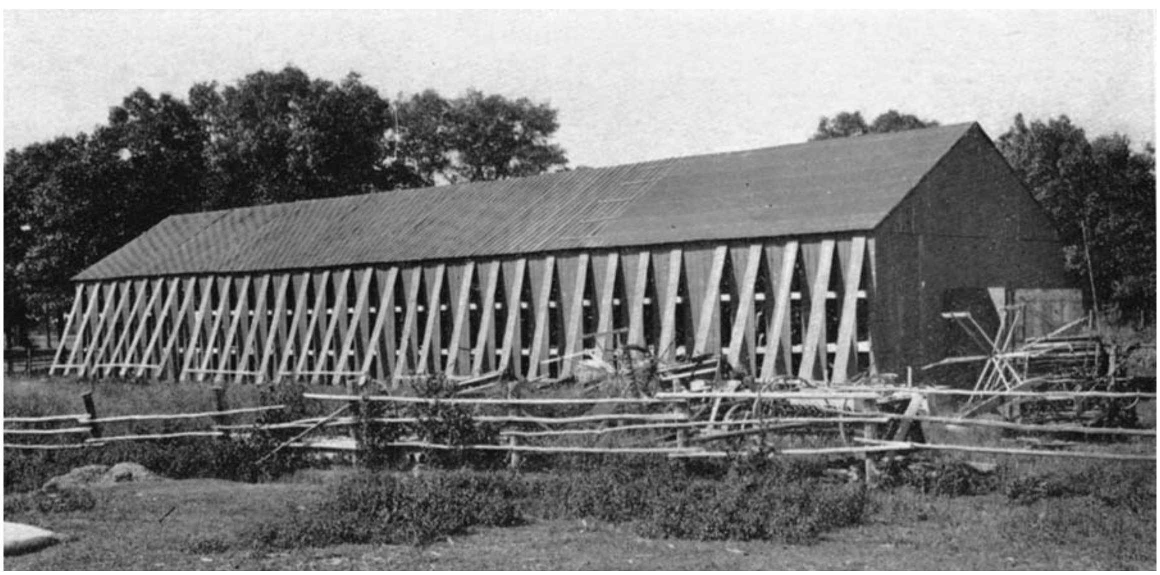

This tobacco barn near St. Cloud had a typical long, narrow form and vertical ventilator panels in the side walls. Location unknown, circa 1908-1911. (MHS photo)

■ UTILITY POLES AND EQUIPMENT

- Some Minnesota farm had electricity by 1909, usually home-generated
- Electrical distribution poles, transmission wires, and related structures were found on nearly every Minnesota farm after electrification
- Farm telephone service began during the 1910s, but only half of Minnesota farms had phones in 1940

Electrical power distribution poles and transmission wires were necessary to carry electricity from the generator to farm buildings, or between buildings on the farm. Before centralized efforts brought electricity to farms in the 1930s-1950s, some farms generated their own electricity. These systems, installed as early as 1910, used water, wind, and especially gasoline power. These farms were the first to install power poles and wires, and were generally the most prosperous farms. In 1929, for example, about five percent of Minnesota farms had electricity (Cavert 1930: 11).

See also "Focus on Farm Electrification" in this report's appendices, and "Power Houses," another individual farm elements section.

In 1939, 41 percent of Minnesota farms had an electrical line within one-quarter mile, 25 percent had farmhouse lighting from an outside electrical line, and 5 percent had farmhouse lighting from an on-farm electrical generating plant (Engene and Pond 1944: 28).

Most Minnesota farms did not receive high line electrical service until the Rural Electrification Administration (REA) was established during the Depression. Beginning in 1936, the REA's first full year in operation, farms were gradually electrified. Progress was slow due to costs, a change in priorities during World War II, and other factors. By 1945, half of Minnesota farms had electricity, and by 1950, 84 percent. In 1960, more than 95 percent of Minnesota farms had electric power (Jellison 1993: 55, 103, 154, 169).

Typically, a farm's main electrical service line entered the farmstead from the nearest public road and extended to a pole-mounted transformer and main line switch (White 1936: 18). It was recommended that the transformer be located near the center of the load, to keep the secondary distribution lines as short as possible (Stewart et al 1928: 7-13). In a typical wiring plan from 1936, overhead distribution lines extended from the transformer to the granary and hog house, silo and cattle barn, milk house, combination machine shed-garage, well, and house. A yard light was mounted on the barn. Power was controlled by 30-amp switches at the granary, silo-barn, machine shed. There were also 60-amp switches at the milk house and farmhouse (White 1936: 18).

Agricultural engineers recommended that the wooden poles be 20' tall. The wires were 8 to 12 gauge, depending on their location within the system.

See also
Power Houses
Farmyards
Appendix: Focus on Farm Electrification
Farmsteads

Complete yard lighting usually required three lamps – one at the house, one at the barn, and one at the garage. Two-hundred-watt lamps were recommended (Stewart et al 1928: 19). It was recommended that yard lights be at least 15′ above the ground and equipped with flat-dome reflectors to create a wide spread of light on the ground. Lamps were often placed on the corner or gable end of the barn. If the yard was large, the yard light was placed on the wooden distribution pole (Stewart et al 1928: 19). For security, it was advised that yard light switches be located in the master bedroom, as well as out in the yard or the barn (Stewart et al 1928: 19; Fox 1940: 64-65).

TELEPHONE SERVICE

Rural telephone service began during the prosperous World War I years, often provided by farmer-organized cooperatives. Wooden telephone poles, similar to electrical poles, were built along rural roads to service area farms. Telephone poles were often shorter and less elaborate than electrical poles. Telephone wires were later hung almost exclusively on electrical poles, usually at the lowest elevation.

By 1920, nearly 40 percent of American farms had telephones. The most common early rural telephone was the magneto set. It was a big contraption, usually hung on the wall, and often served 20 or more subscribers hooked to the same grounded magnet circuit. To make a call, the caller turned the generator crank, which was heard as a ring by other parties on the line. The switchboard operator plugged into the line, the caller lifted the receiver and asked for a number. Private conversations were impossible (Hadwiger and Cochran 1984: 224-225).

During the hard times of the 1920s and 1930s, fewer farmers could afford a phone and many dropped the service. Cooperatives found it hard to maintain existing phone lines and to replace systems lost to road widening and REA power lines, which caused interference on nearby magneto telephone lines. Neglected phone wires were often jury-rigged from fence posts to dead trees, forcing farmers who still had phones to "whoop and holler" to relay messages down the line, from farm to farm (Hadwiger and Cochran 1984: 222-226).

In 1939, just 49 percent of Minnesota farms had telephone service. Nearly two-thirds of farms in southeast Minnesota had phones, and a little over half of farms in southwestern Minnesota. But in the northeastern part of the state, only one-third of farms had telephones in 1939 (Engene and Pond 1944: 28). With the return of farm prosperity after World War II, the number of rural phones began to climb. In 1949, the Hill-Poage Act authorized the Rural Electrification Administration to make loans for rural telephone systems. During the 1950s and 1960s, telephone service was extended to most Minnesota farms: 60 percent of state farms had phone service in 1950, and 80 percent had phones by 1960 (Hadwiger and Cochran 1984: 221; Jellison 1993: 154, 169).

From the beginning, the telephone was more than a social convenience for farmers. It was also useful in the business. Farmers could call the veterinarian to treat sick animals, call the elevator for the latest grain and livestock prices, or ring up the implement dealer for repair parts. Farmers used phones to call the doctor, summon help in emergencies, and warn neighbors of approaching storms (Fite 1989: 291; Hadwiger and Cochran 1984: 222). Many rural phone systems also transmitted news, anticipating radio and television broadcasts. According to one source, "On some systems, [the operator] rang all lines at 7 each evening to report the correct time, the weather forecast, and market questions" (Hadwiger and Cochran 1984: 221).

PREVALENCE

It is expected that many historic utility poles, wires, yard light fixtures, and related structures are still standing on Minnesota farms.

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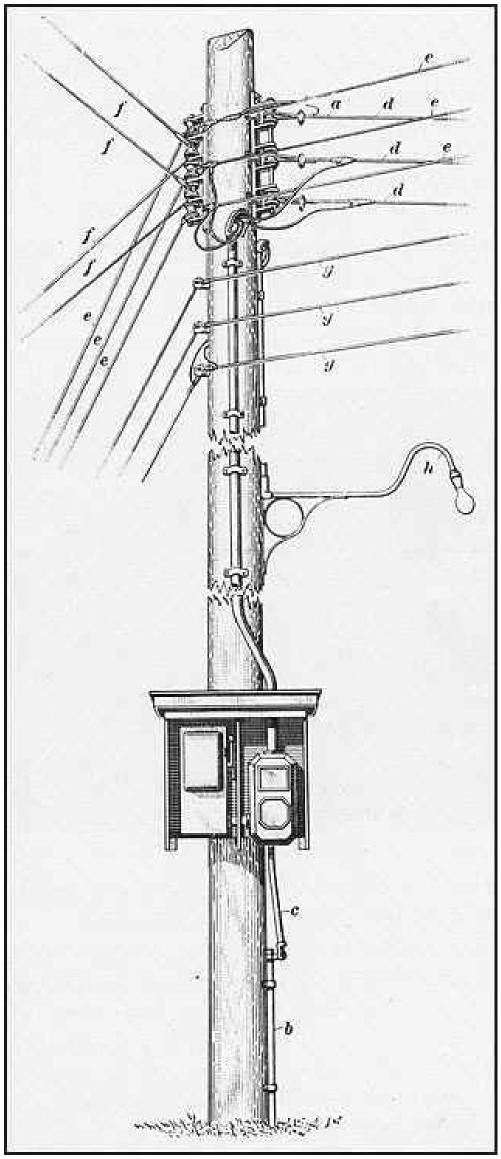
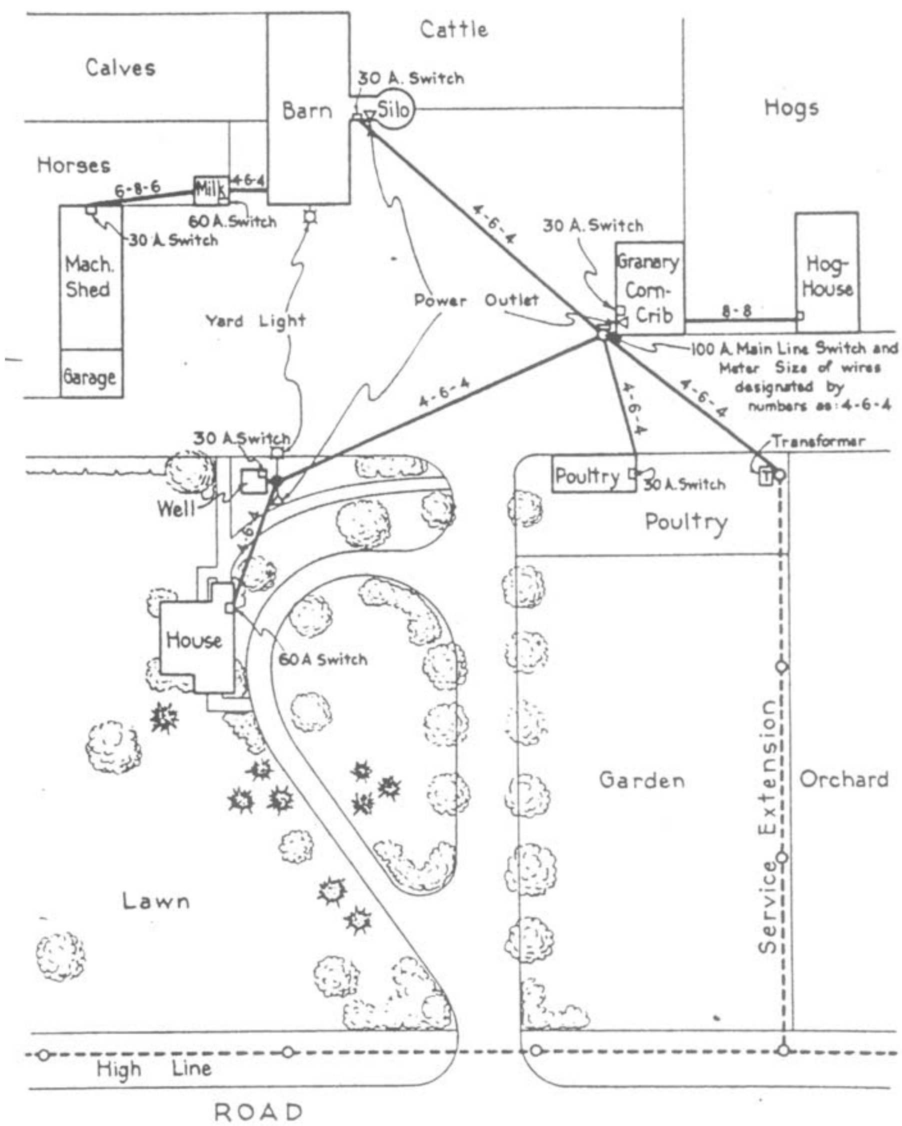


An electrical power distribution pole with yard light and switches. From the 1937 book *Farm Wiring for Light and Power* by C. H. Sprague.



This farmstead wiring diagram appeared in a 1936 issue of *Agricultural Engineering* written by University of Minnesota professor H. B. White. The article was entitled "Farm Structures Planned for Electric Wiring and Appliances."

■ WATER POWER STRUCTURES

- Water power from farm streams could be harnessed to grind grain, saw wood, or generate electricity
- Small dams or batteries could be used to store either the water or the electricity generated

Minnesota farms harnessed water power from rivers and streams to ease a variety of chores. Water-powered mills ground grain and cut lumber. Other water-powered machinery could cut nails or shingles, turn wood, or pump well water.

Various types of water wheels were usually used to harness water power on farms.

In many cases an on-farm source of water power developed into a secondary (or even principal) source of income for the farm. For example, a grist mill or saw mill might serve farmers in a large radius and even form the nucleus of a small village.

GENERATING ELECTRICITY

F. I. Anderson wrote in 1919, "A small stream capable of developing from 25 to 50 hp will supply a farmer (at practically no expense beyond the original cost of installation) not only with light but with power for even the heavier farm operations such as threshing; and in addition will do the washing, ironing and cooking, and at the same time keep the house warm in the coldest weather" (Anderson cited in Schaenzer 1957: 447).

Some Minnesota farmers used water power to generate electricity. There were many types of farm hydro-electric power plants. The setup was dictated by the volume and fall, or pressure, of the flowing water. For example, when the quantity of water was large and the fall was more than 8′, a turbine could be used to produce electricity. If the fall was smaller – for example, 5′ to 8′ – a water wheel was more practical. In the usual arrangement, water was carried through a drive pipe to the wheel, which turned as water fell on it. The wheel was belted to a direct-current generator. A water wheel was also used when the fall was 5′ to 14′ but the quantity of water was small. With a fall of more than 15′ and a small quantity of water, a special water motor was used (Stewart "Water" 1921: 123-124).

Many farm streams could not produce enough power to run an electrical plant without some kind of storage facilities. Where freezing was not a problem, a homemade dam could be used to store water. Or, a small water wheel could produce enough electricity to charge storage batteries. One expert advised, "The installation is cheaper and less bothersome, when storage batteries are used, than when water is stored" with a dam (Stewart "Water" 1921: 124).

See also

Power Houses
Utility Poles and Equipment
Windmills

PREVALENCE

Water power structures were primarily built in hilly regions of the state. Existing structures are assumed to be rare.

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An 18"-diameter Pelton water wheel, used to generate electricity or power other farm jobs. Pelton wheels, made by Pelton Water Wheel Company of California, were recommended to Minnesota farmers by the University of Minnesota for generating electricity using the power of a farm stream. Photograph is from a web site called *Rob's Pelton Place on the Net* (http://www.oldpelton.net/) 2005.

■ WATER TANKS AND TANK HOUSES

- Water tanks stored water for house, barn, and livestock
- Water tank houses sheltered water tanks

The use of windmills and force pumps led to the practice of storing well water in elevated tanks – a practice first introduced by railroad companies (Brooks and Jacon 1994: 71). Farm water tanks ranged from small wooden or galvanized metal tanks, to larger brick, tile, or poured concrete tanks. Some water tanks were pressurized, and some were enclosed in small wooden shelters called water tanks (Structural Clay 1941; Midwest Farm 1937; Boss 1898: 158; Mowry 1914: 97).

The Minnesota Farmers' Institutes promoted the advantages of indoor, rather than outdoor, gravity tanks. An 1898 article described a simple indoor water system that provided running water in the farmhouse and barn. The windmill pumped water from the well into a "good, clean barrel" located in the attic or second floor of the farmhouse. The barrel, covered with muslin and set in a galvanized iron tray to catch overflow and sweat, was fitted with 1" pipes leading to the kitchen sink and to an in-house milk cooling tank on the first floor. The cooling tank was fitted with pipes leading outdoors to the stock tank and a cistern. "Thus, when water is pumped it is forced to the house where it first fills the house tank, then overflows into and fills the milk tank, which in turn overflows into the stock tank, or into the cistern. This always keeps cool, fresh water in the house and milk tanks" (Boss 1898: 158). A 1920 article by University of Minnesota staff described a similar arrangement which diverted rainwater to a tank in the attic or to a tank elevated against an outside wall of the house (Shepperd 1920: 144).

Outdoor elevated tanks were not used year-round in Minnesota because they would freeze, but an elevated outdoor tank "works during the months when help is most needed and least readily available" (Shepperd 1920: 140). Sometimes, elevated water tanks were placed in the barn loft, where heat from the livestock kept the water from freezing. Elevated tanks could also be built in an upper story of a well-insulated pump house or milk house, provided the house extended "clear up around and over the tank to protect it" (Stewart 1922: 2).

Water tanks could also be built on a hill, provided the tank was placed slightly higher than the house or outbuildings. "It will not give trouble with freezing if it is on top of the ground, as long as it cannot freeze under the tank" (Stewart 1922: 2). In 1937, for example, the Midwest Plan Service published plans for a cylindrical concrete water tank that was about 12' in diameter and 18' tall (Midwest Farm 1937). Circular brick or concrete tanks were typical, but wooden tanks were also used (Brooks and Jacon 1994: 71).

Some farms had hydropneumatic water tanks that used air pressure to force water to various parts of the home. These tanks were typically located in the basement of the farmhouse or underground in well pits (Stewart 1922: 15).

See also

Cisterns
Pumps and Pump Houses
Wells
Windmills

PREVALENCE

It is not known how many Minnesota farms used water tanks or tank houses. It is assumed that extant tanks will be rare. Water tank houses are more likely to have survived because they were useful for storage. Tanks and tank houses with associated equipment or within larger water systems are likely rare.

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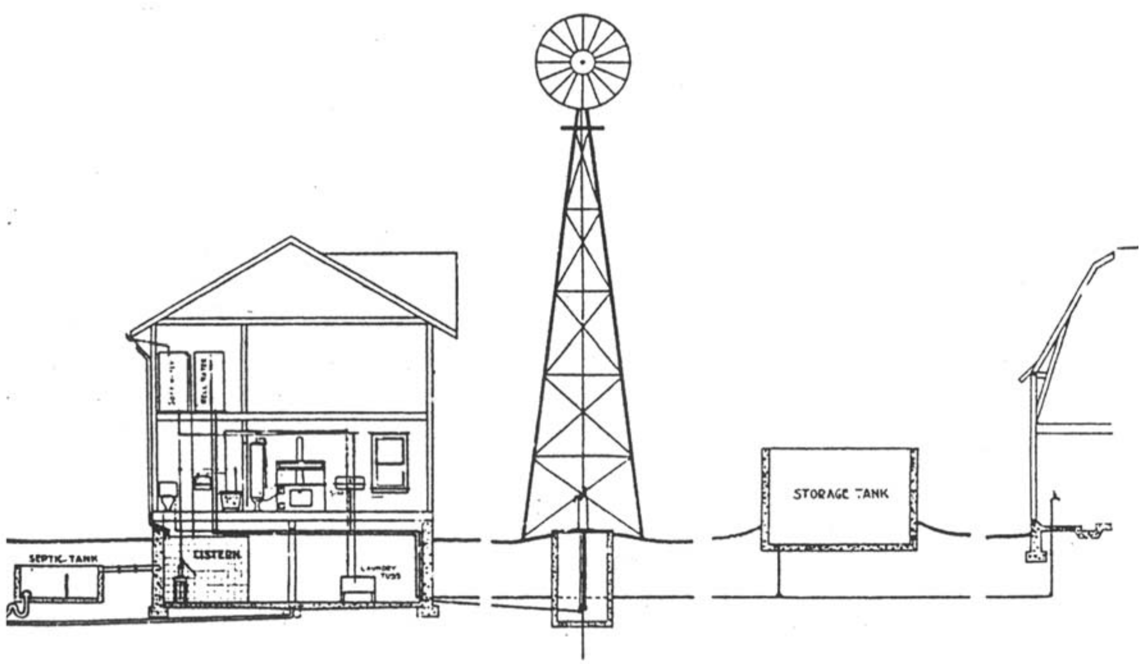

The position of the water storage tank within a typical farm water system, drawn by the University of Minnesota's Division of Agricultural Engineering. If the water tank was elevated, it could only be used for about seven months in Minnesota, but University staff pointed out that those seven months were busy on the farm and an elevated water tank might be well worth the investment. From Shepperd and Stewart's "Low Cost Water Systems for Farm Homes" (1922).

▪ WELLS

- Found on nearly all farms
- Sited above barns and away from other possible contaminant sources
- Early, shallow wells were dug, bored, or driven
- Drilled wells were deepest, safest, and most long-lived
- Drilled wells constituted 30 percent of Minnesota wells in 1922
- Most wells had a mechanical pump to move the water

Essential for the drinking water supply, wells were found on almost all farms. Their type varied depending on the locality, soil composition, water table depth, and the labor, equipment, and resources available for construction (Brooks and Jacon 1994: 72).

Merrill Jarchow wrote of wells in the early settlement period:

> Securing water was another task . . . . In summer, water could be dipped from springs and streams, but in winter it was not always so readily available. Then ice or snow was usually melted on the back of the kitchen stove. Most settlers, of course, dug wells and installed pumps sooner or later. Pumps were offered for sale in St. Paul as early as 1851, but many farmers could not afford them, or lived where they were unavailable. . . . Water was drawn by the primitive means of a rope and bucket. . . . When settlement reached the Red River Valley in the 1870s, the water problem was even more acute than in the wooded sections. Buffalo wallows were relied upon at first, and the water from them had to be boiled. In dry seasons the wallows dried up and deep wells were resorted to. One early settler remembered the well water as being bluish, smelly, and extremely distasteful. Serious illness often resulted when people were not careful to boil such water before using it" (Jarchow 1949: 85).

In addition to providing water, wells were also used for food storage before refrigeration. Jaakkola and Frericks quote Minnesota food historian Marjorie Kreidberg who explained:

> Even wells or cisterns dug deep into the earth were used as places where perishables could be suspended by a rope to hang above the water in the cool hollow of the chamber. They were considered more desirable for storing dairy products than underground cellars or ground-level storage closets, where vegetables were kept along with other raw and unprocessed foods. It was widely recognized that the 'steam and vapor arising from the vegetables' affected the taste of the milk and butter (quoted in Jaakkola and Frericks 1996: 28).

Except for artesian wells, all other wells required mechanical means to raise the water. The water could be drawn from some wells with ropes and buckets, but more typical in Minnesota were pumps

See also

Pumps and Pump Houses
Water Tanks and Tank Houses
Windmills
Cisterns

driven by hand, windmill, or a motor powered by gas or electricity. (See also "Windmills" and "Pumps and Pump Houses", two other individual farm elements sections.)

Agricultural educators provided detailed plans for many building projects so that farmers could do the jobs themselves. But when it came to putting in a well, experts urged farmers to hire a professional. F. L. Marsh cautioned in 1902: "It is often thought anyone can put in a well. In many localities it calls for the highest skill and largest experience" (Marsh 1902: 64).

There were four main types of farm well construction in Minnesota: dug, bored, driven, and drilled.

Dug or Bored Wells. The earliest farmstead wells were often shallow open wells, either dug or bored, and operated with a rope and bucket. "Hand digging was the least expensive and simplest method available" (Brooks and Jacon 1994: 72). This type of well was also used in areas where the water table was low. A hole was dug or bored down into the hard subsoil or clay, and water seeped into the well, often coming from a considerable distance (Stewart 1922: 10).

Dug or bored wells were often less than 25' deep. The well cavity was usually lined, or curbed, with stone, brick, tile, or concrete. Cement pipe and iron culvert pipe were also used. Some wells were lined with lumber, although experts discouraged this practice (Brooks and Jacon 1994: 72; Marsh 1902: 66; Stewart 1922: 7-8).

Many dug or bored wells went dry after a few years: "Some farms have five or six dry bored wells," according to one author (Stewart 1922: 10). In addition, dug or bored wells were very susceptible to contamination from surface water (Stewart 1914: 67; Stewart 1922: 8-9).

Driven Wells. In areas where the water table was high, driven wells were favored. They were used throughout the sandy soil regions of northwest Minnesota and in much of the western prairie region. This type of well had no water reservoir space. It consisted of a pipe fitted with a mesh-covered point that was forced through the soil to a layer or "lense" of water-bearing sand or gravel where water freely entered the pipe. Tubular wells, a variation, were constructed by driving a pipe down to the water-bearing layer and then inserting a pump point and cylinder inside the tube. Windmills often sat over driven wells (Marsh 1902: 64-65; Stewart 1922: 10-11).

Drilled Wells. Drilled wells were more expensive than those dug, bored, and driven. However, the experts urged farmers to replace their shallow wells with deeper drilled wells. In 1922, for example, an Extension Service bulletin reported that only about 30 percent of wells in Minnesota were drilled wells. "The number of drilled wells is too small," the bulletin said. "Their number is increasing yearly, but it should increase more rapidly. A drilled well provides the safest source of water supply" (Stewart 1922: 12-13). Drilled wells, which were 100' to 200' deep, usually penetrated layers of impervious material before reaching water. So "there is almost no danger of contamination from surface drainage. These small, deep wells are to be recommended, for improving sanitary conditions, wherever they can be had." Like driven walls, drilled wells had no water reservoir. Windmills often sat over drilled wells (Stewart 1914: 70).

Wells were generally covered at the surface with double-planked wood, concrete, or cast-iron covers. Sometimes a small gable-roofed, open-sided shed was used, particularly for earlier, shallow wells. The ideal well top was an arch-shaped cover of brick or concrete with openings for the pump and a manhole. An underground concrete collar surrounding the well was also recommended to prevent surface water from moving down the outside of the well to the water stratum (Stewart 1914: 69; Stewart 1922: 8-9).

Farm specialists recommended that wells be placed on ground that was higher than the barn and other farm buildings and that they be located at least 150' to 200' from privies, cesspools, manure piles, and other sources of contamination (Brooks and Jacon 1994: 72; Stewart 1914: 69; Stewart 1922: 9). But judging by experts' warnings, the location of many farm wells was less than ideal. Extension educators frequently lectured farmers about the health risks of poorly located and constructed farmstead wells. In 1902, for example, a Minnesota Farmers' Institutes author observed that "a very large percentage of the wells are not furnishing water of good quality," and reminded farm families of "the sickness and funeral expense resulting from drinking poor water" (Marsh 1902: 64). John T. Stewart of the University of Minnesota severely admonished Minnesota farmers in 1914 about the condition of their wells:

> Any person who is familiar with farm conditions has undoubtedly noticed the lack of sanitary precautions which should be taken in regard to the family water-supply. The well is often located on ground lower than the surrounding buildings, around which are manure piles and other deposits of filth. It is lined with a wooden curb or an open wall, and is covered at the surface of the ground with an open plank top. Poultry and small animals pass freely around over the covering, or wallow in the waste water which stands within a few feet of the well top. Persons coming from the stables, and others with filth and dirt adhering to their shoes, stand on the top while drawing water. As a result, a large amount of this filth, which accumulates on the cover, is carried into the well by the splash of water each time a pail is drawn. Each rain carries a large amount of filth from the cover and the surrounding soil into the well, through both the top and the open wall, thus making an easy method of transmitting into the well disease germs which have been permitted to collect in the near vicinity (Stewart 1914: 67).

In 1922 the Minnesota Extension Service repeated its warnings, noting that "The large number of wells that are polluted is a serious menace" (Stewart 1922: 6).

By 1960 it was common to improve the quality of farm water through such practices as aeration, settling the sediment, filtration, disinfection (e.g., with chlorine), and softening. The latter was used for bathing and clothes-washing water.

PREVALENCE

Wells were located on nearly all Minnesota farms, and historic wells are likely to remain. Evidence of abandoned wells can include well casings, diameter pipes, pumps, surface depressions, or wooden, concrete, or metal covers. Dug wells may be identified by a ring of concrete, clay tile, brick, or stone.

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Using a windlass, rope, and bucket was a simple but labor-intensive way to raise water from an early farm well. Mechanical pumps soon became the preferred method. Photo taken near Marine-on-St. Croix, circa 1900. (MHS photo)

This farm well had a closed wooden cover and a hand pump. Location unknown, 1903. (MHS photo by Edward Albert Fairbrother)

This well had a wooden cover and a hand pump, and was sited near the livestock. Kandiyohi County, circa 1920. (MHS photo)

■ WETLANDS

- Wet, untillable areas were often put to some farm use
- Wetlands were sometimes tilled in very dry years
- Farmland drainage significantly reduced the number and size of wetlands

Like woodlots and hilly areas, wetlands (also sometimes called sloughs, bogs, marshes, swamps, potholes, or ponds) were generally counted among a farm's untillable acres. Even though they were untillable, farm wetlands, like native woodlots and hilly terrain, were landscape resources that farmers tried to put to some use.

A farm's sloughs and potholes often formed an interconnected wetlands system. Wet areas changed in size seasonally, and varied through the years according to the amount of rainfall, the height of the watertable, and the functioning of a farm's tile drainage system. (If a farm's historic drainage outlets were not maintained, for example, they could become plugged, causing sloughs to increase in size.)

Minnesota farmers began draining wetlands in the late 19th century, usually to increase the size of the farm's tillable fields. Wetlands were also drained for road-straightening, railroad-building, and other development. Legislative support for cropland drainage was a significant part of government agricultural policy. (See "Drainage Structures," a separate farm element section.)

Many farms used wetlands for livestock watering. The shores of wetlands were used as grazing areas and as places to cut wild or marsh hay. Wetlands were often fenced to keep livestock either in or out. During very dry years, some wet areas were tilled. Farmers also used wetlands for berry collecting, hunting (e.g., deer and waterfowl), fishing and minnow trapping, and trapping animals like muskrat and beaver whose pelts could be sold for cash.

In the mid-20th century it was common for a farm in western Minnesota, for example, to have one or two moderately-sized wetlands, as well as other scattered wet spots. Wetlands were common in northern Minnesota where some farms contained (or were adjacent to) extensive peat bogs and other wet areas that posed challenges to farming. During dry years peat bogs sometimes burned in fires that were difficult to put out. Crops could be grown on peat bogs, but they were often subject to early frost. After being drained, peat bogs needed treatment with phosphorus and potassium fertilizers before being productive (Pond and Crickman 1933: 8).

PREVALENCE

Wetlands are found throughout Minnesota but are less common in the hilly, more well-drained southeastern part of the state. The size of wetlands can vary seasonally, can change with the watertable, and can be affected by the installation and maintenance of field drainage systems.

See also

Drainage Structures
Fields and Pastures
Erosion Control Structures

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Sloughs or potholes were often used for grazing and watering. Some might be tilled during very dry years. Location unknown, circa 1910. (MHS photo)

Many farm wetlands were drained for cropland. The shores of remaining sloughs were used for hunting, trapping, grazing, and cutting wild hay. Stevens County, 2005. (Gemini Research photo)

▪ WINDBREAKS

- Installed on nearly all farms except in forested areas
- Usually bordered the north and west sides of a farmstead
- Recommended to consist of three layers: a snow catch, a snow trap, and the main windbreak
- Recommended to include a mix of large shrubs, fast-growing trees, hardwoods, and conifers

Farmstead windbreaks were strategically planted groves of trees that sheltered the farmstead from prevailing winds. In the early 20th century farm experts advised that planting a windbreak was just as important on a farm as draining wet land. The University distributed standard farmstead windbreak plans and sent out experts from the School of Forestry to supervise planting (Kenety 1920: 149; Cheyney 1914: 66).

A good farmstead windbreak sheltered the house and outbuildings from wind, driving snow, blowing field dirt, and dust and noise from the road. A windbreak reduced farmhouse heating costs and prevented snow from drifting around buildings, roads, and livestock yards. The windbreak kept animals warmer and healthier (promoting better weight gain), and sheltered and trapped moisture in the garden and orchard. It supplied firewood, fence posts, lumber, and wildlife habitat. And it beautified the farmstead landscape (Stoeckeler and Williams 1949: 191-192; Anderson 1949: 1-2).

Farmers were quick to recognize these benefits and one of the first things new settlers did when they came to the Minnesota prairie "was to have a grove of trees" (Kenety 1920: 149). Pioneer farmers "realized that it was going to take more than a sod house to give them the protection to which they had been accustomed in the wooded East. It was not surprising, therefore, that a plantation of trees often shared with the garden the first patch of sod that was broken. Wildings collected along nearby streams comprised their planting stock" (Stoeckeler and Williams 1949: 192). A Farmers' Institutes expert wrote in 1894, "white willow, cottonwood, box-elder, soft maple, white ash and white elm stand as the old favorites and have done an immense amount of service as windbreaks all over the prairie regions" and that Russian willows and poplars were also becoming popular (Hays 1894: 277).

In 1914 the Minnesota Farmers' Institutes published plans for windbreaks two and four rods wide (33'and 66'). The two-rod plan called for an outer row of box-elder trees, followed by three inner rows of alternating cottonwood and spruce trees: Norway spruce in southern Minnesota, blue spruce in clay soils, and white spruce in northern Minnesota. The four-rod plan added four more inner rows of alternating cottonwood and European larch (Cheyney 1914: 64-65).

In 1926 the Extension Service promoted a three-part farmstead windbreak plan that became the standard for decades. So effective was this windbreak that one expert observed 30 mile-per-hour winds slowed to five or six miles per hour inside the windbreak. The plan consisted of an outer "snow catch" of low-growing trees on the windward sides of the plantation, an empty space

See also

Woodlots
Shelterbelts
Farmsteads
Woodsheds

between the snow catch and the main windbreak which served as a "snow trap," and the main grove (Anderson 1937: 4; Anderson 1949: 2).

The outermost layer, the snow catch, consisted of two or three rows of shrubs or low-growing trees. They were planted in rows about 10' apart. Within the rows, shrubs were set 4' to 6' apart. Recommended snow catch plants included caragana, Russian olive, buffalo berry, low-growing willows, Tatarian honeysuckle, wild plum, chokecherry, pincherry, and common lilac (Anderson 1949: 5).

Blowing snow lodged in the sheltered lee of the snow catch, an empty space about 60' wide. Snow in this area melted slowly in the spring, preserving valuable moisture. That made the space ideal for use in the summer as a garden or high-quality pasture (Anderson 1949: 2-5).

The inner layer of the three-part windbreak consisted of an 80'-wide band of broadleaf and conifer trees arranged in eight staggered rows, spaced 10' to 12' apart. Within the rows the trees were planted about 6' apart, a close spacing that forced trees to grow taller and offered better wind protection. The Extension Service recommended specific types of trees for each row of the main windbreak: "There should be two rows of fast-growing, short-lived, broad-leaved trees; two rows of long-lived, broad-leaved trees; and four rows of hardy conifers. Such a combination insures the best year-round protection. The fast-growing trees not only give early protection but also serve as a nurse crop for the longer-lived, more permanent trees." Specific species were recommended for each type of plant (Anderson 1949: 5-10).

The innermost rows were spruce trees. These evergreen rows were closest to the house, providing year-round beauty and foliage. The minimum recommended distance between the innermost row of the windbreak and the nearest buildings was 100', and 200' was preferable (Anderson 1949: 5-10; Kirkpatrick, 1910: 276; Quam et al 1993).

Recent farmstead windbreak plans offer variations on the historic designs. A 10-row plan issued by the USDA Soil Conservation Service and the North Dakota Extension Service in 1993, for example, had two outer rows of tall, high-density shrubs to trap snow, a 60'-wide snow trap, and eight inner rows, consisting of a row of shrubs, followed by successive rows of small conifers, small deciduous trees, tall deciduous trees, tall conifers, medium conifers, and small trees. The innermost row, closest to the house, was another row of shrubs (Quam et al 1993).

Windbreaks were usually planted on the north and west sides of the farmstead where they offered the greatest protection from the prevailing Minnesota winter winds. "It is almost never necessary to provide protection on more than two sides of a farmstead if you have a good solid grove," the Extension Service said in 1949 (Anderson 1949: 4).

If the farmhouse faced a public road to the north or west, the windbreak could be extended part-way across the front yard, offering partial protection from the wind but allowing some view of the house from the road. Or, one leg of the windbreak could be planted on the other side of the road, although that was not ideal. University of Minnesota building plans also show driveways cut through the windbreak on north and west-facing farmsteads (*Farm Building Plans* 1953; Snyder 1950: 7; Hays 1894: 273).

The recommended distance between the windbreak and the main farmstead buildings was at least 100' to prevent snow from piling up in the yard. On farms where space for the windbreak was limited, experts suggested planting compact belts of conifers in order to increase the amount of snow that collected next to the tree barrier. The space between the windbreak and the buildings made a good location for a garden, orchard, or a sheltered winter cattle yard (Anderson 1937: 3; Anderson 1949: 4; Stoeckeler and Williams 1949: 198).

After planting the windbreak, farmers were advised to protect the young trees by fencing, watering, and frequent shallow cultivation. Pruning windbreak trees was unnecessary, except for removing dead or diseased trees and broken limbs: "The denser the planting, the better the shelter." When trees became crowded, the windbreak could be thinned by cutting individual trees. When spaces appeared in the crowns of mature windbreaks, experts recommended filling in the gaps with shade tolerant trees such as red cedar (Stoeckeler and Williams 1949: 199; Anderson 1949: 15-16).

PREVALENCE

It is expected that windbreaks, an essential part of the farm landscape, will be found on farms throughout the state. Many will be fairly intact. Like all vegetative features, windbreaks are subject to deterioration and death of the plants due to natural forces. However, while individual trees within them may have died or be in poor condition, many windbreaks have been perpetuated by volunteer reseeding of trees and shrubs. In addition, unlike field shelterbelts which may have been superceded by alternative conservation methods, many windbreaks still serve their original purpose and therefore have been retained. Some have been rejuvenated with the addition of new plants.

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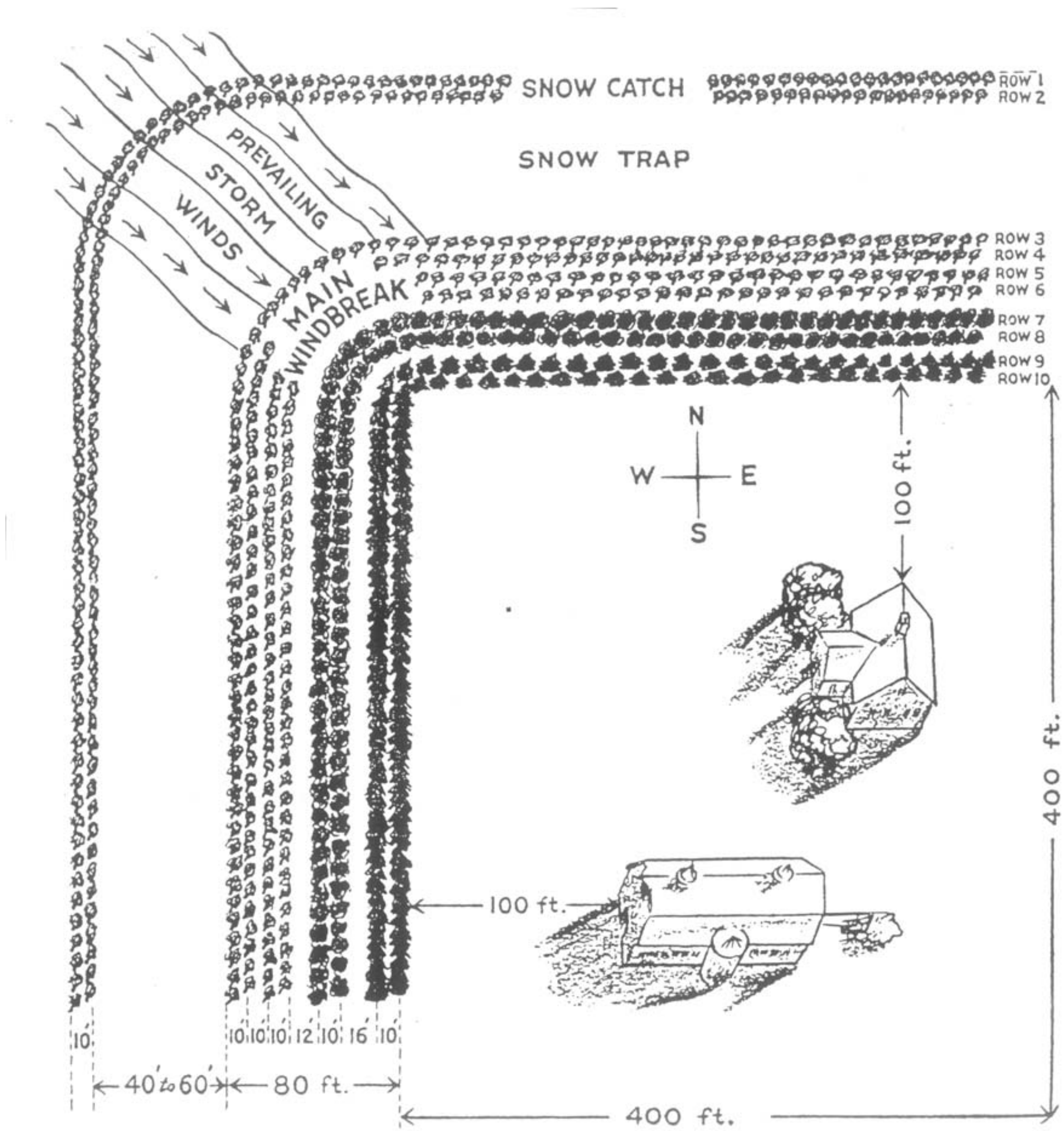

Windbreaks consisted of a strategic arrangement of fast- and slow-growing deciduous trees and shrubs, usually with conifers in leeward rows. The outer section had a snow catch – two rows of tall shrubs – and a 40' to 60' snow trap to stop Minnesota's fierce blowing snow before it hit the main windbreak. This scheme appears in Minnesota Extension publications from at least the 1930s and 1940s. From Anderson's "Planting the Farmstead Shelter Belt" (1949).

▪ WINDMILLS

- Found on most Minnesota farms
- Primarily used to power well water pumps, especially pumping driven or drilled wells
- European-style windmills with large blades and broad bases were rare in Minnesota
- American-style windmills were invented in the 1850s and were first built of wood
- Most windmills were either sectional-wheeled or solid-wheeled
- Steel windmills were introduced in the late 19th century and became common in Minnesota in the 1920s
- The use of windmills declined with electrification

On Minnesota farms, wind power was used almost exclusively to pump the well water for the house and livestock. Most Minnesota farms had a windmill to power their water pump unless the farm had an artesian well, or unless well water was exclusively pumped by hand or by gasoline or electric motor. Until the 1930s windmills were also used to operate small farm machines such as feedmills and sawmills, and to generate electricity.

"Mass-produced, lightweight, and sturdy," windmills provided power on the farm until rural electrification (*Minnesota Farmscape* 1980: 13). One early user of the invention declared the windmill "a national blessing" (Baker 1960: 41).

European-style windmills had been used in the U.S. since Colonial times. These cumbersome-looking machines had towers of brick, wood, or stone that were broad and strong enough to support large turning blades. The mills were used to grind grain and "were not adapted to pumping water for livestock, irrigation, or domestic use" (Baker 1960: 38). According to LaVern J. Rippley, writing in 1981, "As far as can be determined, the only Dutch-type windmills in Minnesota were those built and used by German immigrants." Examples include the stone Seppman Mill near Mankato (1863, listed on the National Register), and mills that once stood near New Ulm, Potsdam, and Claremont (Rippley 1981: 63-64).

The familiar American-style windmill, with a turbine wheel mounted on a tall, lightweight tower and a governor to regulate the wheel speed, was invented in New England in the 1850s (Baker 1960: 38-39).

Water-pumping windmills were built on towers set directly over driven or drilled wells and their associated pumping equipment. Towers were also attached to the ground with stone, brick, or concrete. The towers were sometimes mounted on the roof of a small building.

There were two basic types of American windmills: sectional-wheel and solid-wheel. Sectional-wheel mills had adjustable sections, or blades, that folded inward as the wind speed increased, protecting the wheel and gears from damage. Solid-wheel mills did not fold, but were

See also
Wells
Pumps and Pump Houses
Water Tanks and Tank Houses
Power Houses

instead governed by a side vane that turned the wheel out of the wind when the velocity grew too great (Baker 1960: 40).

Wooden windmills were the most frequently used farm windmills until World War I. Steel windmills, which were first developed in the 1880s, became common in the 1920s and soon surpassed wooden mills in number. Steel windmills were back-geared, which allowed them to run more smoothly and to run in lighter winds than the older wooden windmills (Baker 1960: 45; Brooks and Jacon 1994: 73).

Early windmills, whether steel or wood, had open gears that required weekly maintenance and oiling. In 1912 “self-oiling” steel windmills with enclosed gears were developed, spelling the end of both wooden windmills and open-geared steel mills. Neither wooden or open-geared windmills were manufactured after World War II (Baker 1960: 48).

By 1930 “Aermotor” was the most popular American windmill. It was the first successful all-steel windmill and was manufactured by the Aermotor Company of Chicago.

While the Aermotor Company was a leading manufacturer, there were many other companies, making dozens of different models. Many companies were located in Midwestern states such as Minnesota, Illinois, Wisconsin, Indiana, Nebraska, and Michigan. Popular models included:

- Halladay, the first successful sectional-wheel windmill, manufactured by the U.S. Wind Engine and Pump Company of Batavia, Illinois.
- Eclipse, the first solid-wheel windmill, manufactured by the Eclipse Wind Mill Company of Beloit, Wisconsin.
- Dempster wooden solid-wheel and sectional-wheel windmills, made by the Dempster Mill Manufacturing Company of Beatrice, Nebraska.
- Perkins, a solid-wheel windmill, made by the Perkins Wind Mill and Axe Company of Mishawaka, Indiana.
- Duplex, a sectional-wheel windmill, manufactured in Superior, Wisconsin.
- Manvel, a solid-wheel windmill, made by the Kalamazoo Tank and Silo Company, Kalamazoo, Michigan.
- Hummer, a sectional-wheel windmill, and “Wonder,” a self-oiling mill, both made by the Elgin Wind Power and Pump Company, Elgin, Illinois (Baker 1960: 39-49).

Some windmills had distinctive features. For example, the popular “Dempster” had horse-shaped counterweights. The “Fairbury” had bull-shaped counterweights (Baker 1960: 44).

Although mass-produced windmills were widely available, some farmers made their own out of scrap automobile pieces, steel drums, and other spare parts (Baker 1960: 49).

The use of windmills on Minnesota farms declined when farms were electrified and electric well pumps were installed.

PREVALENCE

Steel windmills, while once very common, are disappearing from Minnesota farms. Wooden windmills and homemade windmills are assumed to be very rare. Evidence of the windmill bases or anchors may exist if the tower itself is gone.

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The towers of European-style windmills, like the Seppman Mill near Mankato (shown here), had to be sturdy enough to support the massive turning blades. They were used to grind grain. Circa 1890. (MHS photo)

Steel windmills were introduced in the late 19th century and became common on Minnesota farms in the 1920s. This may be a Star windmill, identified by the star on the vane and the painted blade tips. The narrow ladder on the tower was used to service the gears and blades. Location unknown, circa 1910. (MHS photo)

This farm windmill was fairly tall. (The height was in part determined by the height of trees on the farmstead.) A wooden silo is visible behind the windmill tower. Location unknown, circa 1900. (MHS photo by Joseph Jay Brechet)

Sectional-wheel windmills had adjustable blades that folded inward as the wind speed increased, protecting the wheel and gears from damage. In early windmills, both blades and tower were built of wood. Some windmills were built on top of small buildings. Location unknown, circa 1900. (MHS photo by Joseph Jay Brechet)

Solid-wheel windmills did not have folding blades, but were instead governed by a side vane that turned the wheel out of the wind when the velocity grew too great. Location unknown, circa 1930. (MHS photo)

▪ WOODLOTS

- Woodlots were natural or planted trees that provided fuel and timber for the farm
- Native woodlots were usually the remnants of original forests
- Woodlots could be used for grazing, hunting, or collecting nuts, berries, or sap
- Planted woodlots were often part of the farmstead windbreak

Farm woodlots were stands of native or planted trees that provided firewood, fence posts, lumber, and even maple syrup. For the purposes of this study they are differentiated from windbreaks, which were usually orderly groups of trees and shrubs planted to block the wind.

During the early settlement period much of Minnesota was forested. In these areas, most farm woodlots were remnants of the original timber stands. Farmers eventually cleared most of the trees that grew on good agricultural soils. Trees growing on poor soil, on unneeded land, or on terrain unsuited for cultivation, were left standing, and farmers cut the trees whenever they needed wood (Cheyney and Brown 1927: 3-4). Woodlots were also used for hunting birds, deer, and other wildlife, could be fenced for grazing, and sometimes provided edible nuts, berries, or tree sap (e.g., for maple syrup).

In northeastern Minnesota's cutover regions, woodlots were a major challenge to farm development. In 1918 the University of Minnesota reported that cutover farmers were only able to clear an average of 3.8 acres per year for fields, given the area's trees, stumps, and rocks (Peck 1918: 6).

In many cases in the cutover, the sale of wood products helped settlers pay for their land. A University of Minnesota study of 141 farms in cutover counties in 1914-1916 found that 23 percent of farm income was coming from wood products, "principally posts and ties with some poles and cordwood" (Peck 1918: 6, 16). One author advised in 1920, "If the settler can sell the wood that he takes off of the land while clearing, there will be more of an incentive for him to clear for he will be receiving pay for each acre he clears. He can have cash coming in for a part of his work and at the same time be developing his farm" (Worsham 1920: 17).

Farmers also planted woodlots, often transplanting hardy, native saplings growing nearby.

Between 1873 and 1891 the federal Timber Culture Act encouraged the planting of trees. The Act, passed by Congress in 1873, gave 160 acres to a landowner who planted and tended 40 acres of trees for 10 years. (The amount was later reduced to 10 acres of trees tended for 8 years.) Another provision of the Act sped up a homesteader's residency requirement under the Homestead Act of 1862 from five years to three years if the settler planted and tended an acre of trees (Blegen 1975: 404).

In 1873 the Minnesota legislature provided a bounty of two dollars annually for ten years for each acre of prairie planted with any kind of forest trees except black locust. There was also a bounty

See also

Woodsheds
Windbreaks
Early Settlement, 1820-1870
Developing the Cutover, 1900-1940

for each half-mile of public highway planted with trees and many farmers took advantage of the offer. "When I came [to Minnesota] in 1875," wrote a farm expert in Worthington, "the planting of tree claims was the every-spring business of about one-half of our farmers" (Ludlow 1894: 278). In southwestern Minnesota cottonwood plantations were popular in the early years of settlement because they grew rapidly from cuttings. Also common were soft maple, box-elder, and white ash woodlots. Cottonwoods suffered in drought years, but white ash and black walnut "which were put out on high rolling prairie" did well, even in dry years (Ludlow 1894: 278-279; Stoeckeler and Williams 1949: 192; Jarchow 1949: 71-72).

Planted woodlots were often part of farmstead windbreaks. In 1914 the *Minnesota Farmers' Institutes Annual* provided plans for a ten-rod woodlot-and-windbreak plantation, with the five rows closest to the farmstead forming the windbreak, and the outer rows forming the woodlot. The woodlot plan called for planting European larch trees, which produced high-quality timber, alternating with cottonless cottonwood trees or Norway or Carolina poplar. All these trees grew rapidly and could begin to furnish firewood and posts within ten years. To encourage farmers to plant woodlots and windbreaks, the University of Minnesota sent out experts from the College of Forestry to supervise planting (Cheyney 1914: 63-64, 66).

As rural areas were electrified and the need for firewood declined, many farmers came to believe that "their woodlots are of little value," according to a 1930 Minnesota survey. For the most part, farmers devoted little time to properly managing their woodlots, and often allowed livestock to graze there continually, a practice that discouraged new tree growth. As a result, their woodlots became unproductive (Rees 1930: 270).

At the same time, farm woodlots represented significant untapped timber resources. In 1930 the University of Minnesota estimated that 75 percent of southeast Minnesota's standing forest was contained in farm woodlots (Rees 1930: 270).

Farm specialists encouraged farmers to see their woodlots as another valuable crop; one that could earn revenue from marginal land and make farmers more productive during the slack winter season. In 1927 the Minnesota Agricultural Experiment Station estimated that an intensively-managed woodlot could produce at least half a cord of firewood per acre per year, plus about 120 board feet of lumber per acre – all of which could be sold for cash. Farmers could increase their woodlot returns by weeding out slow-growing species and replacing them with fast-growing trees, by cutting mature trees, by proper harvesting, and by smart marketing. They were also advised to fill in blank spaces to increase tree density and to prohibit grazing in the woodlot (Cheyney and Brown 1927: 25-28).

Another benefit of a well-managed woodlot was erosion control. In 1927 the Experiment Station noted that woodlots "on all the watersheds of streams in the Upper Mississippi Valley would contribute materially to a rational system of flood control" (Cheyney and Brown 1927: 28).

PREVALENCE

It is expected that farm woodlots will be found throughout Minnesota, but will be more common in forested areas.

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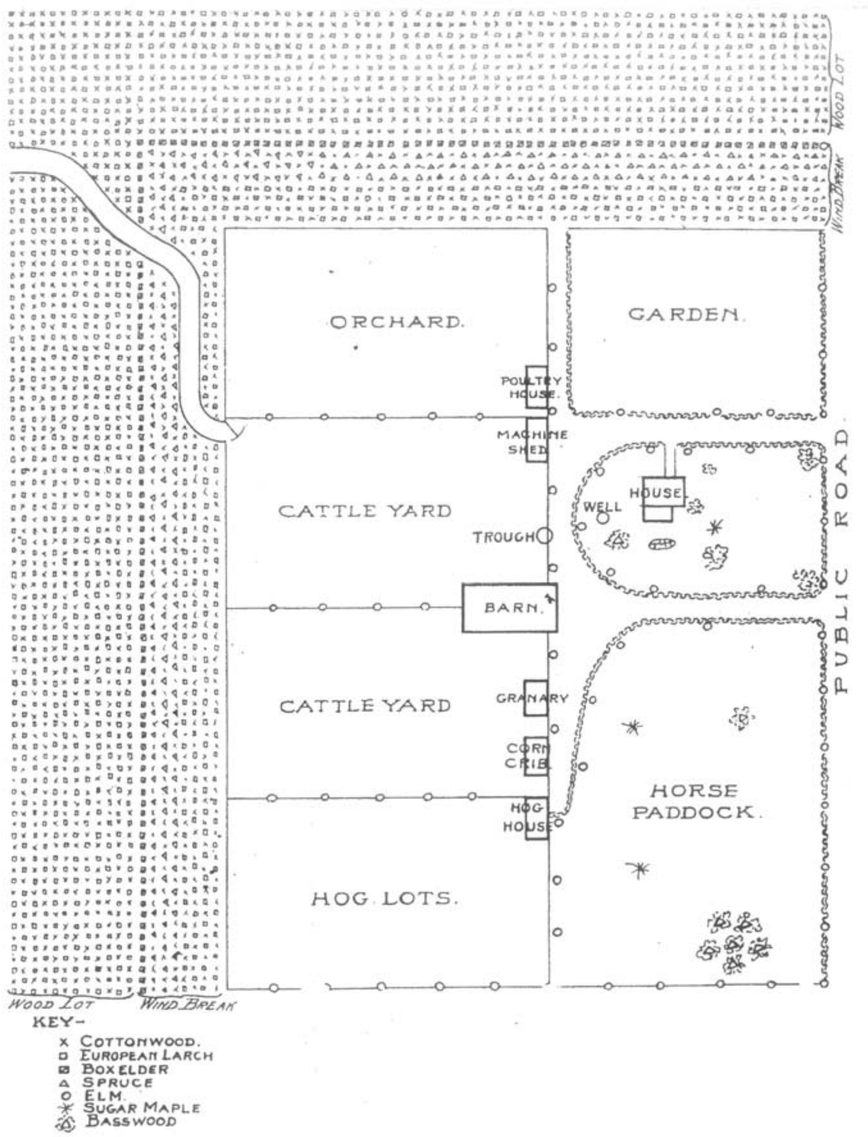

This 1914 University publication for Minnesota farmers demonstrates how a three-acre woodlot could be planted if the farm had no natural stand of timber. The woodlot comprised the outer 12 rows of this scheme and consisted of alternating cottonwood and larch trees from which wood for fuel, fence posts, and other uses could be harvested. The inner eight rows were the windbreak. From Cheyney's "Windbreaks and Woodlots" (1914).

▪ WOODSHEDS

- Once found on many Minnesota farms where wood was widely used for cooking and heating
- Often a simple structure that could have open sides or be enclosed
- Often located close to the back door of the house

In 1984 Allen Noble wrote of the woodshed: "Originally required on virtually every farmstead [in North America], it nevertheless was almost always an unprepossessing structure, and frequently a quite nondescript one. Almost any kind of small frame building served" (Noble 1984: 86).

Woodsheds were either free-standing structures or additions to other outbuildings. They commonly had either gable or shed roofs. They sometimes had one, two, or three open walls.

Wood was widely used as fuel for heating and cooking on Minnesota farms, even after central heating systems were installed.

In the 1910s a small percentage of Minnesota farmhouses had a central heating system consisting of a wood- or coal-fueled furnace in the basement. Many of the furnaces circulated either forced air or hot water (Wilson 1914). (A 1921 survey of readers by *The Farmer's Wife* magazine revealed that, among 892 Minnesota respondents, about eight percent had central heating. The systems included hot air, hot water, steam, and ductless furnaces (Lundquist 1923: 11). In 1940, 19 percent of Minnesota farmhouses had central heating, while 75 percent of the state's urban houses did (Davies 1947: 11).)

PREVALENCE

Woodsheds were prevalent when firewood was the principal fuel for cooking and heating, and keeping the wood dry was important. Electric cooking ranges reduced the need for wood somewhat, as did conversion to coal, fuel oil, or propane gas for farmhouse heating. After woodsheds were no longer needed, many were reused for other storage purposes. It is not known how many examples are still standing.

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See also

Farmhouses
Farmyards
Woodlots

A substantial woodshed. While adults and adolescents usually split the wood, carrying it to the house for cooking and heating was often a child's job. Location unknown, circa 1910. (MHS photo)

EVALUATION OF NATIONAL REGISTER ELIGIBILITY

This chapter provides information on inventorying farm resources and evaluating their National Register eligibility under the historic context "Euro-American Farms in Minnesota, 1820-1960." The chapter is divided into three major sections: some information about inventorying resources, some general guidelines for evaluating eligibility, and a set of recommended guidelines for evaluating the eligibility of specific property types.

DEFINITIONS

The following terms are used in this chapter:

District. A significant concentration of elements such as a group of farms, a farm, or a farmstead.

Farm. A parcel of land historically used for farming and having a headquarters complex and associated acreage, both tillable and nontillable.

Farmstead. The headquarters complex of a farm.

Historic. In this context study, "historic" is defined as from the period of significance.

Property. The resource being evaluated.

PROPERTY TYPES

Properties associated with this historic context include:

- a district of several farms
- a farm
- a farmstead
- part of a farmstead (e.g., a small group of elements such as a house and barn)
- an individual farm element such as a barn

▪ INVENTORYING RESOURCES

One basic goal of the inventory and associated research is to understand the basic operation of the farm and how it changed through time, and farm's historic resources and boundaries and how they changed through time.

Small Scale Elements. All farm elements should be considered in the inventory, even if small in scale (e.g., fences, sheds). Minnesota farms were an interrelated collection of elements – many of them small-scale – that contributed to farm operations. Seeing all elements' physical and functional relationship to each other and to the whole is often important to understanding historic farms, their development, operation, and significance. Small-scale elements should be noted despite the fact that they may not be formally counted in a National Register nomination. (Instructions for completing National Register nominations direct, "Do not count minor resources, such as small sheds or grave markers, unless they strongly contribute to the property's historic significance," (*How to Complete* 1991: 17).)

Landscape Elements. Farms contain landscape elements that were created, manipulated, or used for farming. Examples include fields, pastures, gardens, ornamental plantings, woodlots, wetlands, and erosion control structures. For a useful discussion of farm landscape elements and their evaluation, see McClelland et al, *Guidelines for Evaluating and Documenting Rural Historic Landscapes [National Register Bulletin 30]* (1990).

Initial Inventory of Farm Acreage. When conducting an initial inventory of farm resources, it is usually most practical to look first at the farmstead and assess its integrity and potential significance before determining which parcels of farmland are historically associated with the farm. If the purpose of the survey is to look for National Register-eligible farms, and if the farmstead does not possess sufficient integrity to be National Register-eligible, it will probably not be necessary to determine which acreage is historically associated with the farm and to inventory that acreage.

Research. Useful research sources include historic aerial photos, historic plat maps (atlases), historic photos, historic census data, deed research, oral interviews, and current USGS topographical maps. There are very few documentary sources for information on the operation of individual farms. (Among them are the Minnesota Agricultural Census schedules for the years 1860, 1870, and 1880.)

FUNCTION OF ELEMENTS

To understand the development and operation of Minnesota farms, it may be useful to see that most individual farm elements fall into one of four broad categories based on use: domestic elements, animal husbandry elements, crop husbandry elements, and service and utility elements. Minnesota farms from the period covered by this context study – 1820-1960 – were generally comprised of elements from all four categories.

Domestic Elements

Farmhouses
Hired Workers' Housing
Gardens (Vegetable)
Lawn and Ornamental Plantings
Other Domestic Elements
Saunas
Summer Kitchens

Animal Husbandry Elements

Animal Underpasses
Cattle Guards
Beef Barns
Brooder Houses
Bull Barns
Dairy Barns
Fences
Fields and Pastures*
General Purpose or Combination Barns
Housebarns
Milk Houses
Milking Barns
Manure Pits or Bunkers
Other Animal Husbandry Elements
Poultry Houses
Sheep Barns
Smokehouses
Stock Tanks

Hog Barns and Hog Cots
Horse Barns
Stockyards
*repeated in crop husbandry list

Crop Husbandry Elements

Corncribs
Drainage Structures
Erosion Control Structures
Field Rock Piles
Fields and Pastures*
Granaries, Elevators, Bins, Dryers
Greenhouses, Hotbeds, Coldframes
Hay Barns or Sheds
Irrigation Structures
Orchards
Other Crop Husbandry Elements
Potato Warehouses
Root Cellars
Scale Houses
Shelterbelts
Silos
Sugarhouses
Threshing Barns
Tobacco Barns
*repeated in animal husbandry list

Service and Utility Elements

Acetylene or Carbide Gas Structures
Airplane Hangars
Boundary Markers
Cesspools and Septic Tanks
Cisterns
Combination Buildings
Farm Shops
Farmyards
Garages
Icehouses
Implement or Machine Sheds
Other Service and Utility Elements
Power Houses
Privies
Propane Gas Structures
Pumps and Pump Houses
Roads, Lanes, Tracks, Sidewalks
Roadside Markets
Springhouses and Springboxes
Utility Poles and Equipment
Water Power Structures
Water Tanks and Tank Houses
Wells
Wetlands
Windbreaks
Windmills
Woodlots
Woodsheds

CATEGORIZING ELEMENTS FOR NATIONAL REGISTER NOMINATIONS

The National Register program categorizes individual resources as being either Buildings, Structures, Objects, or Sites. (The category Districts is used for multiple resources.) These distinctions are used primarily for counting and organizing resources within a National Register nomination, but may also be useful in inventorying farm properties. Some of the distinctions are somewhat arbitrary, and follow National Register guidelines and Minnesota SHPO precedent.

Buildings. The National Register defines a building as an element built to shelter any form of human activity. Examples of buildings associated with this historic context include:

Airplane Hangars
Beef Barns
Brooder Houses
Bull Barns
Combination Buildings
Dairy Barns
Farm Shops
Horse Barns
Housebarns
Implement or Machine Sheds
Milk Houses
Milking Barns
Poultry Houses*
Privies

Farmhouses
Garages
General Purpose or Combination Barns
Hay Barns or Sheds
Hired Workers' Housing
Hog Barns and Hog Cots*
Saunas
Sheep Barns
Sugarhouses
Summer Kitchens
Threshing Barns
Tobacco Barns

*hog cots and brooder huts may be categorized as structures

Structures. According to National Register definitions, structures are elements built for purposes other than sheltering a form of human activity. Structures also include landscape elements that have been built or planted (such as erosion control structures and windbreaks), but not naturally-occurring landscape elements (such as natural stands of forest used as woodlots), which are generally categorized as sites. Examples of structures associated with this historic context include:

Acetylene or Carbide Gas Structures
Animal Underpasses
Cattle Guards
Cesspools and Septic Tanks
Cisterns
Corncribs
Drainage Structures
Erosion Control Structures
Fences
Field Rock Piles
Gardens (Vegetable)
Granaries, Elevators, Bins, Dryers
Greenhouses, Hotbeds, Coldframes
Icehouses
Irrigation Structures
Manure Pits or Bunkers
Orchards
Potato Warehouses
Power Houses
Propane Gas Structures
Pumps and Pump Houses
Roads, Lanes, Tracks, Sidewalks*
Roadside Markets
Root Cellars
Scale Houses
Shelterbelts
Silos
Smokehouses
Springhouses and Springboxes
Stockyards
Water Power Structures
Water Tanks and Tank Houses
Wells
Windbreaks
Windmills
Woodlots (if planted)
Woodsheds

*unimproved livestock tracks or lanes may be categorized as sites

Objects. Objects are elements that are "relatively small in scale and simply constructed" or "primarily artistic in nature," according to the National Register program (*How to Apply* 1997: 5). For the purposes of this historic context, objects should be essentially fixed or permanent – movable equipment, for example, is not included. Examples of objects associated with this historic context include:

Boundary Markers
Utility Poles and Equipment
Stock Tanks

Sites. Sites can be places where significant functions or activities occurred, or be natural landscape elements that were manipulated or used. They can possess associative significance or the potential to yield information. Pastures, for example, are generally considered sites unless they were extensively "built" (for example contain drainage structures or terracing to enable use), in which case they may be categorized as structures. Naturally-occurring stands of trees that are used as farm woodlots are considered sites. (On the other hand, farm windbreaks that were planted are considered structures.) Livestock tracks or "cow paths," deer or human trails, and field lanes that are largely unimproved are categorized as sites because they were generally not "built" but were instead the site of activity (despite the fact that the activity may have left significant marks). Most roads, on the other hand, are categorized as structures because they were usually "built." Naturally-occurring waterways, hills, and similar elements are ordinarily not categorized (or counted) except in rare cases. Exceptions may include natural features used in important ways in significant farming operations, or features that possess special cultural significance. Examples of sites associated with this historic context include:

Archaeological Resources (see Volume 4 of this context study)
Farmyards
Fields and Pastures
Landscaping and Ornamental Plantings
Wetlands (if used for farm activity)
Woodlots (if natural)

Counting Elements for National Register Nominations. A National Register nomination form requires a formal count of the property's resources. For example, the National Register generally counts a barn and attached silo as one resource, even if they were built at different times, unless the barn and silo stood detached for some time and were later linked together, in which case they may be counted as two resources (*How to Complete* 1991: 17). Counting a combination building (one built over several years with multiple functional units) may not be immediately obvious. Not all small-scale elements are counted in a nomination.

▪ EVALUATING RESOURCES

AREA OF SIGNIFICANCE

Minnesota farm resources will most likely be eligible for the National Register in the areas of Agriculture, Architecture, and/or Engineering. Ethnic Heritage and Exploration/Settlement are among other possible areas of significance.

PERIOD OF SIGNIFICANCE

The period of significance is defined as the time during which the property attained significance; or the time during which the property was associated with important events, patterns, activities, or persons; or the time that the property attained important physical characteristics. The term "historic" generally means during the period of significance.

Identifying the period of significance is central to the process of evaluating National Register eligibility. Determining the period of significance helps identify the broad patterns, trends, or events with which a property may be associated. Determining the period of significance helps in the analysis of the property's physical integrity or degree of alteration. It also works the other way – the physical integrity helps determine a possible period of significance.

CONTRIBUTING AND NONCONTRIBUTING ELEMENTS

Elements are identified as contributing or noncontributing to the significance of a property based on their age, function, level of historic physical integrity, and historic associations. These distinctions are used primarily for preparing National Register nominations, but may also be useful in assessing the historic integrity of properties and determining National Register eligibility. In general, elements are noncontributing if they have been substantially altered since the period of significance, were added since the period of significance, or do not share the property's historic associations.

BOUNDARIES OF A NATIONAL REGISTER-ELIGIBLE PROPERTY

The boundaries of a National Register-eligible property should generally be drawn to encompass the greatest number of elements that retain acceptable historic physical integrity and thereby contribute to the property's significance. (The research potential of elements should also be considered.)

The boundaries should generally be drawn to exclude noncontributing elements (for example fields that have lost historic integrity) in situations where the inclusion of those elements would disrupt the property's overall ability to convey its historic character, associations, and significance.

Current ownership is not relevant when determining the boundaries of a National Register-eligible property. For example, the boundaries of the National Register-eligible property may include a particular farmstead and a set of fields with which it was historically associated, even though today some of those fields are owned by neighbors.

CONSIDERATIONS WHEN ASSESSING INTEGRITY

To be eligible for the National Register, a property must possess sufficient historic physical integrity to convey its historic character, associations, and significance. Assessing integrity should be grounded in a good understanding of:

- the age, function, intent, and historic appearance of each farm element
- functional and physical relationships among elements, and between elements and the whole
- physical changes that have occurred within and outside of the period of significance
- suspected associations with broad trends, patterns, events, important people, or other aspects of significance

Some general considerations when assessing the integrity of Minnesota farm resources:

- The cumulative effect of changes to the property since the period of significance should be weighed against the cumulative effect of elements and characteristics that retain good integrity. The goal is to assess the property's overall ability to continue to convey its historic character, associations, and significance.
- A property may be in poor physical condition and still retain sufficient integrity to convey its historic character, associations, and significance. In other words, poor physical condition does not in itself render a property ineligible for the National Register.
- Properties that appear to be unusually rare examples of their type, or to contain unusually rare resources, may justify a lower threshold of physical integrity.

- Properties eligible under any of the National Register criteria for evaluation (see below) must retain essential physical integrity. However, properties eligible under Criterion C must generally be more intact that those eligible under Criteria A or B because it is the property's *physical characteristics* that are the basis of its significance under Criterion C.

Integrity of Location. A farm or farmstead, will, by definition, retain integrity of location. An individual farm element, however, may have been moved either during or after the period of significance, especially since farmers routinely moved elements within farms to improve operations or adapt to new methods.

To retain acceptable integrity of location:

- the resource should be on its historic location or in a similar location; a similar location is defined as "an orientation, setting, and general environment that are comparable to those of the historic location and that are compatible with the property's significance" (this wording is from National Register guidelines for moved properties) (*How to Apply* 1997: 30)
- an element moved onto a farm from another location after the period of significance should not interfere with the farm's ability to convey its historic character, associations, and significance
- an individual element moved away from a farm to a non-farm location (for example, to a county fairgrounds) is likely to have lost acceptable integrity of location
- farm resources' functional and physical relationship (historically) with each other and with the whole should be readily apparent

If a large number of elements on a farm have been moved, the property may have lost necessary integrity of location.

Integrity of Design. Integrity of design generally includes aspects such as footprint, plan, massing, form, scale, size, materials, style, structural system, detailing, roofline, and fenestration. Also important to assessing integrity of design for farm resources is an understanding of:

- the elements' function and its expression in form
- the arrangement of elements; i.e., their physical and functional relationships
- preexisting topography and landscape features how this affected design
- technology represented

Some additional considerations when assessing integrity of design:

- To retain acceptable integrity of design, the property's current spatial arrangement, circulation patterns, and physical and functional relationships should not be inconsistent with those of the historic period.
- Additions and alterations made after the period of significance should be modest in scale and should not obscure the resource's historic design characteristics; for example, buildings that have been re-sided after the period of significance should otherwise retain good integrity
- New elements added to the property after the period of significance should be small in number, modest in scale, and should not obscure the property's historic design characteristics or historic interrelationships.

- The impact of missing elements (i.e., elements removed from the property since the period of significance) should be assessed carefully to determine whether the property is still able to convey its historic functions, complexity, interrelationships, etc.
- The presence of small-scale elements such as privies or ornamental plantings will strengthen a property's integrity, but their absence does not necessarily mean that the property has lost essential integrity of design.
- To retain acceptable integrity of design, fields and pastures should retain historic or similar sizes with edges visibly defined by fence lines, lanes, vegetation, topography, or similar details; fields and pastures do not need to be planted with the same crops or vegetation as during the period of significance.
- Because vegetation is subject to change by natural forces such as disease, volunteer reseeding, and limits of natural life span, it is expected that vegetative changes will have occurred since the period of significance. However, the changes should not be so extensive that they interfere with the property's ability to convey its historic character, associations, and significance.
- When assessing integrity of design it is important to consider the cumulative impact of numerous "small" changes made since the period of significance. For example, the removal of fences, the paving of a farmyard with bituminous, and the residing of one building and the expansion of another may have the cumulative effect of removing the property's ability to convey its historic character, associations, and significance.

Integrity of Setting. The setting of a property is generally comprised of the natural and man-made resources that surround it.

To retain acceptable integrity of setting, the property's current setting should not be so inconsistent in character with its historic setting that the property is no longer able to convey its historic character, associations, and significance.

Changes to setting may have a greater impact on a small property's ability to convey its historic character, associations, and significance, than on a large property. For example, a four-acre farmstead now entirely surrounded by 1980s residential development may have a more difficult time conveying its historic character, associations, and significance than does a 25-acre farm in the same setting.

Integrity of Materials. Integrity of materials is an important component of integrity of design (see integrity of design above). Materials can convey information about how Minnesota farms developed, operated, and evolved, what resources and technologies were available, the influence of broad patterns and trends, and the role of individual preferences or variations.

Some considerations when assessing integrity of materials:

- To retain acceptable integrity of materials, changes made to a property's materials after the period of significance should not be so substantial that they prevent the property from conveying its historic character, associations, and significance.
- National Register guidelines indicate that a property "must retain the key exterior materials dating from the period of its historic significance" (*How to Apply* 1997: 45).
- National Register guidelines indicate that a resource whose historic exterior materials have been covered by non-historic materials can still be eligible for the National Register if the

"significant [historic] form, features, and detailing are not obscured" (*How to Apply* 1997: 47). To retain acceptable integrity of materials under this historic context, the historic materials should remain beneath the newer siding and the resource should continue to convey important characteristic such as footprint, massing, style, roofline, fenestration, etc.

- In addition to lumber, roofing shingles, foundation stones, and siding, a farm's historic materials will likely include road surfacing, fencing materials, vegetation (e.g., in woodlots, wetlands, or ornamental plantings), etc.
- Because vegetation is subject to change by natural forces such as disease, volunteer reseeding, and limits of natural life span, it is expected that vegetative changes will have occurred since the period of significance. However, the changes should not be so extensive that they interfere with the property's ability to convey its historic character, associations, and significance.
- It is not expected that fields or pastures will retain historic vegetation (e.g., the same crops as were planted during the period of significance). However, to retain acceptable integrity, fields and pastures should retain historic or similar sizes with edges visibly defined by fence lines, lanes, vegetation, topography, or similar details.

Integrity of Workmanship. Like integrity of materials, integrity of workmanship can convey information about the design and construction of Minnesota farm elements, how farms changed through time, technological developments, the influence of broad patterns and trends, and the imprint of individual craftsman and builders and their preferences and skill levels.

For a property to retain acceptable integrity of workmanship, physical changes made after the period of significance should not obscure or detract from historic workmanship to the degree that the property is no longer able to convey its historic character, associations, and significance.

Integrity of Feeling. According to National Register guidelines, "Feeling is a property's expression of the aesthetic or historic sense of a particular period of time" (*How to Apply* 1997: 45).

To retain acceptable integrity of feeling, a farm resource should retain enough physical characteristics from the period of significance – in other words, location, design, setting, materials, and workmanship – that the property can still convey – or the visitor can still perceive – the property's historic character, associations, and significance. The cumulative effect of changes to the property since the period of significance, weighed against the cumulative effect of elements and characteristics that retain good integrity, often form a basis for integrity of feeling.

Integrity of Association. A property that retains integrity of association, according to National Register guidelines, retains its ability to convey its links to important broad patterns and trends, historic events, important people, etc. (*How to Apply* 1997: 45).

To retain acceptable integrity of association, a farm resource should retain enough physical characteristics from the period of significance – in other words, location, design, setting, materials, and workmanship – to maintain a perceptible link with the events, patterns, people, or economic, physical, and social forces that shaped it. As with integrity of feeling, the cumulative effect of changes to the property since the period of significance, weighed against the cumulative effect of elements and characteristics that retain good integrity, often form a basis for assessing this aspect of integrity.

CONSIDERATIONS WHEN APPLYING THE NATIONAL REGISTER CRITERIA FOR EVALUATION

To be eligible for the National Register, a property must generally be at least 50 years old, retain enough historic integrity to convey its historic character, associations, and significance, and meet at least one of four key National Register Criteria for Evaluation. (See *How to Apply the National Register Criteria for Evaluation* (1997) for a discussion of various criteria considerations and exceptions.)

The discussion below outlines some points to consider when evaluating the National Register eligibility of farm resources under each of the four National Register criteria.

Criterion A. Properties that are associated with events that have made a significant contribution to the broad patterns of our history.

To be eligible under Criterion A, a property not only must be associated with an important historic event or broad pattern, but must be associated with the event or pattern *in an important way*. According to National Register guidelines, "Mere association with historic events or trends is not enough, in and of itself, to qualify under Criterion A: the property's specific association must be considered important as well" (*How to Apply* 1997: 12).

Farms or farmsteads on which particular events occurred would not necessarily be eligible for the National Register unless it is also demonstrated that the event was important to the development of Minnesota farming locally or on a larger scale. For example, a farm on which a Homemakers' Club annual meeting was held would not be eligible under Criterion A unless that meeting was, for example, a watershed event that led to other activities that influenced the broader role of women in Minnesota agriculture or that affected some other important aspect of the development of Minnesota farming. Similarly, the only farm in Pope County on which rutabagas were grown would not be eligible for the National Register unless, for example, that effort helped convince other farmers of the merits of the crop, thereby developing an important local production area.

Examples of association with important historic events or patterns within this historic context might include a farm on which a cooperative purchasing, marketing, or processing association was organized and activities carried out, or a farm that was the first in the area to receive high-line electricity and became a demonstration of the practical details and benefits of electrification.

To be eligible under Criterion A, the property must also retain sufficient physical integrity to allow it to convey its historic character, associations, and significance. (See "Considerations When Assessing Integrity" above.)

Criterion B. Properties that are associated with the lives of persons significant in our past.

Properties may be eligible under Criterion B if they are associated with a person who made a significant contribution to the development of Minnesota farming, locally or on a larger scale.

The property must be materially (i.e., physically) associated with those significant contributions. In other words, the person must have carried on substantive activities relating to their contributions within the farm building (or on the farm) for that farm building (or farm) to materially associated with those contributions and therefore eligible under Criterion B.

The property must have been linked to the important person during the time period in which the person made their significant contributions. For example, if a person made significant contributions to Minnesota agriculture during their working career but not in retirement, a farm they moved to in their retirement years may not be eligible under Criterion B.

Examples of people who made significant contributions under this historic context might include:

- A farmer who engaged in important fruit tree or livestock breeding, or who developed and promoted a farming practice, that was influential locally or statewide
- A farmer important in a pattern of social, economic, or political events that advanced farming such as organization of a cooperative cow testing association or the regional activities of the Farmers' Holiday movement
- A staff member of an agricultural school, experiment station, or county extension office who played a leading role in disseminating information on poultry husbandry that resulted in a significant increase in poultry production in a region
- A leading member of the American Society of Agricultural Engineers (ASAE) who was important in developing improved farm building designs

To be eligible under Criterion B, the property must also retain sufficient physical integrity to allow it to convey its historic character, associations, and significance. (See "Considerations When Assessing Integrity" above.)

Criterion C. Properties that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.

To be eligible under Criterion C, the property must also retain sufficient physical integrity to allow it to convey its historic character, associations, and significance. However, properties eligible under Criterion C must generally be more intact that those eligible under Criteria A or B because it is the property's *physical characteristics* that are the basis of its significance under Criterion C. (See also "Considerations When Assessing Integrity" above.)

Each of the four aspects of Criterion C eligibility are briefly discussed below:

Properties that embody distinctive characteristics of a type, period, or method of construction

The term "characteristics" is defined as the physical features or traits that commonly occur within a class of resources. The phrase "type, period, or method of construction" can refer to the way a class of resources shares:

- an important cultural tradition
- a significant function or functional relationship
- a significant style or type of design, engineering, construction, or craftsmanship
- a significant choice or use of materials
- an important technological stage or advancement

Farm resources can possess "distinctive characteristics of a type, period, or method of construction" if they represent one of the qualities listed below – but only if the quality is very clearly illustrated within or via the resource, and is demonstrated to be important:

- the pattern of features common to a particular class of resources
- a particular period of Minnesota farm development
- the process of response to natural, economic, political, or social forces
- significant individual differences or variation within a class of resources
- evolution of a class of resources
- the transition between classes of resources

To possess "distinctive characteristics of a type, period, or method of construction," the pattern, period, response, variation, evolution, or transition must have been important to the development of Minnesota agriculture, or to the development of a specific type of farming resource, or the development of farming in a particular geographic area. For example, in the 1940s during the transition from horses to tractors, some farmers built combination horse barn-implement sheds to house horses, a tractor, implements, feed grain, hay, and bedding. A well-preserved example of this type of building could represent the gradual but monumental change from horses to gasoline power.

The "distinctive characteristics of a type, period, or method of construction" could represent an *adaptation* through time (rather than a transition). According to National Register guidelines, "a property can be significant not only for the way it was originally constructed or crafted, but also for the way it was adapted at a later period, or for the way it illustrates changing tastes, attitudes, and uses over a period of time" (*How to Apply* 1997: 19). Farm elements that represent adaptations are likely to be found on Minnesota farms since, to remain profitable, farms often had to adapt to changing technology, market forces, environmental conditions, etc. To do this, for example, farmers routinely remodeled, reused, moved, and expanded buildings to best support farm operations. However, to possess distinctive characteristics that represent adaptation, the property must *clearly illustrate* the functions or practices or methods of both earlier and subsequent phases or periods, and the *adaptation must be significant* to the development of Minnesota farms or farming. For example, a threshing barn in southeastern Minnesota that was built during the wheat monoculture era might have been subsequently remodeled to support livestock when area farms diversified. Significance would be strengthened if the adaptation inspired others to diversify and/or similarly alter their threshing barns. The barn would need to retain physical characteristics that clearly demonstrate its uses during both grain-only and diversified eras.

Properties that represent the work of a master

To represent the work of a master, a farm resource could represent the work of a recognized or prominent designer or builder.

To represent the work of a master, a farm resource could instead represent the work of an anonymous designer or builder. The designer or builder's work should be distinguishable from others by its characteristic style and high quality.

According to National Register guidelines, if the resource is the only known work of a designer or builder (whether the person is known or anonymous), the resource should be considered under "high artistic value" (see below) rather than under "work of a master" because the term "master" implies multiple works.

The resource should be compared to other works by the same designer or builder so the significance of the resource as an example of a particular phase, theme, or aspect within a larger body of work is understood.

Properties that possess high artistic value

To possess high artistic value, a farm resource must express superior artistic ideals, superior design or engineering quality or concepts, superior aesthetic values, or superior craftsmanship. It must be demonstrated that the property possesses or expresses these values to a higher degree than similar properties within this historic context. Typical or modest examples of design or craftsmanship would not qualify.

Properties that represent a significant and distinguishable entity whose components may lack individual distinction

To qualify under this aspect of Criterion C, a group of elements (e.g., a farm or farmstead) must derive its importance from being a unified and interrelated entity composed of a wide variety of resources that may lack individual distinction. The entity must be distinguishable from surrounding resources and must form a significant whole. The identity of the group must be derived from important shared relationships or interrelationship among the elements that create a significant whole. It is recommended that Minnesota farm resources would not likely be eligible for the National Register by meeting this aspect of Criterion C alone, but should also meet one of the other aspects of Criterion C at the same time.

Criterion D. Properties that have yielded, or may be likely to yield, information important in prehistory or history.

For information on evaluating resources under National Register Criterion D, see Volume 4 of this context study, which discusses historical archaeological resources.

▪ RECOMMENDED GUIDELINES FOR EVALUATING THE NATIONAL REGISTER ELIGIBILITY OF SPECIFIC PROPERTY TYPES

Recommended guidelines for National Register eligibility under the historic context "Euro-American Farms in Minnesota, 1820-1960" are outlined below. The guidelines are organized by the type of property being evaluated:

- a district of several farms
- a farm
- a farmstead
- part of a farmstead (e.g., a small group of elements such as a house and barn)
- an individual farm element

It is expected that these guidelines will require periodic modification as the extent of surviving farm resources in Minnesota is better understood. While the guidelines were field-tested during the preparation of this historic context study, they were not based on a statewide survey of existing resources. It is recommended that they be reviewed and updated as surveys are conducted and as more is learned about the prevalence and survival of specific types of resources.

▸ A DISTRICT OF SEVERAL FARMS

To be eligible under National Register Criterion A or B:

For Criterion A, see the guidance under "Criterion A" in the discussion "Considerations When Applying the National Register Criteria for Evaluation" above.

For Criterion B, see the guidance under "Criterion B" in the discussion "Considerations When Applying the National Register Criteria for Evaluation" above.

In addition, a district of several farms must possess sufficient historic physical integrity to convey its historic character, associations, and significance. See the discussion "Considerations When Assessing Integrity" above.

To be eligible under National Register Criterion C:

A district of several farms should meet one of the following requirements:

- embody distinctive characteristics of a type, period, or method of construction
- be the work of a master
- display high artistic value
- represent a significant and distinguishable entity whose components lack individual distinction (generally must also meet one of the other three)

For guidance on the above, see "Criterion C" in the discussion "Considerations When Applying the National Register Criteria for Evaluation" above.

In addition, a majority of the resources within a district of several farms eligible under Criterion C should meet the integrity guidelines listed under Criterion C for a farm (see "Farm" below).

To be eligible under National Register Criterion D:

See Volume 4 of this historic context study which addresses historical archaeological resources.

▸ A FARM

To be eligible under National Register Criterion A or B:

A farm must be associated with a significant event, pattern, trend, or person.

For Criterion A, see the guidance under "Criterion A" in the discussion "Considerations When Applying the National Register Criteria for Evaluation" above.

For Criterion B, see the guidance under "Criterion B" in the discussion "Considerations When Applying the National Register Criteria for Evaluation" above.

In addition, a farm must possess sufficient historic physical integrity to convey its historic character, associations, and significance. See the discussion "Considerations When Assessing Integrity" above.

To be eligible under National Register Criterion C:

A farm must meet one of the following requirements:

- embody distinctive characteristics of a type, period, or method of construction
- be the work of a master
- display high artistic value
- represent a significant and distinguishable entity whose components lack individual distinction (generally must also meet one of the other three)

For guidance on the above, see "Criterion C" in the discussion "Considerations When Applying the National Register Criteria for Evaluation" above.

In addition, a farm eligible under Criterion C must retain sufficient historic physical integrity. A farm eligible under Criterion C will generally be more intact than a farm eligible under Criteria A or B because it is the property's *physical characteristics* that are the basis of its significance. A farm eligible under Criterion C should have cumulative physical integrity based on meeting a majority of the following integrity guidelines:

integrity of location
- a majority of elements should be on historic or similar locations; a similar location is defined as "an orientation, setting, and general environment that are comparable to those of the historic location and that are compatible with the property's significance" (this wording is from National Register guidelines for moved properties) (*How to Apply* 1997: 30)
- if an element has been moved within the farm since the period of significance, it should still be within the farmstead if it was historically within the farmstead, and still be in a non-farmstead location (e.g., field, pasture, woodlot, windbreak, or wetland area) if it was historically in a non-farmstead location
- see also the integrity of location discussion in "Considerations When Assessing Integrity" above

integrity of design
- see the integrity of design discussion in "Considerations When Assessing Integrity" above
- the farm's historic function should be readily apparent through the retention of design characteristics that enabled that function
- the farm's historic spatial arrangement, circulation patterns, and physical and functional relationships should be apparent

- additions and alterations made after the period of significance should be modest in scale and should not obscure the resource's historic design characteristics
- footprints, rooflines, door and window openings, and/or massing from the period of significance should be readily apparent on a majority of elements
- a substantial amount of historic materials should be present on a majority of elements
- if re-sided after the period of significance, elements should otherwise retain good integrity
- new elements added to the property after the period of significance should be small in number, modest in scale, and should not obscure the property's historic design characteristics or historic interrelationships. (A provisional rule of thumb used during this study: it seems to be disruptive to a farm's integrity of design if its building complex (the farmstead) contains more than approximately 850 sq. ft. of buildings or structures constructed after the period of significance, unless the recent construction is situated at the edge of the building complex, or unless the farmstead is unusually large.)
- the impact of missing elements (i.e., elements removed from the property since the period of significance) should be assessed carefully to determine whether the property is still able to convey its historic functions, complexity, interrelationships, etc.
- the presence of small-scale elements such as privies or ornamental plantings will strengthen a property's integrity, but their absence does not necessarily mean that the property has lost essential integrity of design.
- fields and pastures should retain historic or similar sizes with edges visibly defined by fence lines, lanes, vegetation, topography, or similar details; fields and pastures do not need to be planted with the same crops or vegetation as during the period of significance
- it is expected that vegetative changes will have occurred since the period of significance; however, vegetative changes should not be so extensive that they interfere with the property's ability to convey its historic character, associations, and significance
- multiple "small" changes made since the period of significance may have the cumulative effect of removing the property's ability to convey its historic character, associations, and significance
- the farm should retain domestic, animal husbandry, crop husbandry, and service and utility elements as follows (see "Function of Elements" in the discussion "Inventorying Resources" above for a list of resources in each of the four categories):

  domestic elements
  - the principal farmhouse from the period of significance should be present
  - other domestic elements from the period of significance such as hired workers' housing, a vegetable garden, lawn and ornamental plantings, sauna, and summer kitchen need not be present unless especially important to the operation of the particular farm being evaluated, but their presence strengthens Criterion C significance

  animal husbandry elements
  - the principal barn from the period of significance should be present
  - a majority of the livestock housing used during the period of significance should be present including facilities for housing beef cattle, dairy cows, draft horses, hogs, poultry, and sheep. (A provisional rule of thumb used during this study was seventy-five percent of livestock housing should be present.)
  - if loose dairy housing was used during the period of significance, the milking barn or parlor should be present
  - if a milk house was used during the period of significance, it should be present

- at least one of the following from the period of significance should be present: fences (or evidence of fence lines), stockyards, and pastures
- other animal husbandry elements from the period of significance such as an animal underpass, brooder house, bull barn, cattle guard, manure pit, smokehouse, stock tank, and tracks or cow paths need not be present unless especially important to the operation of the particular farm being evaluated, but their presence strengthens Criterion C significance
- some field or pasture land should be present and retain its historic or similar size with edges visibly defined by fence lines, lanes, vegetation, topography, or similar features; a provisional rule of thumb used during this study: a minimum of five acres (this could vary based on topography, presence of untilled areas such as stream banks or wetlands, wooded or unwooded setting, etc.)

crop husbandry elements

- a majority of the facilities for storing silage, ear corn, grain, hay, and potatoes and other crops during the period of significance should be present including silos, corncribs, threshing barns, granaries, elevators, bins, dryers, hay barns or sheds, potato warehouses, and root cellars; where multiple units were used (e.g., several grain bins), a representative example is acceptable. (A provisional rule of thumb used during this study was seventy-five percent of facilities for crop storage and processing should be present.)
- field or pasture land: see animal husbandry elements above
- other crop husbandry elements from the period of significance such as drainage structures, erosion control structures, field rock piles, a greenhouse or coldframe or hotbed, irrigation structures, an orchard, scale house, shelterbelt, sugarhouse, and tobacco barn need not be present unless especially important to the operation of the particular farm being evaluated, but their presence strengthens Criterion C significance

service and utility elements

- roads or lanes and a farmyard from the period of significance should be present
- facilities for storing and repairing implements during the period of significance should be present
- a windbreak or woodlot from the period of significance should be present
- at least one of the following water/cooling/sewer elements from the period of significance should be present: a cesspool or septic tank, cistern, icehouse, privy, springhouse or springbox, water tank or tank house, well, or similar element
- at least one of the following power/fuel elements from the period of significance should be present: acetylene or carbide gas structure, power house, propane gas structure, pump or pump house, utility poles and equipment, water power structure, windmill, woodshed, or similar structure
- other service and utility elements from the period of significance such as an airplane hangar, boundary marker, combination building, farm shop, garage, and roadside market need not be present unless especially important to the operation of the particular farm being evaluated, but their presence strengthens Criterion C significance

integrity of setting

- see the integrity of setting discussion in "Considerations When Assessing Integrity" above

integrity of materials

- see "Integrity of Design." See also the integrity of materials discussion in "Considerations When Assessing Integrity" above

integrity of workmanship

- see "Integrity of Design." See also the integrity of workmanship discussion in "Considerations When Assessing Integrity" above

integrity of feeling

- see the integrity of feeling discussion in "Considerations When Assessing Integrity" above

integrity of association

- see the integrity of association discussion in "Considerations When Assessing Integrity" above

To be eligible under National Register Criterion D:

See Volume 4 of this historic context study which addresses historical archaeological resources.

▸ A FARMSTEAD

To be eligible under National Register Criterion A or B:

For Criterion A, see the guidance under "Criterion A" in the discussion "Considerations When Applying the National Register Criteria for Evaluation" above.

For Criterion B, see the guidance under "Criterion B" in the discussion "Considerations When Applying the National Register Criteria for Evaluation" above.

In addition, a farmstead must possess sufficient historic physical integrity to convey its historic character, associations, and significance. See the discussion "Considerations When Assessing Integrity" above.

To be eligible under National Register Criterion C:

A farmstead should meet one of the following requirements:

- embody distinctive characteristics of a type, period, or method of construction
- be the work of a master
- display high artistic value
- represent a significant and distinguishable entity whose components lack individual distinction (generally must also meet one of the other three)

For guidance on the above, see "Criterion C" in the discussion "Considerations When Applying the National Register Criteria for Evaluation" above.

In addition, a farmstead eligible under Criterion C must retain sufficient historic physical integrity. A farmstead eligible under Criterion C will generally be more intact than a farmstead eligible under

Criteria A or B because it is the property's *physical characteristics* that are the basis of its significance. A farmstead eligible under Criterion C should have cumulative physical integrity based on meeting a majority of the following integrity guidelines:

integrity of location
- use same guidelines as for a farm (see "Farm" above)

integrity of design
- use same guidelines as for a farm (see "Farm" above) except fields and pastures (and the structures within them) will not be included in a farmstead

integrity of setting
- see the integrity of setting discussion in "Considerations When Assessing Integrity" above

integrity of materials
- see "Integrity of Design." See also the integrity of materials discussion in "Considerations When Assessing Integrity" above.

integrity of workmanship
- see "Integrity of Design." See also the integrity of workmanship discussion in "Considerations When Assessing Integrity" above.

integrity of feeling
- see the integrity of feeling discussion in "Considerations When Assessing Integrity" above

integrity of association
- see the integrity of association discussion in "Considerations When Assessing Integrity" above

To be eligible under National Register Criterion D:

See Volume 4 of this historic context study which addresses historical archaeological resources.

▸ PART OF A FARMSTEAD

It is possible that a small cluster of adjacent elements such as farmhouse, barn, and granary may be eligible for the National Register. This small group of elements will generally not possess the complex spatial and functional interrelationships inherent in a farm or farmstead, and it is recommended that the eligibility guidelines for farm and farmstead do not apply. Instead, it is recommended that *each* element in the cluster must *individually* meet the requirements for National register eligibility listed under "An Individual Farm Element" below. However, the boundaries of the National Register-eligible property should be drawn around the entire cluster to help preserve the resources' physical, functional, and associational relationships.

▸ AN INDIVIDUAL FARM ELEMENT

To be eligible under National Register Criterion A or B:

An individual farm element is not likely to be individually eligible under Criterion A or B unless the association or link with a significant event, pattern, trend, or person is outstanding (e.g., the resource is the sole resource known to be associated with the significant event, pattern, trend, or person).

For Criterion A, see the guidance under "Criterion A" in the discussion "Considerations When Applying the National Register Criteria for Evaluation" above.

For Criterion B, see the guidance under "Criterion B" in the discussion "Considerations When Applying the National Register Criteria for Evaluation" above.

In addition, the individual farm element must possess sufficient historic physical integrity to convey its historic character, associations, and significance. See the discussion "Considerations When Assessing Integrity" above.

To be eligible under National Register Criterion C:

An individual farm element must meet one of the following requirements:

- embody distinctive characteristics of a type, period, or method of construction
- be the work of a master
- display high artistic value

Note that representing a "significant and distinguishable entity whose components lack individual distinction" would likely not apply to an individual farm element. For guidance on the above, see "Criterion C" in the discussion "Considerations When Applying the National Register Criteria for Evaluation" above.

An individual farm element is not likely to meet the above requirements unless it is *especially distinctive*, for example:

- displays outstanding craftsmanship
- is a rare example of a significant property type
- displays distinctive or unusually well-developed ethnic-influenced design or construction or an important cultural tradition
- is a distinctive (e.g., very early) or unusually well-developed example of a significant design type, structural form, or technological stage or advancement
- comprises a distinctive or unusually well-developed example of a significant type or form of system (as in a set of drainage structures or erosion control structures),
- displays distinctive and significant innovation by the designer, builder, or farmer
- displays distinctive or unusually well-developed use of significant materials,
- displays early or experimental use of significant "new" or "modern" materials or prefabrication

In addition, an individual farm element eligible under Criterion C must retain sufficient historic physical integrity. In many cases an individual farm element eligible under Criterion C will be more intact than an individual element eligible under Criteria A or B because it is the property's *physical characteristics* that are the basis of its significance. An individual farm element eligible under Criterion C should meet the following integrity guidelines:

integrity of location

- the resource should be on its historic location or in a similar location; a similar location is defined as "an orientation, setting, and general environment that are comparable to those of the historic location and that are compatible with the property's significance" (this wording is from National Register guidelines for moved properties) (*How to Apply* 1997: 30)
- see also integrity of location guidelines for a "Farm" above; see also the discussion "Considerations When Assessing Integrity" above
- an individual element moved away from a farm to a non-farm location (for example, to a county fairgrounds) is likely to have lost acceptable integrity of location

integrity of design

- historic function should be readily apparent through the retention of design characteristics that enabled that function
- additions and alterations made after the period of significance should be modest in scale and should not obscure the resource's historic design characteristics
- historic footprint, roofline, door and window openings, and/or massing should be readily apparent
- a substantial amount of historic materials should be present
- if re-sided after the period of significance, the element should otherwise retain good integrity
- it is expected that vegetative changes will have occurred since the period of significance; however, vegetative changes should not be so extensive that they interfere with the resource's ability to convey its historic character, associations, and significance
- multiple "small" changes made since the period of significance may have the cumulative effect of removing the resource's ability to convey its historic character, associations, and significance
- see also the discussion "Considerations When Assessing Integrity" above

integrity of setting

- see integrity of setting guidelines for a "Farm" above. See also the integrity of setting discussion in "Considerations When Assessing Integrity" above.

integrity of materials

- see "Integrity of Design." See also the integrity of materials discussion in "Considerations When Assessing Integrity" above.

integrity of workmanship

- see "Integrity of Design." See also the integrity of workmanship discussion in "Considerations When Assessing Integrity" above.

integrity of feeling

- see the integrity of feeling discussion in "Considerations When Assessing Integrity" above

integrity of association

- see the integrity of association discussion in "Considerations When Assessing Integrity" above

More specific information about the potential Criterion C eligibility of individual farm elements follows. This information pertains especially to integrity of design. It was developed without benefit of a statewide survey and should be revised as more is learned about the prevalence of particular resources.

Acetylene or Carbide Gas Structures. Acetylene or carbide gas structures were built on farms in Minnesota in the early 20th century, generally before electrification. It is not known how prevalent they were. Typical characteristics are described in the individual farm elements section of this study. It is suspected that well-preserved examples of this resource will be rare and will therefore fit the definition of especially distinctive (see page 7.20 above) and possibly be eligible under Criterion C. This rule of thumb should be revised if it is learned that the resource is more common than suspected. The resource should have only minor alterations that postdate the period of significance.

Airplane Hangars. Airplane hangars were built on farms throughout the state, particularly around the time of World War II. Typical characteristics are described in the individual farm elements section of this study. It is not known how many well-preserved examples remain. An airplane hangar is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Animal Underpasses. Animal underpasses are believed to have been fairly common on Minnesota farms. They were built from the late 19th century to 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. An animal underpass is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Beef Barns. Barns designed specifically for beef cattle were built beginning in the late 19th century and still being built in 1960, the ending date of the context study. If this served as the farm's principal barn, it was likely one of the two largest and most expensive buildings on the farm, the other being the farmhouse. Typical characteristics are described in the individual farm elements section of this study. The most common construction materials were timber or dimensional lumber framing (plank or balloon) with wood siding, and pole-framing with sheet metal siding. Beef barns were less often built of brick, structural clay tile, concrete block, and other materials. A beef barn is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance. If a silo was historically attached it should be present. The interior can be altered unless central to the property's significance or significant physical characteristics.

Boundary Markers. Boundary markers were apparently built on nearly all farms in the mid to late 19th century as land was originally surveyed, and were supplemented and updated through time. Typical characteristics are described in the individual farm elements section of this study. It is suspected that early well-preserved examples of this resource will be rare and will therefore fit the definition of especially distinctive (see page 7.20 above). However, the resource may be so simply constructed that eligibility under Criterion C is not appropriate. The resource should have only minor alterations that postdate the period of significance.

Brooder Houses. Both centralized and colony brooder houses were built beginning in the early 20th century, perhaps through 1960, the ending date of the context study. Colonies may typically have consisted of two to six houses; it is not known how usual it was for all houses in a colony to be identical, as opposed to a farm having a mixed set of various styles of colony houses. Typical characteristics are described in the individual farm elements section of this study. Neither a centralized brooder house or a colony brooder house is likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Bull Barns. Bull barns were common on Minnesota farms that raised beef or dairy cattle. They were built beginning in the late 19th century; a few were perhaps still being built in 1960, the ending date of the context study. Typical characteristics are described in the individual farm elements section of this study. A bull barn is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Cattle Guards. Cattle guards are not believed to have been widely used in Minnesota, except perhaps in western parts of the state where more feeder livestock was raised. Typical characteristics are described in the individual farm elements section of this study. A cattle guard is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Cesspools and Septic Tanks. Cesspools and septic tanks were constructed on farms throughout the state. Most were built between the early 20th century and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. A cesspool or septic tank is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Cisterns. Cisterns were constructed on farms throughout the state before electrification and before household plumbing became well developed. Most were likely built between the late 19th century and about 1950. Typical characteristics are described in the individual farm elements section of this study. A cistern is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Combination Buildings. Combination buildings were fairly common on Minnesota farms. They were built between the early settlement period and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. A combination building is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Corncribs. Corncribs were widely built on Minnesota farms beginning in the late 19th century. Many fewer were being built in 1960, the ending date of this context study. Corncribs were sometimes combined with granaries. Typical characteristics are described in the individual farm elements section of this study. At mid-20th century the most common construction materials were wood and steel wire, but corncribs were also made of other materials including cement staves and structural clay tile. A corncrib is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Dairy Barns. Dairy barns were built in Minnesota through 1960, the ending date of this context study. The dairy barn was likely one of the two largest and most expensive buildings on the farm, the other being the farmhouse. Typical characteristics are described in the individual farm elements section of this study. Efficient milking, milk handling, and sanitation were important; a milk house was often included or added. The most common construction materials were dimensional lumber framing (plank or balloon) with wood siding and, after World War II, pole-framing with sheet metal siding. Dairy barns were less often built of brick, structural clay tile, concrete block, and other materials. A dairy barn is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance. If a silo and milk house were historically attached they should be present. The interior can be altered unless central to the property's significance or significant physical characteristics.

Drainage Structures. Drainage structures were widely built throughout the state between the late 19th century and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. Drainage structures are not likely to be individually eligible under Criterion C unless they are outstanding (see page 7.20 above). The resource should have only minor exterior alterations that postdate the period of significance.

Erosion Control Structures. Erosion control structures were widely built in hilly areas. They were built between the late 19th century and 1960, the ending date of this context study, with a concentration of building activity during the Depression. Typical characteristics are described in the individual farm elements section of this study. Erosion control structures are not likely to be individually eligible under Criterion C unless they are outstanding (see page 7.20 above). The resource should have only minor exterior alterations that postdate the period of significance.

Farm Shops. Farm shops were fairly common on Minnesota farms. They were built between the late 19th century and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. A farm shop is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Farmhouses. Farmhouses were built from the early settlement period through the ending date of this context study, 1960. The farmhouse was often one of the two largest and most expensive buildings on the farm, the other being the principal barn. Typical characteristics are described in the individual farm elements section of this study. The most common construction materials were dimensional lumber, but farmhouses were also built of logs, brick, concrete block, and, more rarely stone or other materials. A farmhouse is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance. The interior can be altered.

Farmyards. A farmyard was the central common area between house and outbuildings into which the main driveway usually led. It was sometimes called a barnyard or court, and was often a central work area and the site of domestic, crop, and livestock chores. Typical characteristics are described in the individual farm elements section of this study. A farmyard is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). The resource should have only minor alterations that postdate the period of significance.

Fences. Fences were widely built throughout the state between the early settlement period and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. Fences are not likely to be individually eligible under Criterion C unless they are outstanding (see page 7.20 above). The resource should have only minor alterations that postdate the period of significance.

Field Rock Piles. Field rock piles were built on farms throughout the state between the early settlement period and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. A field rock pile is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Fields and Pastures. All Minnesota farms historically contained fields and most contained pastures (either permanent or rotational). Most fields and pastures were developed in the early settlement period and gradually enlarged and improved with drainage and erosion control structures as needed. Typical characteristics are described in the individual farm elements section of this study. A field or pasture is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). An outstanding example may have an unusually very well-developed, innovative, and well-preserved set of drainage or erosion control structures of a particular type. The field or pasture should retain historic size with edges visibly defined by fence lines, lanes, vegetation, topography, or similar details. The field or pasture does not need to be planted with the same crops or vegetation as during the period of significance.

Garages. Garages were common on Minnesota farms. Most were built between the early 20th century and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. A garage is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Gardens (Vegetable). Most Minnesota farms had a vegetable garden. Typical characteristics are described in the individual farm elements section of this study. A vegetable garden is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance, adjusted for some expected change due to plant disease, limits of natural life span, and other natural forces.

General Purpose or Combination Barns. General purpose or combination barns were the most common barn type built in Minnesota from the early settlement period to about 1960, the end of the diversified farming era (and of this context study). If this served as the farm's principal barn, it was likely one of the two largest and most expensive buildings on the farm, the other being the farmhouse. Typical characteristics are described in the individual farm elements section of this study. The most common construction materials were timber or dimensional lumber framing (plank or balloon) with wood siding. General purpose barns were less often built of logs, brick, structural clay tile, concrete block, and other materials. A general purpose or combination barn is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance. If a silo was historically attached it should be present. The interior can be altered unless central to the property's significance or significant physical characteristics.

Granaries, Grain Elevators, Grain Bins, Grain Dryers. Some type of grain storage structure was built on nearly every Minnesota farm. They were built from the late 19th century to 1960, the ending date of this context study. They were sometimes combined with corncribs. Typical characteristics are described in the individual farm elements section of this study. Before World War II the most common construction material was wood. Grain bins of steel were introduced around 1910, and steel bins and steel warehouse-like storage structures became prevalent after World War II, especially after crop dryers were introduced. Granaries were also built of materials such as cement staves and structural clay tile. A granary, grain elevator, grain bin, or grain dryer is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Greenhouses, Hotbeds, Coldframes. Greenhouses, hotbeds, and coldframes in simple form were widely built on farms throughout the state, with more elaborate examples less common. They were built between the late 19th century and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. It is not known how many well-preserved examples remain. A greenhouse, hotbed, or coldframe is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Hay Barns or Sheds. Hay barns or sheds were fairly common on Minnesota farms. They were built between the late 19th century and 1960, the ending date of this context study. They were one of few buildings or structures that were sometimes found outside of the farmstead building cluster (i.e., in a field instead). Typical characteristics are described in the individual farm elements section of this study. A hay barn or shed is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Hired Workers' Housing. Housing built specifically for hired workers is not believed to have been common on Minnesota farms. Some is linked with particular high-labor crops such as sugar beets and canning vegetables. Typical characteristics are described in the individual farm elements section of this study. It is suspected that well-preserved examples of this resource will be rare and will therefore fit the definition of outstanding (see page 7.20 above) and possibly be eligible under Criterion C. This rule of thumb should be revised if it is learned that the resource is more common than suspected. The resource should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Hog Barns and Hot Cots. Centralized hog barns were built in Minnesota beginning in the late 19th century (though most were not that early), and were still being built in 1960, the ending date of the context study. If this served as the farm's principal barn, it was likely one of the two largest and most expensive buildings on the farm, the other being the farmhouse. Hog cots were built beginning in the early 20th century, perhaps through 1960. Minnesota farms typically had four to ten hogs in 1930, suggesting that colonies of four to eight cots may have been common. Typical characteristics of both centralized hog barns and hot cots are described in the individual farm elements section of this study. The most common construction materials for centralized hog barns were dimensional lumber framing (plank or balloon) with wood siding; they were less often built of brick, structural clay tile, concrete block, and other materials. Strength in construction was important, as were cleanable materials such as poured concrete for floors, lower walls, and yards, which helped reduce disease. Hog cots were usually wood, and either farm-built or prefabricated. It is not known how usual it was for all houses in a colony to be identical, as opposed to a farm having a mixed set of various styles of cots. A hog barn or hog cot is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). If a silo was historically attached to the barn it should be present. The resource should have only minor exterior alterations that postdate the period of significance. The interior can be altered unless central to the property's significance or significant physical characteristics.

Horse Barns. All Minnesota farms had provisions for housing draft horses if they were used during the period of significance, but it is not known how many Minnesota farms built dedicated barns for their horses. (Horse barns were generally only built on farms that used more than about six horses; Minnesota farms typically had about five to eight horses in 1900, and about five or six horses in 1930.) If this served as the farm's principal barn, it was likely one of the two largest and most expensive buildings on the farm, the other being the farmhouse. Horse barns were likely built from the 1870s through the early 1920s. Late examples may include features such as tractor storage rooms that represent the important (and gradual) transition to gasoline power. Typical characteristics are described in the individual farm elements section of this study. The most common construction materials were timber or dimensional lumber framing (plank or balloon) with wood siding. Horse barns were less often built of brick, structural clay tile, concrete block, and other materials. It is suspected that well-preserved examples of this resource will be rare and will therefore fit the definition of outstanding (see page 7.20 above) and possibly be eligible under Criterion C. This rule of thumb should be revised if it is learned that the resource is more common than suspected. The resource should have only minor exterior alterations that postdate the period of significance. If a silo was historically attached it should be present. The interior can be altered unless central to the property's significance or significant physical characteristics.

Housebarns. Housebarns are rare in Minnesota. Characteristics are described in the individual farm elements section of this study. Examples with acceptable integrity will likely fit the definition of outstanding (see

Icehouses. Icehouses were widely built on Minnesota farms beginning in the late 19th century, particularly if milk needed to be cooled. They generally preceded electrification; new icehouses were probably not built after World War II. Typical characteristics are described in the individual farm elements section of this study. An icehouse is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Implement or Machine Sheds. Provision for storing implements or machines was essential for Minnesota farms between the late 19th century and 1960, the ending date of this context study. Buildings constructed specifically for this purpose were common. Typical characteristics are described in the individual farm elements section of this study. An implement or machine shed is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Irrigation Structures. Irrigation structures were uncommon in Minnesota before 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. Irrigation structures are not likely to be individually eligible under Criterion C unless they are outstanding (see page 7.20 above). The resource should have only minor exterior alterations that postdate the period of significance.

Lawns and Ornamental Plantings. Some form of lawn and ornamental plantings, even if small and simple, was found on most Minnesota farms. Typical characteristics are described in the individual farm elements section of this study. Lawns and ornamental plantings are not likely to be individually eligible under Criterion C unless they are outstanding (see page 7.20 above). The resource should have only minor alterations that postdate the period of significance, adjusted for some expected change due to plant disease, limits of natural life span, and other natural forces.

Manure Pits or Bunkers. Manure pits or bunkers were apparently fairly common on Minnesota farms that raised dairy cows or other livestock. They were built from the early 20th century through 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. A manure pit or bunker is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Milk Houses. Milk houses were common on Minnesota farms that milked cows, and were eventually required on farms that sold milk meeting state standards. They were built from the late 19th century and early 20th century through 1960, the ending date of this context study. Separation from the stable, cleanability, and efficient milk handling were important considerations; design attributes were eventually regulated. Typical characteristics are described in the individual farm elements section of this study. The most common construction materials were dimensional lumber balloon framing with wood siding (sometimes with poured concrete lower walls), concrete block, and structural clay tile. A milk house that was built as an addition to a barn should generally be evaluated as part of that barn, rather than separately. A milk house is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Milking Barns. Milking barns were generally built on farms using pen barns or loose housing for dairy cows. A few were built before the 1940s, and they became more common after World War II. If this served as the farm's principal barn, it was likely one of the two largest and most expensive buildings on the farm, the other being the farmhouse. Typical characteristics are described in the individual farm elements section of this study. Efficient milking, milk handling, and sanitation were important; inclusion of a milk house was common. The most common construction materials were dimensional lumber framing (plank or balloon) with wood or metal siding, often with poured concrete lower walls. Concrete block was also fairly common. They were also built of structural clay tile, pole-framing with sheet metal siding, and other materials. A milking barn is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance. If a milk house was historically attached it should be present. The interior can be altered unless central to the property's significance or significant physical characteristics.

Orchards. Many Minnesota farms had a small orchard in which apples, plums, and other fruits were grown for home use. A few farms had large orchards for cash crops. Typical characteristics are described in the individual farm elements section of this study. An orchard is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance, adjusted for some expected change due to plant disease, limits of natural life span, and other natural forces.

Potato Warehouses. Potato warehouses were built in regions of the state where potatoes were an important cash crop. They were constructed between the late 19th century and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. A potato warehouse is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Poultry Houses. Poultry houses were built on nearly all Minnesota farms from the late 19th century to about 1950, and on a few farms from 1950 to 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. The most common construction materials were dimensional lumber balloon framing with wood siding, and pole-framing with sheet metal siding. They were less often built of brick, structural clay tile, concrete block, and other materials. A poultry house is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics. (See also Brooder Houses.)

Power Houses. Power houses were common on Minnesota farms. Most were built between the late 19th century and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. A power house is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Privies. Privies were essential buildings on all Minnesota farms beginning in the early settlement period. Few were likely built after the 1950s. Typical characteristics are described in the individual farm elements section of this study. A privy is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Propane Gas Structures. Propane gas structures were built on farms throughout the state from about the 1920s through 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. A propane gas structure is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Pumps and Pump Houses. Nearly all Minnesota farms had pumping equipment, and many had a pump house to protect the pump from the elements. These resources were built from the late 19th century through 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. A pump or pump house is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Roads, Lanes, Tracks, Sidewalks. Beginning in the early settlement period, all Minnesota farms had a system of routes for human, animal, and vehicle travel. Elements were variously called roads, driveways, field lanes, cartways, animal tracks, etc., and ranged from very simple to highly improved. Typical characteristics are described in the individual farm elements section of this study. A road, lane, track, sidewalk or similar element is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). The resource should have only minor alterations that postdate the period of significance.

Roadside Markets. Roadside markets were built on farms throughout the state, especially if the adjacent road or highway was busy or the area attracted summer tourists. It is suspected they were built between the early 20th century and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. It is not known how many well-preserved examples remain. A roadside market is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Root Cellars. Root cellars were built on farms throughout the state from the early settlement period through about 1950. Typical characteristics are described in the individual farm elements section of this study. A root cellar is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Saunas. Saunas were not common on Minnesota farms and were primarily linked with specific ethnic groups such as northern Minnesota's Finnish farmers. Typical characteristics are described in the individual farm elements section of this study. It is suspected that well-preserved examples of this resource will be rare and will therefore fit the definition of outstanding (see page 7.20 above) and possibly be eligible under Criterion C. It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Scale Houses. Scale houses sheltered equipment used to weigh crops and livestock. It is not clear how prevalent they were in Minnesota. Typical characteristics are described in the individual farm elements section of this study. A scale house is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Sheep Barns. Barns designed specifically for sheep were not common in Minnesota. They were beginning in the late 19th century; a few may have been built as late as 1960. If this served as the farm's principal barn, it was likely one of the two largest and most expensive buildings on the farm, the other being the farmhouse. Typical characteristics are described in the individual farm elements section of this study. The most common construction materials were dimensional lumber framing (plank or balloon) with wood siding, and pole-framing with sheet metal siding. Sheep barns were less often built of brick, structural clay tile, concrete block, and other materials. It is suspected that well-preserved examples of this resource will be rare and will therefore fit the definition of outstanding (see page 7.20 above) and possibly be eligible under Criterion C. This rule of thumb should be revised if it is learned that the resource is more common than suspected. The resource should have only minor exterior alterations that postdate the period of significance. If a silo was historically attached it should be present. The interior can be altered unless central to the property's significance or significant physical characteristics.

Shelterbelts. For the purposes of this context study, shelterbelts were rows of trees or shrubs planted in fields (outside of the farmstead) to protect crops and soil from erosion. (They are differentiated in this study from "windbreaks," which were planted to shelter a farmstead, and "woodlots" – whether native or planted – which provided firewood, building materials, fenceposts, wild game, etc.) Typical characteristics are described in the individual farm elements section of this study. A shelterbelt is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance, adjusted for some expected change due to plant disease, limits of natural life span, and other natural forces.

Silos. Silos were widely built on Minnesota farms beginning in the late 19th century through 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. Vertical silos were usually attached to an adjacent barn for ease in moving the silage to the livestock. At mid-20th century, the most common construction materials for vertical silos were cement staves, but they were also being built of glass-lined steel and other materials. At mid-20th century, horizontal silos of various materials were also fairly common. Since most vertical silos were built as an attachment to a barn, they should generally not be evaluated separately from the barn except in special circumstances. A silo is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). The resource should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Smokehouses. Smokehouses were fairly common on Minnesota farms. Most were built between the early settlement period and about 1950. Typical characteristics are described in the individual farm elements section of this study. A smokehouse is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Springhouses and Springboxes. Springhouses and springboxes were widely built on farms in hilly or wooded regions where natural springs flowed. They were built from the early settlement period through about the 1940s. Typical characteristics are described in the individual farm elements section of this study. A springhouse or springbox is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Stock Tanks. Stock tanks were built on farms throughout the state between the early settlement period and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. A stock tank is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Stockyards. Stockyards were widely built throughout the state between the early settlement period and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. Stockyards are not likely to be individually eligible under Criterion C unless they are outstanding (see page 7.20 above). The resource should have only minor alterations that postdate the period of significance.

Sugarhouses. Sugarhouses were built on farms with stands of sugar maple trees beginning in the late 19th century. It is not clear how prevalent they were. Typical characteristics are described in the individual farm elements section of this study. A sugarhouse is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Summer Kitchens. Summer kitchens were fairly common on Minnesota farms, with most built between the 1870s and the 1930s. Typical characteristics are described in the individual farm elements section of this study. A summer kitchen is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor exterior alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

Threshing Barns. Threshing barns – that is, barns built for this purpose before (or just as) threshing was mechanized – are rare in Minnesota. Characteristics are described in the individual farm elements section of this study. Examples with acceptable integrity will likely fit the definition of outstanding (see page 7.20 above) and possibly be eligible under Criterion C.

Utility Poles and Equipment. Utility poles and equipment were ubiquitous on Minnesota farms beginning at electrification. They continued to be built through 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. Utility poles and equipment are not likely to be individually eligible under Criterion C unless they are outstanding (see page 7.20 above). The resource should have only minor exterior alterations that postdate the period of significance.

Water Power Structures. Water power structures were built on farms with streams or other natural sources of water that could be harnessed for power. They were generally built between the early settlement period and farm electrification. It is not known how prevalent they were. Typical characteristics are described in the individual farm elements section of this study. It is suspected that well-preserved examples of this resource will be rare and will therefore fit the definition of outstanding (see page 7.20 above) and possibly be eligible under Criterion C. This rule of thumb should be revised if it is learned that the resource is more common than suspected. The resource should have only minor alterations that postdate the period of significance.

Water Tanks and Tank Houses. Water tanks and tank houses were built between the late 19th century and about the 1950s. Typical characteristics are described in the individual farm elements section of this study. A water tank or tank house is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Wells. Most Minnesota farms had a well unless fresh water was obtained from a natural spring or similar source. Wells were built between the early settlement period and 1960, the ending date of this context study. Typical characteristics are described in the individual farm elements section of this study. A well is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Wetlands. Wetlands were found on farms throughout Minnesota. They were usually natural low areas too wet to till. They were often put to some farm use for grazing, trapping, berry-picking, etc. Wetlands were generally not highly developed or improved. As a largely natural idea that was *used* by farmers but not built or developed, a wetland is not likely to be individually eligible under Criterion C.

Windbreaks. Farmstead windbreaks were strategically planted rows or groves of trees that sheltered the farmstead from prevailing winds. (For the purposes of this context study, "shelterbelts" are rows of trees or shrubs planted outside of the farmstead to protect crops and soil from erosion, and "woodlots" – whether native or planted – are stands of trees that provided firewood, building materials, fenceposts, wild game, etc.) Windbreaks were essential in prairie or treeless areas of the state, and nearly all farms had either a planted windbreak or a natural or planted woodlot. Typical characteristics are described in the individual farm elements section of this study. A windbreak is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance, adjusted for some expected change due to plant disease, limits of natural life span, and other natural forces.

Windmills. Harnessing wind power for pumping water and other chores was very common on Minnesota farms before electrification. Most windmills were built between the late 19th century and about 1950. Typical characteristics are described in the individual farm elements section of this study. A windmill is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance.

Woodlots. Farm woodlots were stands of trees – either native or planted – that provided firewood, fence posts, lumber, and even maple syrup. (For the purposes of this study they are differentiated from "windbreaks," which were planted to shelter farmsteads, and "shelterbelts," which were planted to protect crops and soil.) Typical characteristics are described in the individual farm elements section of this study. A planted woodlot is not likely to be individually eligible under

Criterion C unless it is outstanding (see page 7.20 above). A natural woodlot that was *used* but not built or developed is even less likely to be eligible under Criterion C. A planted woodlot should have only minor alterations that postdate the period of significance, adjusted for some expected change due to plant disease, limits of natural life span, and other natural forces.

Woodsheds. Woodsheds were widely built on Minnesota farms between the late 19th century and about 1950. Typical characteristics are described in the individual farm elements section of this study. A woodshed is not likely to be individually eligible under Criterion C unless it is outstanding (see page 7.20 above). It should have only minor alterations that postdate the period of significance; the interior can be altered unless central to the property's significance or significant physical characteristics.

To be eligible under National Register Criterion D:

See Volume 4 of this historic context study which addresses historical archaeological resources.

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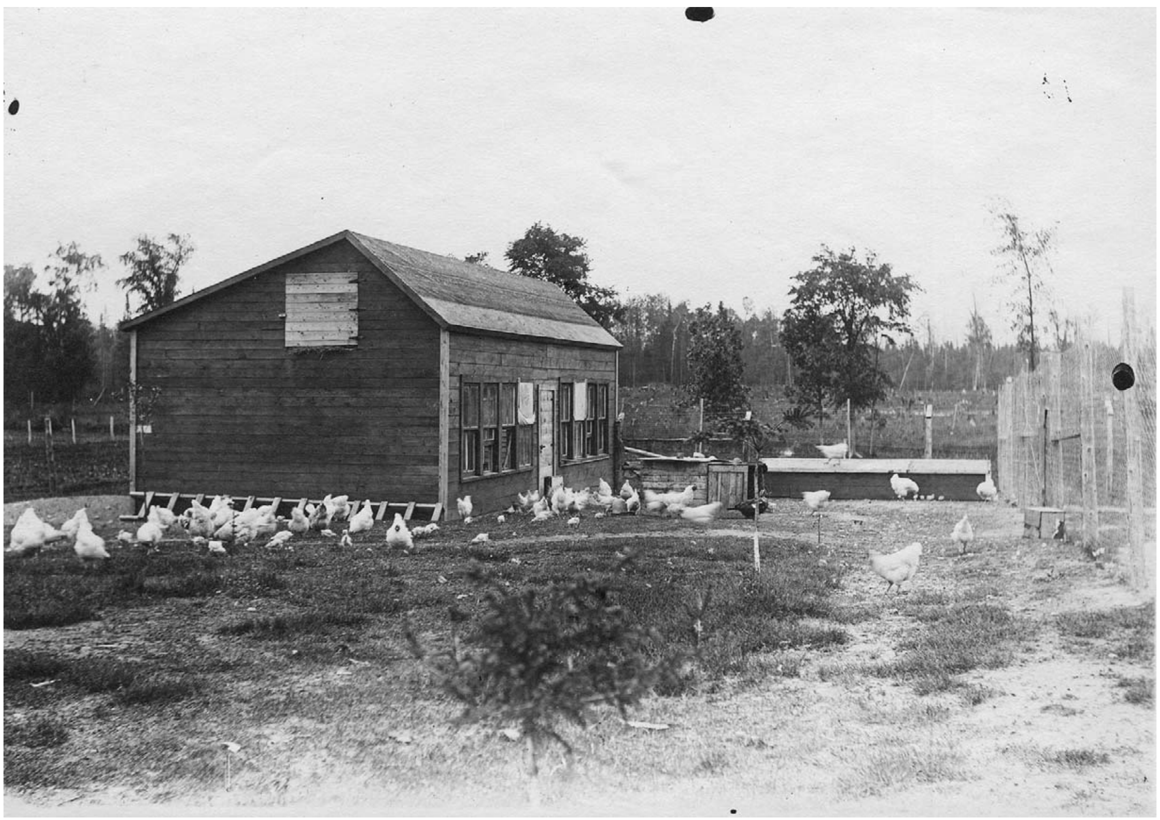
The wooden stave silo was being shingled when this photo was taken, and both the silo and the adjacent barn look new. Firewood and building materials are stacked in the farmyard. Hackney Farm, Ramsey County, circa 1910. (MHS photo by Harry Darius Ayer)

Meyer Farm, near Potsdam, Olmsted County, circa 1972. (MHS photo by Thomas J. Lutz)



Location unknown, circa 1920. (MHS photo)

Tessmer Farmstead, Hennepin County, 1974. (MHS photo)

FOCUS ON GOVERNMENT LAND PROGRAMS

Some Milestones of Government Land Programs

1785	–	Land Ordinance established the township and range system
1847	–	Survey of present-day Minnesota began
1854	–	Preemption extended to unsurveyed lands in Minnesota, beginning a settlement rush
1862	–	Homestead Act
1873	–	Timber Culture Act
1891	–	General Public Lands Reform Act ended dispersal of land through most programs

Economist and historian Willard Cochrane wrote that "abundant land" was the stimulus for the nation's development. He wrote, "Land was the magnet that drew the first settlers to English colonies . . . It was the magnet that continued to draw them to these shores for almost three centuries. And it was the magnet that drew settlers into the wilderness, over the Appalachians, and across the continent in one century following the Revolutionary War. To the landless and land-hungry people of Western Europe the pull of cheap or free land in North America was overwhelming" (Cochrane 1979: 173).

The federal government obtained the majority of its public land during an approximately 90-year time period – between the Revolutionary War and the Civil War. The government acquired this land under the doctrine of Manifest Destiny – the belief that it had the right to expand U.S. territory and that this was necessary for the public good. Most land was obtained from Native Americans through various land cession treaties. By 1850 the American territory included almost 3 million square miles, and by 1865 there were 1.2 billion acres in the public domain (Schlebecker 1975: 69-70; 139). The public domain was sold (often at auction) and given away through 1891, when the "frontier" was essentially closed with the passage of the General Public Lands Reform Act of 1891. This act discontinued the auctioning of public land.

The Land Ordinance of 1785 was the first of a series of federal laws that determined the distribution of the public domain. The Land Ordinance and subsequent measures established the township and range survey system, also called the Public Land Survey System or the quarter-section system. All states except the original 13 colonies were surveyed using this system. The Land Ordinance dictated the minimum acreage that could be purchased and the price per acre. The Land Ordinance also provided for education by reserving five sections in each township – four to be held by the federal government and one section to be reserved for school land. Eventually school land was raised to two sections (Schlebecker 1975: 21; Cochrane 1979: 45). The survey of Minnesota lands began in 1847.

As disbursal of the public domain land slowly continued, congressmen from eastern states – states that had virtually no public domain land remaining in the 1800s – favored continuing to sell the public land as a source of federal revenue. Congressmen from western states, however, believed the land should be given away to settlers. Geographer John Fraser Hart explained:

> They [western congressmen] argued that settlers were performing a patriotic service when they tamed the wilderness and advanced the frontier. Land should be free, they said, or at least it should be available in tracts so small and at prices so low that every person who wanted a farm could afford the 'threshold price' (the minimal acreage of land multiplied by the minimal price). They gradually managed to hammer down the minimal sales unit from 640 acres in 1785 to 320 acres in 1800, 160 acres in 1804, 80 acres in 1820, and 40 acres from 1832 until 1862, when the Homestead Act gave 160 acres free to anyone who would live on the land and cultivate it for five years (Hart 1998: 156-157).

The minimum parcel size in 1785 – 640 acres – comprised one square mile, or one Section as defined by the Public Land Survey System. The parcel size of 160 acres, which was the amount used in the Homestead Act of 1862, "was thought to be the maximum amount of land a family could realistically farm" given available technology at the time, according to the National Park Service which operates Homestead National Monument in Nebraska (National Park 2005).

The minimum purchase price for federal land was also reduced through time until in 1820 it was lowered to $1.25 per acre, which translates to about $19.50 in 2003 dollars.

MAJOR PROGRAMS UNDER WHICH SETTLERS OBTAINED LAND

Most public domain land in Minnesota was not purchased from the federal government at auction, but entered private hands by some other means, including the programs listed below. These patents were the origins of many Minnesota farms.

Military Warrants or Scrip. About 73.5 million acres of federal land nationwide were disbursed under military land bounties and warrants to veterans. Military bounty warrants (later scrip) were issued to veterans of each war from the American Revolution through the Mexican War (1846-1848). (Land bounties for Civil War veterans were addressed under the Homestead Act of 1862. See below.) Military warrants gave 160 acres of free land to every enlisted man who served at least five years. (Officers were included beginning in 1847.) Initially, the land had to be within a federal military reserve and the warrants were nontransferable – both requirements were designed to encourage veterans to settle along the "Indian frontier." Originally, only the land and not the scrip could be transferred, but in 1852 Congress made the scrip transferable (Schlebecker 1975: 62).

It became a widespread practice for land speculators, farmers, timber companies, and others to purchase scrip from veterans at prices far lower than the value of the land based on the minimum purchase price of $1.25 per acre. In Minnesota in the 1850s, for example, lumber companies obtained much of the forest land in the St. Croix Triangle by buying military warrants from veterans. Land in northern Minnesota was similarly purchased with military warrants. Many veterans in other parts of the country sold their warrants to dealers and agents in Minnesota for as little as 10 cents an acre, not knowing or caring about the value of the land and instead seeking the immediate cash (Blegen 1975: 322).

By 1856 military warrants for 160 acres of free land were authorized for all veterans of wars or their heirs. Schlebecker wrote, "Since Americans had fought wars almost continuously after 1775 and almost everyone had some relative who had served in one of the wars, the act amounted to a general distribution of land and of warrants" (Schlebecker 1975: 62). The majority of the scrip was transferred to farmers, and not speculators, according to Schlebecker who wrote, "In all states with public lands, people obtained a sizeable amount of land with bounties. We can scarcely underestimate the significance of the military acts both in terms of disposal and as a precedent for later free land acts" (Schlebecker 1975: 63).

Preemption Act of 1841. Under the federal Preemption Act of 1841, settlers who had settled or "squatted" on land could file a claim for up to 160 acres if they filed at the land office and paid the official price (usually $1.25 an acre). As long as the squatter complied with the terms of the law, his claim "preempted" subsequent claims on the land. The preempted land had to have been federally surveyed, however, which posed problems in developing territories and states like Minnesota where the number of surveyors could not meet the demand for land. Beginning in 1849, residents of the new Minnesota Territory lobbied Congress to extend preemption to unsurveyed lands. Congress did so in 1854, opening large portions of Minnesota to a rush of settlement (Blegen 1975: 174; Brooks and Jacon 1994: 12; Schlebecker 1975: 63). The Preemption Act was repealed in 1891.

Homestead Act of 1862. The federal Homestead Act of 1862 gave 160 acres free to any head of a household, widow, or single person, who was at least 21 years old and a citizen of the U.S., on the condition that the homesteader would improve the land (with crops and a minimum 12′ x 14′ dwelling) and reside on it for a minimum of five years. The homesteader also had the option of purchasing the acreage at $1.25 an acre after living there for six months. Like the Preemption Act, the Homestead Act initially applied only to land that had been surveyed, but in 1880 unsurveyed public land was also included. Most land available to homesteaders was located in Minnesota, South Dakota, North Dakota, Nebraska, and Kansas because the majority of public land in states east of the Mississippi River had already been transferred to private ownership by 1862. The free land offered by the Homestead Act was a great enticement for settlers to move west to places like Minnesota and Dakota Territory from states farther east including Wisconsin, Ohio, and Illinois. In Minnesota from 1862-1880, more than 62,379 homestead entries involving 7.3 million acres – almost one-seventh of the state's land area – were filed (Jarchow 1949: 65-66). During the 1860s-1880s, more than 200,000 acres in Minnesota were transferred to settlers each year (Blegen 1975: 253, 344). Minnesota total homestead entries averaged 335,226 acres per year from 1890-1900. A total of about 147 million acres were disbursed nationwide under the Act.

Soldiers' Homesteads (within Homestead Act of 1862). The Homestead Act of 1862 also provided Soldiers' Homesteads, or soldiers' claims, for veterans of the Civil War. Initially, only Union soldiers qualified, but in 1866 Congress included Confederate veterans. Any veteran who had served at least 90 days (or his widow or minor children) could claim the 160 acres of free land and deduct his time of service (up to four years) from the residency requirement of the Homestead Act.

Federal Land Grants to Railroads, 1850s-1871. Railroads began receiving free public land from states in 1850, and from the federal government itself beginning in 1851. In Minnesota, approximately 10 million acres, or about 20 percent of the state's total land, was granted to railroad companies (Blegen 1975: 344). The railroad grants included land 10, 20, and sometimes 40 miles on either side of a proposed rail line. Nationwide, 131 million acres were granted to railroads. Public opposition helped end the practice in 1871.

Much of the railroad land was sold to farmers and speculators who bought it at an average price of $4 an acre. The railroads sold their land at a premium in part because they didn't want "poor" farmers locating along their lines, according to John T. Schlebecker. He explained, "A farmer who had so little capital that he could not buy a farm usually could not succeed with a free farm, for homesteaders led the parade of bankrupt farmers. The railroads had no interest in creating zones of poverty along their rights-of-way or in not disposing of their land. They wanted customers with money." For many farmers who bought railroad land, the advantage of being near the railroad more than compensated for the higher price of the land (Schlebecker 1975: 141).

Timber Culture Act of 1873. The federal Timber Culture Act of 1873 was designed to help settle prairie regions, many of which were just being reached by rail service. The law gave 160 acres to a landowner who planted and tended 40 acres of trees for 10 years, stimulating both settlement and the planting of trees in prairie areas. The landowner did not have to live on the land. The Timber Culture Act also reduced the Homestead Act residency requirement from five years to three years if the homesteader planted and tended an acre of trees for two of those three years. Few lands were claimed under the Timber Culture law at first, and in 1878 the law was changed to require only 10 acres of trees planted and tended for 8 years. Between 1873 and 1880, about 1.166 million acres of Minnesota land were dispersed in about 8,500 filings under the law (Jarchow 1949: 70). The Act was repealed in 1891 (Blegen 1975: 404; Brooks and Jacon 1994: 12).

In 1873 the State of Minnesota passed its own timber culture law, offering a cash bounty to farmers who planted and maintained trees on prairie lands or along public highways.

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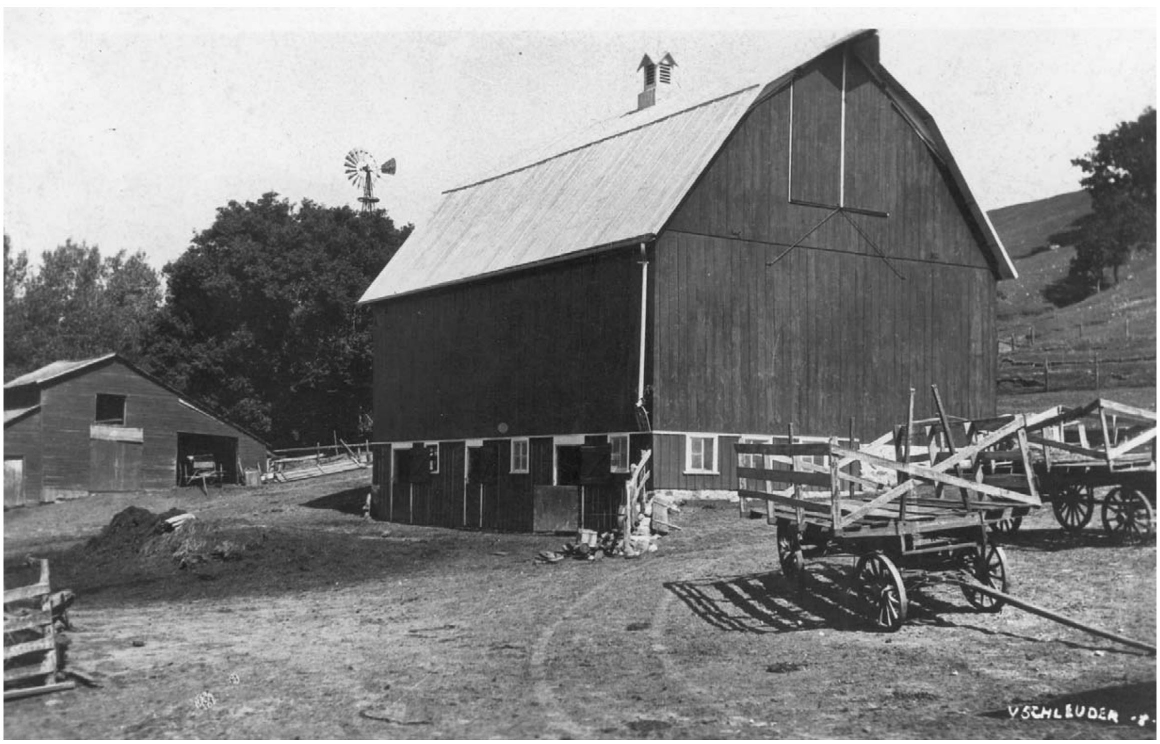
Mainquist Farm, Rockford Township, Wright County, circa 1920. (MHS photo)



Barns and farmyard in Brown County, circa 1910. (MHS photo)

FOCUS ON MINNESOTA CROPS

Some Milestones of Minnesota Crops

1895	–	Minnesota Experiment Station released its first improved wheat strain
1900	–	Grimm alfalfa came to the attention of Experiment Station; distributed soon after
1910	–	Minnesota had ten vegetable canning companies
1926	–	First hybrid corn released commercially
1945	–	Oats, long Minnesota's leading crop, peaked in production
1946	–	Very few soybeans grown; Experiment Station began testing
1960s	–	New types of corn hybrids released

Minnesota farms of the early settlement era were diversified operations that were mostly self-sustaining. To generate cash, farmers soon began to market some of their crops and livestock, as well as animal products like milk. Minnesota's leading crops of the 1850s-1880s included wheat, oats, corn, potatoes, barley, rye, and buckwheat – not always in that order (Jarchow 1949: 233-234).

During the 1860s and 1870s, the production of wheat dominated Minnesota agriculture and was the state's principal cash crop. The wheat monoculture was successful while land was cheap and plentiful, prices were high, and soils were "new." Eventually farmers could not sustain their income as yields decreased, markets fluctuated, and weather, pests, and crop diseases intervened.

Minnesota farmers' early, sole dependence on wheat was replaced by a diversified system that was one of the hallmarks of the "scientific agriculture" of the early 20th century. Farmers planted a flexible arrangement of crops that often changed from year to year, rotated crops in an optimal sequence, and practiced multiple- or double-cropping in which crops were grown together in the same field or in succession in the field during a single season.

Diversification required, however, that farmers be familiar with the characteristics and marketability of a larger variety of crops, and that they own and maintain a more complex set of buildings and machines to plant, cultivate, harvest, and store the crops. In addition, they needed to become adept at raising a variety of animals and marketing those products, as well as creating the physical environment that would support livestock enterprise.

In the first three-quarters of the 20th century, five farm products generated most of Minnesota farm income: livestock, poultry, dairy products, oil crops, and wheat. The most important specialty crops during this period were vegetables, potatoes, sugar beets, and barley for malting. Much of Minnesota's crop yield was grown to feed livestock, and a strong livestock industry developed in the state. In addition, Minnesota was home to an array of processing industries that bought and used the commodities produced on Minnesota farms (Tweton 1989: 282).

Briefly described below (in alphabetical order) are the principal crops historically grown on Minnesota farms. Not included in the list are minor and/or post-1960 crops such as Christmas trees, forestry stock, grapes, hops, lawn sod, millet or Hungarian grass, mint for oil, mushrooms, mustard, nuts, popcorn, safflower, triticale (a hybrid of wheat and rye), and wild rice.

ALFALFA

Alfalfa was first introduced to U.S. farmers in 1855, but this type wasn't hardy enough to be grown in the Midwest. Two years later, in 1857, a German farmer named Wendelin Grimm immigrated to the U.S. carrying a small supply of alfalfa. Grimm settled in Carver County, MN, and planted his first crop of alfalfa in the spring of 1858. Despite losses, he persistently selected seed for winter hardiness over successive years. By the 1890s a small group of German farmers in Carver County were growing alfalfa and in 1900 the fields came to the attention of W. M. Hays of the Minnesota Agricultural Experiment Station. Hays and colleagues began to experiment with and promote the crop, and Hays brought national attention to Grimm alfalfa in 1905-1913 when he served as assistant U.S. secretary of agriculture.

Only seed that was directly descendent from Grimm's fields displayed sufficient hardiness. In the 1910s and early 1920s, Minnesota county extension agents distributed the first alfalfa seed that many farmers had ever encountered. Minnesota seed growers eventually supplied the alfalfa seed planted in much of the nation.

Alfalfa proved to be one of the best forage crops for dairy cows, and acreage grew with the rise of dairy industry. Alfalfa played a leading role in the diversification of Minnesota agriculture, rejuvenating cropland harmed by years of wheat monoculture. Like all legumes, alfalfa "fixed" nitrogen in the soil and improved soil tilth when plowed under. It was often planted with clover and grasses in forage mixes. Alfalfa and clover were also primary crops for Minnesota farmers who kept honey bees.

Most alfalfa in Minnesota was cut as hay for winter livestock feed. Alfalfa was good for hay because it grew upright, and farmers could get three, and sometimes four, cuttings each season. Because alfalfa was a deep-rooted perennial, it could be left in the hay field or pasture for many productive years if fertilized with manure. Alfalfa was also planted as a second or "catch crop" after another crop such as oats had been harvested.

Grimm was the leading alfalfa variety planted throughout the Midwest between the 1910s and the 1950s. Grimm alfalfa was especially productive in west central and northwestern Minnesota where soil was alkaline and well-drained, and rainfall somewhat light. Farmers in southeastern Minnesota generally needed to treat their soil with powdered lime before they grew alfalfa.

One expert source wrote in 1938, "The production of a forage plant so hardy as Grimm alfalfa, with its permanence, enormous yields, high protein content, economy as a crop, and value as a soil builder and weed throttler, is almost without parallel in plant history. It is impossible to compute in dollars and cents what it has meant to the nation" (Edwards and Russell 1938: 32; Lyman 1922; Arny 1922; Wayne 1977: 31).

In 2001 Minnesota was among the top four alfalfa-producing states in the U.S. It is grown through the state and is used for grazing, fed fresh as green chop, and baled, cubed, ground, pelleted, and ensiled. At the present time the Universities of Minnesota and Wisconsin are the only two state universities where winter hardiness tests for new alfalfa varieties are conducted.

Farm Resources. Alfalfa was grown in fields and pastures on a majority of Minnesota farms. Farmers that cut hay stored it in three major ways: piled in outdoor haystacks, within livestock barns, and within hay barns or sheds. Alfalfa hay, however, did not fare well in outdoor storage and most farms used mow storage or hay sheds for alfalfa. Alfalfa was also ensiled and, beginning in the 1940s, farmers also began to preserve "haylage" in glass-lined silos.

BARLEY

Minnesotans have historically grown two kinds of barley: one for beer production, breakfast food, and pearled barley, and a second for animal feed.

Barley, like wheat, was one of the state's early cash crops and remained important through at least the 1950s. Up to ten percent of Minnesota's barley crop was sold to the state's breweries which, in the 1890s, collectively brewed enough beer to place Minnesota 13th nationally in volume of beer produced. Many barley fields were concentrated in counties near breweries. While acreage planted to malting barley was depressed during Prohibition (1920-1933), beer production and demand for barley grew after World War II (Tweton 1989: 286-287).

Barley was excellent animal feed and most Minnesota barley was grown for this purpose. Barley was recommended as a good feed crop for northern Minnesota farmers who could not grow corn well, and was the best small grain for silage. Barley was good feed for work horses and was fed to hogs, lambs, and calves, especially when sufficient corn was not available. Barley straw was used in the barn for animal bedding.

Minnesota farmers used barley in three-crop rotation systems that included, for example, corn, a small grain, and hay. Barley's role in the rotation was to supply animal feed or grain for cash, suppress weeds with its dense stems, and often to serve as a "nurse crop" for the hay. Because it didn't shade the ground as completely as oats and used less moisture, barley made a better nurse crop for hay than did oats. Many farmers diversified their small grain rotation – planting both barley and oats, for example – to protect themselves against single crop losses and to spread out their labor since oats and barley didn't mature at the same time. Barley did not grow well on newly-broken land, sandy soil, soil of poor fertility, or acidic soil. Its yields surpassed those of wheat, oats, and rye during periods of drought, however.

Before 1870 most of the state's barley was grown near the Mississippi River and other water routes on which it could be shipped to market. By 1880 production had shifted west and northwest with the state's railroad-stimulated settlement. In the 1920s and 1930s most barley was grown in south-central and southwestern Minnesota, but experts were recommending that more could be grown farther north (Immer et al 1935; Arny and Hayes 1925; Blegen 1975: 391-392).

In 1925 barley ranked fifth among the most-planted crops in Minnesota. Minnesota was the nation's leading barley grower in 1935. Because barley, like oats, was a principal food for draft horses, barley production decreased as gas-powered equipment replaced horses and mules. In 1957 Minnesota was sixth among states in the value of barley produced. Most barley is now grown in northwestern Minnesota.

Farm Resources. Like all small grains, barley was raised in farm fields, threshed in barns, and stored in granaries and bins. Some farmers also ensiled the crop. Barley hay and straw were stored in livestock barns, outdoor stacks, and hay barns.

BUCKWHEAT

Buckwheat, a small grain, was grown in Minnesota as early as the 1840s and was used primarily as livestock feed and for flour, with the straw used for livestock bedding. Buckwheat-growing reached an early peak in the U.S. in 1866, declined as farmers chose to grow more profitable small grains, and had a resurgence during World War I. Although buckwheat could be fed to livestock, it was less useful than wheat, oats, barley, rye, or corn, and was therefore usually mixed with other grains in feed. In crop rotations, buckwheat acted like other small grains to supply a cash crop, to suppress weeds with its dense stems, and often to serve as a "nurse crop" for forage legumes.

In the 1970s buckwheat came into favor again as a nutritionally-superior ingredient for noodles and for breakfast food such as cereal and pancakes. Today Minnesota is one of the nation's top five buckwheat-growing states. The state's crop is used for food, livestock feed, and planted as "green manure" (i.e., plowed under as a soil builder).

Farm Resources. Like all small grains, buckwheat was grown in Minnesota farm fields, threshed in barns, and stored in granaries and bins. Buckwheat was also ensiled, and was stored as hay and straw in livestock barns, outdoor stacks, and hay barns.

CLOVERS

Most of Minnesota's settlement-era farmers cut wild hay (and let livestock graze freely), but little "tame" hay or forage was grown before 1880. Minnesota's first clover is believed to have been grown in the southern part of the state around that year (Jarchow 1949: 239).

Clover grew best in open, porous, well-drained soils. It did not flourish in acidic conditions, so farmers in southeastern Minnesota had to add lime to their fields. In some areas, clover was advantageous because certain types could be grown in wet fields where alfalfa wouldn't grow.

The most common clovers planted in Minnesota were red, white, alsike, kura, and sweet clover. Rich in protein, most clover was grown for livestock feed, but it was also used for honey bees, planted for seed, and used a soil builder and cover crop.

Clover production increased as farming diversified and as the state's dairy industry grew. Clover made an excellent grazing crop and for winter feed it could be ensiled, or cut and stored as hay. Because clover plants were short, however, clover was less suited than alfalfa for hay cutting.

Clover was often planted in forage mixes with alfalfa and/or perennial grasses such as smooth brome grass, timothy, and Kentucky bluegrass. A parcel of land planted with this mix could remain as pasture for many years, especially when well-rotted manure was added to sustain productivity. Clover was also grown in fields with wheat, rye, and oats, or on corn stubble. After the taller grain was harvested, the clover remained in the ground for grazing.

Clover was valuable in crop rotations. Like all forage legumes, it improved fertility by fixing nitrogen, increased the soil's organic matter, and improved soil texture and water infiltration. Within rotations clover was planted alone, in hay mixes, and with grain crops or corn (Moore et al 1920: 110-114).

Farm Resources. Clover was grown in fields and pastures on a large percentage of Minnesota farms, especially those that milked cows. Clover hay did not keep well in outdoor haystacks and was better stored in a haymow or hay barn. Clover was also included in silage. Beginning in the 1940s Minnesota farmers also began to preserve hay (including clover) as "haylage" made in glass-lined silos.

CORN

Corn was a valued crop for Minnesota's pioneer farmers, in part because it could be planted and harvested on land that was newly-broken or only partly cleared. While the proportion of corn on Minnesota farms declined during the years of wheat monoculture, corn has always been one of the state's top five farm crops. Most Minnesota corn has been grown to feed livestock. (For sweet corn, see Vegetables below.)

Beginning in the 1890s, corn played an important role in farm diversification, and corn was critical to the rise of the state's dairy and livestock-feeding industries, especially between 1900 and 1960.

Minnesota's first seed corn came from the South and did not fare well in the state's shorter, colder growing season. The situation improved in the mid-1890s when the Minnesota Agricultural Experiment Station developed 'Minnesota 13' (also called University No. 13), an open-pollinated variety more suited to Minnesota and southern Canada.

Corn improved significantly when hybrids were developed beginning in 1926. (Incidently, corn was the first hybrid seed crop to be marketed extensively in the U.S.) The first hybrid corn – known as a double-hybrid – was introduced by Henry A. Wallace, an Iowa farmer who six years later became U.S. Secretary of Agriculture and whose company became the well-known Pioneer Hi-Bred. The University of Minnesota released its first corn hybrids in 1930. Hybrid corn began to spread across the state, and was planted almost exclusively in Minnesota from the end of World War II until the early 1960s. Another improvement came when single-hybrid corn was introduced in the early 1960s and yields increased again.

The southern one-quarter of Minnesota was especially good for corn culture and considered to be within the U.S. Corn Belt. At first most Minnesota corn was grown along the Iowa border where summers were hottest. By 1909 intensive corn-growing had moved northward by about two tiers of counties. In 1930 most corn was still found in the southwestern quarter of the state. With the use of double-hybrids, however, intensive corn-growing advanced to a diagonal line drawn through Breckenridge, Little Falls, and Cambridge. Today the most productive cornfields are still found south of that line.

In southern Minnesota where corn flourished, so did livestock-feeding. But northern counties could also grow corn for winter dairying through the use of a silo. The corn didn't have to be fully-mature to be placed in the silo, and corn silage was excellent winter feed for dairy cattle and allowed year-round milking.

Minnesota farmers grew 14 million bushes of corn in 1880, 47 million in 1900, and 104 million in 1930. By 1925 corn was the state's second-most-planted crop behind oats. Both corn production and livestock feeding grew sharply in Minnesota after World War II.

Because corn was a nitrogen-demanding crop (like the small grains), it needed to be rotated with legumes to maintain soil fertility. However, growing corn also contributed to the rotation – cornfields needed deep cultivation to keep weeds at bay, and this cultivation tended to both improve soil texture and suppress weeds through the next growing season. Through World War II many Minnesota farmers used a three-crop rotation of corn, small grains, and mixed hay. After the war many switched to a two-crop system of corn and soybeans, combined with chemical fertilizers. Today many farms now specialize in corn production and use advanced seed strains and chemical pesticides, herbicides, and fertilizers to play the role of crop rotation (Jarchow 1949: 225, 227, 234; Robinson 1915: 176; Dunham 1928: 2; Blegen 1975: 391).

In 1957 Minnesota was third among states in the value of corn produced, and in 2003 it was fourth. In 2003 corn was the predominant cash crop in both Minnesota and the U.S. It is grown throughout the state but concentrated in the southern half.

Farm Resources. Minnesota farmers grew corn in fields and stored ear corn in corncribs (especially between the early settlement period and the 1960s) and shelled corn in granaries and bins. They began to ensile corn stalks in the 1890s and to ensile shelled corn in the 1950s.

COWPEAS

See Field Peas.

FIELD BEANS

The term "field beans" (sometimes called cow peas, black-eyed peas, southern peas) usually refers to legumes such as pinto beans and lentils that are grown for human consumption. Minnesota farmers have traditionally grown small amounts of field beans, and the Minnesota Agricultural Experiment Station began studying them in earnest in the 1950s.

After many decades as a minor crop, field beans were grown by more Minnesota farmers beginning around 1970. Many field beans grow well in areas that are also favorable to potatoes and they are today concentrated in the Red River Valley and on irrigated sandy soils in the potato-growing region that stretches from Wadena and Park Rapids to Elk River. Common types grown today include adzuki, pinto, navy, kidney, great northern, black turtle, and cranberry. Minnesota is currently the leading state for dark red kidney bean production.

Farm Resources. Minnesota farm resources associated with field beans include fields and granaries and bins.

FIELD PEAS

Field peas, sometimes called Canada peas, are an annual legume mostly grown for animal feed. In the early 20th century field peas were grown in Minnesota, other northern states, and Canadian provinces like Ontario.

Field peas were useful as a nitrogen-fixing crop in places too infertile or too dry for other legumes like soybeans. They were used as feed for all types of livestock and planted in crop rotation schemes as hay, as a companion to grain in forage crop mixes, or as green manure (i.e., planted and plowed under). Field peas were generally superceded by soybeans and other legumes.

Farm Resources. Minnesota farm resources associated with field beans include fields and granaries and bins.

FLAX

Some of Minnesota's first farmers planted flax because it was a good "breaking crop" for newly-tilled ground, could grow in heavy soils, and did not require high fertility. However, very little flax was apparently grown in the 1840s and 1850s (or the fact was not recorded), because flax did not appear in the state's agricultural census until 1860 (Jarchow 1949: 240).

While some flax seed was used as livestock food and the straw for bedding, the major demand for flax was created by manufacturing processes. One was the fiber industry, which used flax to make linen – once the principal cloth fabric in the U.S. Even after linen was superceded by cotton cloth, some companies continued to make fabric from flax. A company in Duluth, for example, bought large amounts of flax from northeastern Minnesota farmers between 1909 and the 1950s (Tweton 1989: 279).

Flax was made into paper by companies in Winona, Windom, and Breckenridge beginning in the 1930s. Flax by-products were also used for wallboard and insulation (Tweton 1989: 279-280).

The most important market for Minnesota flax, however, was the linseed oil industry. During 75 years of U.S. industrialization, linseed oil was in high demand as an ingredient in paint, linoleum, varnish, printing ink, and other products. Minnesota's first linseed oil plant opened in Minneapolis in 1862, and the Twin Cities hosted many of the nation's earliest and largest paint factories. Industrial demand for linseed oil declined considerably after 1960, and with it, Minnesota flax production.

Flax was well-suited to the medium-heavy soils and cool temperatures of Minnesota – especially the northern counties. In crop rotations, flax (like other small grains) suppressed weeds with its dense stems, provided a source of cash, and could serve as a "nurse crop" for forage legumes. However, flax farmers were continually challenged by a crop disease called flax wilt. Because the pathogen stayed in the soil for several years, farmers had to space flax rotations many years apart to prevent the fungus from spreading to the next crop. In 1920 Minnesota had 378,000 acres in flax production – a number that rose to over 1.6 million acres in 1943. Flax acreage steadily declined after World War II, and in 1999 Minnesota had 10,000 acres planted in flax.

Minnesota was the U.S. leader in flax production in the 1890s. Minnesota and North Dakota led production between 1921 and 1950. In 1957 Minnesota was third among states in the value of flax produced, and today Minnesota is second in flax production behind North Dakota (Tweton 1989: 279-280; Arny and Hayes 1925: 120; Blegen 1975: 391).

Farm Resources. Like all small grains, flax was raised in farm fields, threshed in barns, and stored in granaries and bins. Flax was also ensiled, and was stored as hay and straw in livestock barns, outdoor stacks, and hay barns.

FLOWERS, ORNAMENTAL PLANTS, AND NURSERY CROPS

Minnesota's first nursery was established in 1851 in present-day St. Paul, and soon thereafter commercial greenhouses, "market gardens," and nurseries were established in and around the Twin Cities. Cut flowers, bedding plants, ornamental shrubs, deciduous and evergreen trees, and garden seeds were among the products grown and sold. In 1885, for example, Henry and Hattie Bachman established a truck farm that eventually became Bachman's, one of the state's largest commercial flower and nursery companies and now owned by the fifth generation. In other parts of the state, commercial growers established farms and greenhouses in and near Mankato, Winona, Duluth, Austin, Owatonna, and numerous other cities by 1900 (Widmer 1997).

Various professional associations, the Minnesota Agricultural Experiment Station, and the University's agricultural college and schools, encouraged Minnesota horticulture through extensive research, plant breeding, teaching, and the development of dozens of new plant releases between the late 19th century and 1960.

Farm Resources. Minnesota farm resources associated with horticultural and nursery crops include fields, greenhouses, coldframes, hotbeds, and on-farm storage and sales facilities.

FRUIT

Minnesota had orchards, vineyards, and berry fields as early as the 1850s, and the state's first agricultural periodical, the *Minnesota Farmer and Gardener* of 1860-1862, was geared in part to the fruit grower. The Minnesota Fruit Growers Association was founded in 1866, becoming the Minnesota Horticultural Society in 1868. Farms that grew fruit, like those that grew vegetables, were concentrated in southeastern Minnesota to serve the Twin Cities market. Fruit-growing was not an exclusive activity, however, and most farms that sold fruit raised livestock and other crops as well (Gimmestad 1980).

Minnesota's early fruit crops included apples, pears, cherries, quince, grapes, and raspberries. Jarchow reports that the value of Minnesota orchard products was only $649 in 1860 but had risen to $121,648 by 1880 (Jarchow 1949: 243-244). The Excelsior Fruit Growers Association was founded in 1900 by about 25 growers in the Minneapolis area who organized to collectively market. The group eventually expanded to include growers in Hopkins and St. Paul, and their activity peaked around 1930. At that time, raspberries comprised much of the association's sales (Gimmestad 1980).

The University of Minnesota operated experimental fruit-breeding farms first at Minnetonka (1878-1889) and then at Owatonna (1887-1925) before establishing the Fruit Breeding Farm, now Horticultural Research Center, in 1907 in Excelsior. University staff initially planted more than 21,000 seedlings of grapes, apples, plums, raspberries, and strawberries at the farm, and by 1944 had planted a total of about 276,400 including pears, currants, and more tender cherries, peaches, apricots, and prunes (Alderman 1944: 2-3). Among the University's dozens of varietal releases have been the winter-hardy Latham raspberry, released in 1920, the Haralson apple, released in 1922 and named for the Fruit Breeding Farm's first director Charles Haralson, and the Beacon apple, released in 1936.

The growth of the Twin Cities suburbs eventually displaced many of the region's orchards and fields. Between 1939 and 1959, for example, acreage planted to fruits and berries in the 11-county metropolitan area decreased from 5,528 acres to 1,625 acres. In 1958, about 12 percent of the fruits, vegetables, and potatoes entering the Minneapolis-St. Paul wholesale market were locally grown.

Not all fruit was grown near the Twin Cities, however. In the 1920s, fruit farmers near Elbow Lake (as well as those near the Twin Cities) were the first farmers in Minnesota to use field irrigation equipment (Wright 2005). In the mid-1850s a significant apple industry developed around the nascent settlement of La Crescent along the Mississippi River in southeastern Minnesota. The area once had 40 orchards and today grows about 80 percent of Minnesota's apples (Hanes 1964: 11, 22-23; Blegen 1975: 401-404).

In 2002 Minnesota's leading fruit crops, listed in order of acres planted, were apples, strawberries, raspberries, grapes, tame blueberries, plums and prunes, tart cherries, and pears. Most apples are grown in central and southeastern counties.

Farm Resources. Minnesota farm resources associated with fruit-growing include orchards, vineyards, fields, greenhouses, hotbeds, coldframes, and on-farm storage and sales facilities.

GRASSES

Forage grasses were important livestock food and were grown in pastures and mixed hay fields. (See also Hay.) Grasses were grazed, cut for hay, and/or ensiled. The most important "cool season" grasses (those that grew best during cool temperatures) were brome grass (or smooth brome grass), orchard grass, reed canary grass, and timothy. Switch grass was an important warm season grass that flourished in the mid-summer.

Each type of grass had its advantages and mixes were common. Brome grass, for example, was productive and palatable, but recovered more slowly when grazed in a pasture. Orchard grass, while fast in recovery, was not as hardy as brome grass. Reed canary grass grew better in wet areas, and switch grass grew better in hot weather.

Grasses, like corn and small grains, depleted the soil's nitrogen and for this reason were often planted in mixtures with nitrogen-fixing legumes such as clover.

One of the most popular forage grasses, timothy, was a perennial planted by early Minnesota farmers for grazing and hay. It was especially good for cattle and horses. Timothy was preferred for outdoor haystacks because it shed water better than other types of hay.

While very few farmers grew "tame" grasses before 1880, there were some exceptions. Among them was Major Joseph R. Brown who, according to Jarchow, was "a pioneer in raising tame grasses, having introduced timothy on his farm [on Lake Traverse] in 1831." Jarchow also cites Charles Larpenteur who was raising red clover and timothy in Ramsey County in the 1850s and 1860s (Jarchow 1949: 237-239).

Farm Resources. Grasses were grown in fields and pastures on many Minnesota farms. Farmers that cut hay stored it in outdoor haystacks, within livestock barns, and in hay barns or sheds.

Grasses were also included in silage. Beginning in the 1940s farmers began to preserve "haylage" in glass-lined silos.

HAY

The term hay generally referred to a legume, grass, or grass-legume mixture that was cut, dried, and stored to be used for livestock feed during winter months.

"Wild hay" refers to plants cut from wetlands, roadside ditches, drainage channels, and other rough areas. In wet locations the hay was often cut after the ground froze in November or December. In addition to making mowing easier, late cutting also gave the plants a chance to reseed which helped rejuvenate the stand. The harvest of wild hay, which began with Minnesota's earliest farmers, was one of the factors that led to the loss of one of Minnesota's native ecosystems – the northern tall grass prairie.

"Tame hay" refers to species intentionally planted. In 1880 Minnesota farmers harvested one-third fewer acres of hay than wheat. It is not known how much of this harvest was tame hay and how much was wild hay (Jarchow 1949: 236-239).

Legume hays include plants like alfalfa and clover. Because of their nitrogen-fixing ability, legume hays played a key role in crop rotation schemes that helped maintain soil fertility. The hay seed was sometimes planted simultaneously with a small grain that served as a nurse crop for the more fragile seedlings. The grain could be harvested first and the field then used as a hayfield or pasture.

Grass hays include plants such as timothy, brome grass, reed canary grass, and sometimes small grains. Mixtures of grasses and legumes often provided the best yields and sustainability. Red clover, alsike clover, and timothy grass was a common Minnesota hay mix.

In 1957 Minnesota was fourth among states in the value of tame hay produced (Blegen 1975: 391).

See also Alfalfa, Clover, and Grasses.

Farm Resources. Hay was grown in fields and pastures on a large percentage of Minnesota farms. It was stored in outdoor haystacks, within livestock barns, and within hay barns or sheds. Hay was also included in silage mixes. The ensiling of "haylage" in glass-lined silos began in the 1940s.

MANGELS

Mangels are a root crop related to sugar beets. They were grown on many Minnesota farms as livestock feed. They were especially useful in cool areas where corn yields were low.

Growing and handling root crops like mangels, turnips, and rutabagas, required considerable hand labor, however. They needed to be planted, weeded, thinned, dug at harvest, moved to storage, and then chopped for feed. In part because of the labor, many farmers chose to ensile corn and other crops instead. Mangels could also be used as a pasture forage crop.

Farm Resources. Minnesota farm resources associated with mangels include fields and root cellars.

OATS

Oats were the state's leading small grain crop from the earliest settlement by Europeans until about 1858 when wheat surpassed oats. Oats were again the leading crop as farmers moved away from dependence on wheat, remaining in the lead through World War II.

While oats were not as nutritious as wheat for either humans or animals, there was a demanding market because they were excellent feed for horses, mules, animals being bred, and young livestock that were building muscle but not being quickly fattened for slaughter. Oats were also beneficial for some farmers because they grew in cooler conditions than did wheat or barley and were more tolerant of acidic soils.

Oats were widely grown to feed the draft animals needed to power farms, mines, logging camps, factories, and cities. Some farms needed to devote 25 percent of their land just to growing oats, hay, and straw for the farm's own work horses. As gasoline engines were developed and draft animals disappeared, fewer oats were grown and more profitable crops took their place.

Because of their importance to the state's economy, oats were among the first crops researched by the Minnesota Agricultural Experiment Station, established at the University of Minnesota in 1885. In 1895 the Station released its first improved variety of oats.

In addition to being threshed for grain, oats were the best small grain to use for hay. Oat straw was used in the barn for animal bedding. In crop rotations, oats played the role of all small grains by suppressing weeds with their dense stems, providing a source of cash, and often serving as a "nurse crop" for slower-growing forage legumes by protecting the legume seedlings from erosion, weeds, and baking sun. By the middle of the summer, the oats could be harvested as grain, cut green for silage, or mowed for hay while the legumes were still maturing. Oats were also planted as a cover crop.

Minnesota farmers raised 2.5 million acres of oats in 1900 and about 5.4 million acres at the crop's peak in 1945. In 1957 Minnesota was second among states in the value of oats produced (Blegen 1975: 391).

In 2000 Minnesota led the nation in the production of oats. Today the state's farmers plant about 300,000 acres of oats in counties throughout the state. About 80 percent are grown for animal feed. Oats are also ground for flour and rolled for breakfast food.

Farm Resources. Like all small grains, oats were grown in Minnesota farm fields, threshed in barns, and stored in granaries and bins. Oats were also ensiled, and were stored as hay and straw in livestock barns, outdoor stacks, and hay barns.

OIL SEED CROPS

The term "oil seed" most often refers to flax, rape seed, sunflowers, safflowers (rarely grown in Minnesota), and mustard (grown in northwestern Minnesota beginning in the 1960s). These crops are primarily grown for the oil pressed from their crushed grains. The term "oil seed" crop could also describe soybeans, but soybeans are generally listed as soybeans in crop discussions.

See Flax, Rape Seed, and Sunflowers.

POTATOES

Most early Minnesota farmers grew potatoes for their own use, but during the early settlement era they were also an important cash crop. Acreage in potatoes soon grew, and in the late 19th and 20th centuries potatoes were one of Minnesota's most important specialty crops.

Potatoes grew well in parts of Minnesota with fertile, deep, well-drained soil. They flourished where the subsoil held sufficient moisture but the topsoil was sandy, which allowed the tuber to grow large without too much resistance. Most potatoes grown in Minnesota where white or Irish potatoes; the state was generally too cold for sweet potatoes, although a few were planted.

Like corn, potatoes required frequent, deep cultivation while growing. (Potatoes and corn are often called "inter-tilled" or "cultivated" crops.) When potatoes were used in crop rotations, the cultivation helped improve soil texture and tended to suppress weeds even through the next season's rotation of a different crop.

Many early potato growers were located near the Twin Cities, a major market and a port for the shipment of agricultural products down the Mississippi River. In the words of historian Jerome Tweton, a "specialized potato district" developed north of the Twin Cities, particularly in Anoka, Isanti, and Chisago counties (Tweton 1989: 284, 282; Jarchow 1949: 225). This was the first of Minnesota's three major potato-growing areas.

Wheat farmers in the Red River Valley began to grow potatoes between 1900 and 1920 in an effort to diversify, forming the state's second concentration of growers. Among the region's potato pioneers were farmers in Clay County, Minnesota, and Walsh County, North Dakota (Kenney 1995: 7). Potato production in the valley grew considerably between 1900 and 1920, and by 1920 Red River farmers were growing about 55,000 acres of potatoes per year. By the early 1980s the Red River Valley was harvesting about two-thirds of Minnesota's potatoes.

Shortly after 1900 the third potato-growing region developed in north central Minnesota, part-way between the Twin Cities and the Red River Valley.

In 1920 Minnesota farmers harvested 319,000 acres of potatoes compared with 36,000 acres in 1875. In 1920 all of Minnesota's top ten potato-growing counties were located in the three regions: near the Twin Cities were Hennepin, Chisago, Isanti, and Anoka counties; in the Red River Valley were Clay, Norman, Polk, and Otter Tail; and in north central Minnesota were Todd and Stearns (Black et al 1921: 9).

Minnesota's potato washing and processing plants were established in the three growing regions. Among the earliest were potato starch factories in Anoka (established in 1886), and in Harris, North Branch, and Monticello. Later plants included the Red River Potato Company, established in 1929 in East Grand Forks; Old Dutch, established in 1934 in St. Paul; and, more recently, Barrel o' Fun, established in 1973 in Perham. Waste from Minnesota processing plants was generally discarded until 1974 when the Minnesota Agricultural Experiment Station developed a method of ensiling the culled potatoes and potato waste, along with other forage crops, for use as animal feed.

By 1930 Minnesotans grew 25 million bushels of potatoes, compared to 5 million bushels in 1880, and the state was a national leader in production. In 1948 an important research facility, the Red River Valley Potato Research Center, was built in East Grand Forks. In 1957 Minnesota was ninth among states in the value of potatoes produced (Kenney 1995: 230; Blegen 1975: 391).

In the mid-1990s, growers in the Red River Valley (on both Minnesota and North Dakota sides of the river) were planting 180,000 to 200,000 acres of potatoes annually. This was the second-largest concentration in the U.S. (Kenney 1995: 7). Today most Minnesota potatoes are grown in northern, central, and southeastern counties, including in the historic growing areas. North Dakota, Minnesota, Wisconsin, and Michigan collectively grow about one-third of U.S. potatoes.

Farm Resources. Minnesota farm resources associated with potato-growing include fields, root cellars, and potato warehouses.

RAPE SEED OR CANOLA

Rape is an oil seed crop whose grains are crushed to expel the oil. Some varieties of rape seed have oil and protein levels comparable to those of soybeans.

Growing rape seed did not become popular in the U.S. until World War II when the oil was used industrially as a machine lubricant. Rape seed shares many of the same cultural needs as soybeans, but can be grown in cooler areas.

Breeding for the properties found in edible “canola” oil began in Canada about 1960, but the term “canola” was not used until 1979. The oil processed from this type of rape seed was valued as a cooking oil because it was low in erucic acid, which was linked to heart disease. The meal from the seed could be used for livestock feed because of its lower levels of glucosinolates, a component of rape seed whose breakdown product could be toxic to animals.

In addition to being grown for machine oil, livestock feed, and cooking oil, rape seed was also used as a forage crop, especially for hogs and poultry.

Today most Minnesota farmers – except those in cool northwestern counties – choose to plant more profitable soybeans, rather than rape seed. Most Minnesota rape seed fields are today concentrated in northwestern Minnesota, where the crop is usually grown in rotation with small grains. Farmers in North Dakota, South Dakota, and Minnesota produce most of the rape seed grown in the U.S.

Farm Resources. Minnesota farm resources associated with rape seed include fields and granaries and bins.

RUTABAGAS

Rutabagas were a high-quality livestock food that, like turnips and other root crops, were grown on many Minnesota farms, especially in cooler areas where corn did not flourish.

Growing and handling root crops required considerable hand labor, however. They needed to be planted, weeded, thinned, dug at harvest, moved to storage, and then chopped for feed. In part because of this, farmers who could ensile corn and other crops preferred to do so. Rutabagas were also grazed in pastures.

Today some Minnesota farmers plant rutabagas as a pasture crop and for "green chop" – succulent feed for livestock.

Farm Resources. Minnesota farm resources associated with rutabagas include fields and root cellars.

RYE

Rye has been grown in Minnesota since the early settlement era. In 1860 most rye was grown north of the Minnesota River. By 1880 rye culture was moving into "districts formerly wooded," according to Jarchow (Jarchow 1949: 228, 231).

Rye, like flax, could be planted in poor soils where other small grains like wheat did not flourish. Included were areas both too cool and too dry for high wheat yields. (Northern Europe and Scandinavia, for example, grew more rye than did warmer parts of Europe.)

Rye was the most winter-hardy of the small grains grown in Minnesota, and was often sown in the fall to remain in the field over the winter, similar to winter wheat.

Rye was valued for its grain, which was eaten by both humans and livestock, and for hay, silage, as a grazing crop, as a cover crop to prevent erosion, and as a green manure crop to improve the soil. Rye could serve as one of the small grains in a crop rotation of, for example, corn, small grains, and hay. Like all small grains, rye was valued in the rotation because it provided a source of cash, suppressed weeds with its densely-spaced stems, and could serve as a "nurse crop" for slower-growing forage legumes.

Rye was never as popular in Minnesota as wheat, oats, or barley, however. Rye fields yielded less grain than those of wheat or barley, and rye was less profitable for other reasons. For human consumption, rye contained much less gluten than wheat and was therefore less desirable for bread flour. For livestock, rye was nutritious, but the grain had a strong flavor and became sticky when chewed. Rye therefore had to be diluted in mixtures that commonly contained no more than 30 percent rye. Rye was generally good as a pasture crop, except that it couldn't be grazed by dairy cows because the rye flavored the milk.

Rye production increased as Minnesota farmers sought to diversify from their wheat monoculture. Minnesotans harvested 215,000 bushels of rye in 1880, for example, and 6.5 million bushels in 1930. In 1957 Minnesota was eighth among states in the value of rye produced (Blegen 1975: 392).

Today most Minnesota rye is grown in a diagonal band that stretches between northwestern Minnesota and Wabasha County. South Dakota, Georgia, Nebraska, North Dakota, and Minnesota lead the nation in rye production.

Farm Resources. Like all small grains, rye was grown in Minnesota farm fields, threshed in barns, and stored in granaries and bins. Rye was also ensiled, and was stored as hay and straw in livestock barns, outdoor stacks, and hay barns.

SORGHUM

Some Minnesota farmers raised sorghum for the syrup extracted from the crushed stalks, especially during times of high sugar prices. Minnesota had a surge of sorghum production, for example, in the 1860s and 1870s that was promoted by a rise in the price of southern cane sugar during the Civil War. Among the leading proponents of sorghum during this period was Minnesotan William LeDuc, who served as U.S. Commissioner of Agriculture from 1877-1881 and promoted sorghum while in office (Jarchow 1949: 240-241).

Farm experts advised that, if sorghum were planted for syrup, the crop should be timed to ripen during a late-summer slack period on the farm. This was because sorghum needed to be processed very quickly – with the fields cut, the leaves removed, and the stems crushed – to produce the best syrup (Moore et al 1920: 95-96).

Most sorghum was raised as livestock feed. While sorghum silage was less digestible than corn silage, sorghum could be a valuable ingredient in silage mixtures. As a pasture crop, some types of sorghum were poisonous to cattle and sheep, especially if grazed when the plants were young. Most farmers, therefore, harvested sorghum as dry hay, or cut it for silage after the plants had matured.

Sorghum grew best in warm conditions, similar to those needed for corn. However, because sorghum was less valuable than corn and was easily damaged by wind, most farmers chose to grow corn instead. Most sorghum that was planted was raised in southern Minnesota.

Today there are several types of sorghum grown in Minnesota including grain sorghum, forage sorghum, Sudan grass, and sorghum-Sudan grass hybrids. Grain sorghum is used to feed poultry and livestock. Forage sorghum, a 6'- to 12'-tall plant with heavy stems, is usually cut for silage. Sudan grass is a finer-stemmed type that is often used as pasture grass or green chop, especially during the hot mid-summer when perennial pasture grasses are dormant. Sorghum-Sudan grass hybrids are used for pasture, hay, and silage.

Farm Resources. Minnesota farm resources associated with sorghum include fields, sorghum mills or presses, silos, and hay storage facilities.

SOYBEANS

Small amounts of soybeans were grown in the U.S. in the late 19th and early 20th centuries, often on an experimental basis. There were almost no soybeans grown in Minnesota until 1930, and soybeans did not become a major crop in the state until after World War II.

In 1930 only about 25 percent of the U.S. soybean crop was harvested for beans. The beans were pressed into oils for paints and other industrial products, and the meal was used for livestock feed. The other 75 percent of the U.S. soybean crop was cut for hay or plowed under as a soil builder.

In about 1930 a market for soybean cooking oil developed. Soybean cooking oil had been introduced to the U.S. during World War I when wartime shortages of fats and oils had prompted the importation of soybean oil from Manchuria. American food companies began to use soy more often in the 1930s as food scientists succeeded in making soybean oil more flavorless and introduced it into margarine and other processed foods. Minnesota processors included the Twin Cities' Archer-Daniels-Midland Company, which introduced an effective soybean crushing process in the late 1930s (Tweton 1989: 280). The demand for soybean oil increased during World War II when it was again substituted for more popular fats and oils due to shortages. Since World War II, soybeans have been the leading U.S. farm crop grown for cooking oil.

Soybean meal – the part remaining after oil was extracted – made good livestock feed because of its high protein content and digestibility. Among common oil seeds, soybeans produced the greatest proportion of meal to oil when crushed, making it a superior feed crop. During World War II, farmers were encouraged to grow more soybeans for livestock feed (as well as more livestock), and the federal government introduced the first soybean price supports. Many southern Minnesota farmers raised their first soybeans during the war in fields that had been previously planted with barley and oats no longer needed to feed draft animals.

In the mid-1930s soybeans were promoted by the federal government as a green manure crop (i.e., to be planted and plowed under) for rebuilding depleted soil. Like all legumes, soybeans improved fertility by fixing nitrogen, although soybeans also tended to leave fields susceptible to soil erosion and moisture depletion. Soybeans were especially useful as a nitrogen-fixer to farmers in southeastern Minnesota because soy could tolerate the region's acidic soils better than could legumes like red clover and alfalfa.

In 1946 the University of Minnesota began its first soybean breeding program. At that time, there were still only 450,000 acres of soybeans planted in Minnesota, compared to 5.8 million acres in 1984.

Soybean production rose with the growth of the U.S. livestock industry after World War II. Largely because of its value for livestock feed, soybean acreage in the U.S. increased tenfold between 1941 and 1977. In Minnesota, production of soybeans increased 224 percent between 1958 and 1982.

In 1949 soybeans were Minnesota's third-largest cash crop and 20 percent of the state's farms were growing some soy. The same year, the U.S. became a net exporter of oils, oil seeds, and protein meals for the first time, primarily because of soybeans. In 1951 Minnesota had eight soybean processing plants and ranked sixth among states in soybean production. In 1953 soybeans were Minnesota's second-largest cash crop, and in 1957 Minnesota was third among states in the value of soybeans produced (Cavert 1956; Tweton 1989: 281).

Soybeans were generally planted in the spring if the beans were to be harvested for oil or meal, but could be planted later in the growing season if the crop was cut for hay. In the latter case, soybeans could be used as a "catch crop" to salvage the season if an earlier crop in the field failed.

Soybeans, like corn, need warm growing conditions. In the 1930s most of Minnesota's few fields were concentrated near the Iowa border. By 1950 most soybeans were grown south of approximately St. Cloud. After World War II, soybean culture continued to spread as many Minnesota farmers moved from a traditional three-crop rotation of corn, small grains, and legume hay, to a two-crop rotation of corn and soybeans, along with commercial fertilizers (Tweton 1989: 280; Hart 1986: 62).

In 1986 geographer John Fraser Hart called soybeans "the wonder crop of the Corn Belt." He wrote that, in 1982, soybeans were the only crop other than corn to be widely grown in the Corn Belt, and that some counties in the Corn Belt grew more soybeans than corn (Hart 1986: 62).

Soybean production in Minnesota continued to increase and in recent decades some farmers have grown soybeans almost exclusively. In 1992 Minnesota ranked fourth nationally in soybean production. In 2003 soybeans were the state's second-largest cash crop. Today soybeans are grown throughout the state except in the northern cutover counties, with fields especially concentrated southwest of a line from Fargo to Rochester.

Farm Resources. Minnesota farm resources associated with soybeans include fields and granaries and bins. Soybean crops were also ensiled and cut, dried, and stored as hay.

SUDAN GRASS

See Sorghum.

SUGAR BEETS

During most of the 20th century, sugar beets were one of Minnesota's most important specialty crops. They were the northern states' alternative to sugar cane and became a major source of sugar in the U.S., especially after World War II. In addition to making sugar, sugar beet plants made livestock feed from the dried beet pulp.

Sugar beets grew in alkaline soils but were best where soils were not so heavy that digging the tubers at harvest was impeded. Because of their bulk and weight, most beets were grown in locations with a sugar refinery nearby, often under contract with the processor.

Minnesota's sugar beet farming began in southeastern areas, particularly along the Minnesota River southwest of the Twin Cities. From this beginning, sugar beet fields spread westward along the river valley to Swift and Redwood counties.

Much of this early crop was sold to the state's first sugar beet processing plant, established in 1898 in St. Louis Park. In 1905 the plant burned, but in 1906 a new plant that was opened in Chaska by the Carver County Sugar Company, renamed the Minnesota Sugar Company in 1911. Southern Minnesota farmers also grew beets for processing plants in Chippewa Falls, WI (operational by 1912), Mason City, IA (opened in 1917), and Belmond, IA.

In the meantime farmers in the Red River Valley began to grow sugar beets, like potatoes, to help reduce their dependence on wheat. Farmers found sugar beets could tolerate the heavy and often wet soils of the valley. Initially the sugar beets were shipped to Chaska, but by the early 1920s enough beets were being grown that farmers organized the Red River Sugar Company (established 1924) and made plans to collaborate with Minnesota Sugar to build the state's second processing plant in East Grand Forks. That facility opened in 1926. (The East Grand Forks plant was actually owned by the American Beet Sugar Company which had purchased Minnesota Sugar before construction was completed. American Beet Sugar, based in Denver, became American Crystal Sugar in 1934 (Tweton 1989: 287-289).)

In 1938 Minnesota's sugar beet fields were concentrated near the two refineries in the Red River Valley (Moorhead) and the Minnesota River Valley (Chaska).

Sugar beet acreage was historically small because beets were far more labor-intensive than most crops. Beets had to be cultivated, thinned, harvested, topped, and loaded by hand. In 1924 a Minnesota Extension Service expert reported that labor comprised 80 percent of the cost of growing sugar beets and wrote, "It is apparent than the profit from this crop is largely dependent upon the supply of cheap labor" (McGinnis 1924: 10-11).

Most sugar beet fields were tended by seasonal workers. Some farmers hired youth from the neighborhood. Before World War I most sugar beet workers were recent immigrants to Minnesota from eastern Europe. After World War I, most beet workers were Mexican citizens and Mexican immigrants. (See the individual farm elements section entitled "Hired Workers' Housing" for more information.) Machinery developed during and after World War II eventually reduced the number of tasks that needed hand work, but seasonal labor was still important. In 1958, for example, it took 2.7 man-hours to grow one ton of sugar beets. About 11.2 man-hours were needed to grow one ton in the 1910s. In 1960 nearly all sugar beets were harvested mechanically but hand labor was still used to thin the plants (Rasmussen 1967: 33, 35).

Sugar beets could be substituted for corn as a rotational crop on farms that did not have livestock to feed. The substitution also worked in regions with cool summers where corn yields were low. A common rotation was sugar beets (year one); potatoes, small grains, soybeans, or corn (year two); and a legume such as alfalfa or clover (year three).

Sugar beet production expanded after World War II when consumer demand for sugar rose nationwide, at the same time that new technology was reducing some of the labor costs. New processing plants were built by American Crystal Sugar in Moorhead (built 1948) and Crookston (built 1954), giving Minnesota four refineries. Minnesota farmers in the Red River Valley also contracted with plants across the river in North Dakota. In 1973, local farmers, through the Red River Valley Sugarbeet Growers Association (which had formed in 1926), cooperatively purchased the American Crystal Sugar Company. The company headquarters were moved from Denver to Moorhead. Meanwhile in south central Minnesota, the Chaska sugar beet plant closed in 1971. To replace the lost market, local farmers cooperatively built a new processing plant in 1975 in Renville. Growers in that area planted 50,000 acres of sugar beets in 1975 (Tweton 1989: 287-289).

In 1957 Minnesota was eighth among states in the value of sugar beets produced. Between 1991 and 2002 Minnesota farmers led the nation in sugar beets, planting 30 percent of total U.S. acres harvested.

Today more than one-third of U.S. sugar comes from beets. Minnesota still leads the nation in sugar beet production, with North Dakota ranking second. Most of Minnesota's sugar beets are still grown in counties near the Red River and the Minnesota River.

Farm Resources. Minnesota farm resources associated with sugar beets include fields and hired workers' houses. Because sugar beets were moved directly from the fields to receiving stations established by the processing plants, on-farm storage structures were not needed.

SUNFLOWERS

Sunflowers did not become a major Minnesota cash crop until after World War II. Many were grown in the Red River Valley where wheat farmers planted them to diversify their cropping systems. Most sunflowers were used in food industries and much of the crop was processed at sunflower oil plants in Hastings and in North Dakota cities such as West Fargo and Enderlin. The leftover meal was used for livestock feed and as a food additive (Tweton 1989: 281). Sunflowers were also grown for silage, and could be planted as a catch crop in a field after early small grains had been harvested.

In 2002 Minnesota ranked fourth nationally in sunflower production. Today most sunflowers are grown in northwestern Minnesota.

Farm Resources. Minnesota farm resources associated with sunflowers include fields, granaries and bins, and silos.

TOBACCO

Tobacco was grown in Minnesota at least as early as the 1910s (possibly earlier), and was still being grown in small amounts in the 1970s. Around 1920 commercial tobacco production was "highly localized" in the counties of Morrison, Benton, Sherburne, Meeker, and Stearns in central Minnesota. In 1930 there were also fields in Mille Lacs, Houston, and Freeborn counties. Small cigar factories to process the crop were located in towns like St. Cloud and Foley, and a "sweat barn" where tobacco was cured was located in Watkins in 1941-1947 (Vogeler and Dockendorff 1978: 77-80).

Tobacco acreage probably peaked in Minnesota in the 1920s. In 1930 about 2,060 acres were harvested statewide, with about 85 percent grown in central Minnesota by approximately 300 growers. After 1930 levels remained low – about 100 acres were harvested in both 1937 and in the early 1960s. There were about 60 growers statewide in 1970 (Vogeler and Dockendorff 1978: 77-79).

Tobacco required large amounts of labor, knowledge and experience, and careful handling during curing to be profitable. The curing stage was helped by having a specialized tobacco shed (Vogeler and Dockendorff 1978: 77-79).

Farm Resources. Minnesota farm resources associated with tobacco include fields and tobacco sheds.

TREES AND SHRUBS

See Flowers, Ornamental Plants, and Nursery Crops.

TURNIPS

Turnips and other root crops like rutabagas and mangels were grown as livestock food, especially in areas like northern Minnesota where corn did not flourish.

Growing turnips required considerable hand labor. They needed to be planted, weeded, thinned, dug at harvest, moved to storage, and then chopped for feed. In part because of this, farmers who could ensile corn and other crops preferred to do so. Turnip plants were also grazed in pastures.

Today some Minnesota farmers plant turnips as a pasture crop and for "green chop" – succulent feed for livestock.

Farm Resources. Minnesota farm resources associated with turnips include fields and root cellars.

VEGETABLES, OTHER THAN POTATOES

Market produce, including vegetables, were first reported in the Minnesota agricultural census in 1850. Minnesota's truck farms – that is, farms that raised vegetables for fresh rather than processed use – were established close to the Twin Cities so that farmers could haul crops to market while they were still fresh. Fresh vegetables were also raised near Duluth, other logging and iron mining towns, and similar population centers (Jarchow 1949: 241).

By the 1930s Minnesota truck farmers were shifting away from fresh produce and toward raising vegetables for processing. For example, in the 11-county Twin Cities metropolitan area between 1939 and 1959, crops of tomatoes, cucumbers, cabbage, and dry onions – all grown primarily for the fresh market – decreased by 2,000 acres, while crops of sweet corn and green peas – primarily for processing – grew by 6,400 acres (Hanes 1964: 22-23).

In 1958, only about 12 percent of the fruits and vegetables (including potatoes) moving through the Minneapolis-St. Paul wholesale market were locally grown. In the same year, only about 6 percent of fresh fruits and vegetables handled by Duluth wholesalers were grown in that area (Hanes 1964: 10, 32).

Farms that grew canning crops, or vegetables for processing rather than fresh sale, were clustered around canning plants that were first established in the late 19th and early 20th centuries. Minnesota had ten vegetable canning and preserving companies in 1910. They were located in and near Dodge, Steele, Faribault, Le Sueur, and Scott counties in south central Minnesota. One of the largest, the Minnesota Valley Canning Company of "Green Giant" fame, opened in Le Sueur in 1903, creating an early market for sweet corn and peas (Tweton 1989: 282).

By 1947 Minnesota had 37 vegetable canning factories. This increase was encouraged by a nationwide demand for frozen foods created when electric refrigerators became affordable after World War II. Among the state's largest canneries were the Owatonna Canning Company (established 1911), Minnesota Valley Canning of Le Sueur (established 1903), and Gedney of Minneapolis (established 1881). For many decades Gedney contracted with Minnesota farmers to grow pickling cucumbers (Tweton 1989: 282).

In 1957 Minnesota was second nationally in sweet corn production and fourth in green peas (Blegen 1975: 391). In 1992 Minnesota was the country's largest producer of green peas and the second-largest producer of sweet corn.

The 2002 federal agricultural census reported 32 vegetable crops raised in Minnesota. The top ten, listed in order of acres harvested, were sweet corn, green peas, snap beans, pumpkins, carrots, radishes, squash, beets, cucumbers and pickles, and cabbage. Today vegetable crops are grown in most Minnesota counties and especially in the southern one-third of the state.

Farm Resources. Minnesota farm resources associated with vegetable crops include fields, greenhouses, hotbeds, coldframes, and on-farm storage and sales facilities.

WHEAT

The first wheat in Minnesota was raised in 1820 at the confluence of the Minnesota and Mississippi rivers. Wheat became a commercially important crop in Minnesota about 1858. By that time, railroads from Chicago had reached the Mississippi River, lands west of the Mississippi were open to Euro-American settlement, and both the demand for wheat and total population were rising in the U.S. and Europe (Larson 1926: 17-18).

Wheat was superior to other small grains because its gluten made a lighter, better-rising bread. Wheat flour was also more nutritious and contained more protein than that of other small grains.

The first phase of Minnesota wheat-growing – which began in 1858 – was centered in southeastern Minnesota, especially those counties west of the Mississippi River and south of the Minnesota. The crop was hauled in wagons to local mills or to the nearest river where it was shipped downstream (Jarchow 1949: 227). As wheat culture spread, wheat occupied 53 percent of the state's cultivated land in 1860 and 62 percent in 1868. In 1870 the principal wheat-growing counties were Olmsted, Goodhue, Filmore, Wabasha, Dakota, and Winona – all in southeastern Minnesota (Jarchow 1948: 12-13).

The second phase of Minnesota wheat-growing was concentrated farther west. It was stimulated by the growth of Minneapolis' world-dominant flour milling industry in the 1860s-1870s and by the construction of railroads linking the Minneapolis mills and the Duluth harbor to the Red River Valley. Wheat-growing began in the Red River Valley around 1873. By 1878 at the peak of its supremacy, wheat was grown on nearly 70 percent of all tilled fields in Minnesota. At the turn of the century Minnesota's four largest wheat-growing counties were Polk, Clay, Marshall, and Otter Tail – all in and near the Red River Valley.

Minnesota became the national leader in wheat production, and Minneapolis and Duluth became the nation's largest wheat markets. Between 1882 and 1930, Minneapolis led the world in flour milling (Drache 1964: 14-15). Yet while wheat production nearly doubled between 1870 and 1880 and nearly tripled between 1880 and 1900, wheat as a percentage of tilled acres in Minnesota did not again match the 1878 level (Jarchow 1948: 17-18, 28).

During this period most farmers in Minnesota grew wheat as their exclusive cash crop. Typically grown on a region's frontier, wheat was attractive because it required less equipment, buildings, and farming knowledge than did mixed crop and livestock farming, because during this time land prices were low and wheat prices high.

Farmers who planted only wheat placed their entire farm incomes at risk, warned agricultural experts. As early as 1867, for example, the Minnesota State Agricultural Society stated, "the continual cropping of wheat, year after year, in the same field, without even a change of seed, is bad farming, and ought to be discouraged" (quoted in Jarchow 1949: 253). Some farmers heeded the message, but many continually planted wheat in a single field for 20 years or more. Yields declined due to infertile soil, and wheat rust, stem blight, and grasshoppers ravished crops. Some farmers in western areas where land was affordable simply planted more acres. Farmers in southeastern counties where land prices were higher were the first to turn to more diverse crops, livestock feeding, and dairying to maintain their incomes (Jarchow 1948: 26-27).

As the wheat monoculture ended, Minnesota agriculture was transformed with the rise of scientific agriculture, the development of the diversified farm, and the growth of livestock and dairy industries. Where Minnesota farmers harvested 34 million bushels of wheat in 1880 and 95 million bushels in 1900, they produced only 19 million bushels in 1930. Farms diversified with cornfields, silos, dairy cattle, poultry houses, and stockyards replacing wheat operations.

For a diversified farm, wheat had the same advantages as other small grains and was planted in similar ways. Wheat was used in crop rotations to suppress weeds with its dense stems, to provide a source of cash, and often as a nurse crop to protect more fragile legume seedlings planted at the same time. Wheat straw was used for livestock bedding, wheat was cut for hay, ensiled, grazed in pasture mixes, and planted as a cover crop.

The University of Minnesota began to research wheat in 1889 and released its first improved strain in 1895. In 1916 a catastrophic stem rust epidemic destroyed almost 300 million bushels in the U.S. and Canada. (There were actually serious wheat rust outbreaks in 1878, 1904, 1914, 1916, 1923, 1925, 1935, and 1937.) Twelve years later in 1928 the University issued ‘Marquillo,’ its first stem rust-resistant variety. Another University of Minnesota introduction, ‘Thatcher’ which was released in 1934, became one of the most popular wheat varieties ever grown in the U.S. For many farmers it replaced ‘Marquis,’ a Canadian-developed variety that had accounted for more than 75 percent of the wheat grown in Minnesota in 1925. In 1951 ‘Thatcher’ was still the principal wheat planted in North America (“Food for Life” 2001; Arny and Hayes 1925: 7).

Minnesota farmers grew mostly hard red spring wheat, a standard for bread making and a type that could withstand extreme conditions. All University of Minnesota releases after 1948 were varieties of hard red spring wheat.

Along with their Dakota counterparts, Minnesota farmers also grew most of the nation’s durum wheat. Durum required conditions similar to those for hard spring wheat and was processed primarily for pasta flour.

Some Minnesota farms also grew hard red winter wheat, a fall-sown wheat that was not reliably hardy in Minnesota. While planting the crop was a risk, some farmers used winter wheat to better distribute their work load and to seek the crop’s superior yields. If the wheat survived the winter, the yields could be higher than those of spring wheat because the plants had a head-start in the spring, could make use of spring moisture, and could prevail against competing weeds.

In 1957 Minnesota was 17th among states in the value of wheat produced – a reflection of Minnesota’s shift to dairying, corn, soybeans, and livestock feeding.

Today most Minnesota wheat is grown north of New Ulm and west of Wadena.

Farm Resources. Like all small grains, wheat was grown in Minnesota farm fields, threshed in barns, and stored in granaries and bins. Wheat was also ensiled, and was stored as hay and straw in livestock barns, outdoor stacks, and hay barns.

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Although these ears of seed corn were strung outside, they would probably have been moved indoors to dry because outdoor conditions were generally too moist. Drying and storing the seed properly was critical to ensuring a crop for the following year. Photo taken in Providence Township, Lac qui Parle County, 1915. (MHS photo)

A crop of Grimm alfalfa with shocks covered with pegged tarps to protect them from the rain. Among hay crops, alfalfa spoiled easily and was generally stored inside. Carver County, circa 1938. (MHS photo by Harry Darius Ayer)

FOCUS ON MINNESOTA LIVESTOCK

Some Milestones of Minnesota Livestock

1860	–	Oxen outnumbered draft horses
1875	–	Minnesota farmers began to diversify into dairying
1900	–	Beef cattle numbers were low in Minnesota; by 1915 the state ranked fifth nationwide in beef cattle
1930	–	20 to 25 percent of farms in northwestern Minnesota raised sheep
1930	–	Hog numbers began to increase with hybrid corn
1939	–	90 percent of Minnesota farms had dairy cattle
1955	–	The last Minnesota farm draft horses were retired; nationwide, one-fifth of all cropland had been used to raise feed for draft animals
1950s	–	Poultry became concentrated on a small number of large farms

In 1964, Minnesota farmers were making 65 percent of their revenue from livestock (Borchert and Yaeger 1969: 45). Animals were not a large part of farm operations until the late 19th century, when average farmers began to add livestock in an effort to diversify from wheat-only operations.

Livestock offered another source of farm income and diversified farm operations, both of which reduced farmers' business risks. Livestock added value to crops, thereby increasing the productivity of land and labor. Livestock manure helped maintain soil fertility and controlled erosion. Some animals such as hogs, sheep, and beef cattle could be raised with relatively little labor or capital, and could be housed in inexpensive straw buildings or open-sided sheds. Other benefits of raising livestock included:

- Poultry, dairy cows, hogs, and other livestock brought in cash throughout the year, instead of just at harvest time.
- Historically crop prices and livestock prices moved in opposite directions, providing some measure of protection for farmers' balance sheets.
- Animals spread farmers' labor more evenly throughout the year, making good use of winter months.
- Pasturing animals allowed farmers to make profitable use of steep, rocky, or otherwise untillable land. Livestock were also grazed in harvested fields, eating crop residues that were otherwise wasted.
- Animals could make use of low-value farm products. These included skim milk, which could be fed to calves, pigs, and poultry; table scraps and other leftovers that could be fed to pigs and poultry; cornstalks, which could be fed as silage; and grain straw, which could be used for bedding.
- Animals could be fed byproducts of food processing including corn gluten (a milling leftover), distillers' grain, and culled potatoes or potato skins.
- Livestock allowed crops to be shipped to market "on the hoof." It was often more profitable to feed the farm's crops to cattle and then ship the cattle to market, instead of selling bulky corn and grain, whose market price might barely cover shipping costs. This was a particular advantage for farmers who lived far from major grain markets and therefore bore high shipping costs (Anderson 1943: 3).

Briefly described below are the principal types of livestock historically raised on Minnesota farms. Not included in the list are animals that were only raised on a few farms, or animals that did not appear on Minnesota farms until after 1960. Mink, for example, were raised on a small number of farms beginning in the late 19th century and were scattered throughout the state in the 1940s and 1950s. Today Minnesota is the nation's third-largest fur-raising state. In addition to the animals described below, in 2000, Minnesota farmers also raised bison, deer, elk, emus, goats, llamas, mink, and ostrich.

BEEF CATTLE

Beginning in the early statehood period, Minnesota had an early phase of cattle raising when some wealthy southern Minnesota farmers experimented with stock breeding and raised herds of cattle on the frontier's wild hay and grasslands. As Euro-Americans settled the state, the free and low-cost ranges disappeared and cattle raising declined. In 1880 Minnesota ranked 24th among states in beef production, while neighboring Iowa ranked second.

In the 1890s some Minnesota farmers began to try beef as a way to diversify their income and operations. Rather than raising top beef breeds, many farmers used so-called dual-purpose breeds whose cows were milked while the calves were fattened and sold for meat. The introduction of 'Minnesota 13' corn, the establishment of the South St. Paul Stockyards in 1886, and the presence of several large meatpackers advanced the growing industry.

For farmers who wanted to add livestock, beef required less investment or labor than hogs or dairy, as long as the farm had a good source of feed. Beef cattle needed only basic housing and relatively little care. Research and experience eventually revealed that open-sided sheds or even good windbreaks were all that were usually needed.

By 1915 Minnesota ranked fifth nationwide in the number of beef cattle. Farmers in southern counties where corn was grown raised the most beef and had the largest herds. In the 1920s these farmers also began to buy feeder calves from Iowa and South Dakota which they fattened and then sold.

In 1930 Minnesota had about 3.2 million cattle – about 30 percent beef and about 70 percent dairy. About 25 percent of the state's beef cows were being raised in southwestern Minnesota. The University reported in 1934 that beef cattle were being raised in practically every county, but "the principal producing sections of the state are the southwest, the southeast, and, to a much lesser degree, the west central and the Red River Valley" (Crickman et al 1934: 9, 17; Engene and Pond 1944). West central Minnesota grew in cattle numbers during the next several years, but cattle raising did not become large-scale in the Red River Valley.

Increases in corn yields through the 20th century and the introduction of soybeans as a major crop in the 1940s encouraged continued growth in cattle raising. Leading beef cattle breeds in the U.S. in 1943 were Aberdeen Angus, Brahman, Galloway, Hereford, Polled Herford, Polled Shorthorn, and Shorthorn. Leading dual-purpose breeds were Devon, Milking Shorthorn, and Red Polled (Anderson 1943: 21).

In 1940 Minnesota's beef cattle industry was still much smaller than its dairy industry, but there was a significant increase in beef cattle breeding and production following World War II. After the war corn acreage rose, the U.S. population rose, and consumers began to buy more red meat, all of which encouraged the industry. In 1956, Minnesota ranked fourth in beef cattle production (Roberts et al 1956: 335).

By 1950 herds were growing larger and cattle raising was becoming specialized. Some farms with large herds were concentrating on calving, and selling the calves at weaning time. Others were buying weaned calves and "finishing" them, for example.

As the industry changed, one expert explained in 1960, "As feeding operations get larger, the overhead cost of producing a pound of beef becomes smaller. Anything that will change the utilization of feed will greatly affect the profit picture, because 85 percent of the total cost of fattening a beef animal (not counting the cost of the animal itself) is the cost of feed itself. . . . So we see that operations have of necessity become larger and almost completely mechanized in many instances to cut per unit costs" (Darlow 1960: 611-612).

The expert suggested, "The middle-sized operator may disappear and the two types left will be the small feeder and the one who feeds enough cattle so he can afford to install the necessary machinery for storing, handling, mixing, processing, and distributing the feed to the cattle" (Darlow 1960: 611-612).

Today beef is produced in most parts of the state except northeastern Minnesota. Southwestern Minnesota, however, still has the most cattle farms. In 2003 cattle and calves were Minnesota's fifth-largest agricultural commodity. Minnesota now ranks sixth among states in red meat production.

For more information on beef cattle, see these sections of this context study: "Beef Barns;" "Development of Livestock Industries, 1900-1940;" "World War II and the Postwar Period, 1940-1960."

Farm Resources. Elements associated with raising beef cattle include beef barns, animal underpasses, bull barns, cattle guards, combination or general-purpose barns, fences, fields and pastures, hay barns or sheds, scale houses, silos, smokehouses, stock tanks, and stockyards.

BEES

Keeping swarms of honey bees on Minnesota farms was encouraged by the planting of alfalfa in the early 20th century, a crop that also stimulated the state's dairy industry and other farm diversification. At first, some farmers kept bees in cellars during the winter, fearing they would not survive the cold. Beginning in the 1920s several of the University of Minnesota's regional experiment stations kept honey bees and provided swarms to interested farmers. Bee-keeping remained a fairly small-scale activity.

Farm Resources. Elements associated with raising honey bees include fields and pastures.

DAIRY CATTLE

At least one cow was an essential part of nearly all early settlement period farms. Commercial dairying began in Minnesota in the 1870s and steadily grew, and within 30 years Minnesota was a leading dairy state (Tweton 1989: 271). Ninety percent of Minnesota farms had dairy cattle in 1939. Many average-sized farms had about 12 cows (Engene and Pond 1944). In 1957, 110,000 Minnesota farms were milking cows.

Minnesota's dairy industry was especially concentrated in southeastern and central Minnesota, regions well-suited to the production of hay and feed grains. In areas adjacent to large cities, dairy farmers' main market was fluid milk. Farmers located in most of the state produced milk for butter, and also cheese, dried milk, and other processed dairy products (Anderson 1943: 224).

Dairy farming was a labor- and capital-intensive type of farming. Unlike beef cattle, which were sturdy animals and resistant to the cold, dairy cattle needed much more care, including twice-daily milking. Dairy cows did not produce well if upset, uncomfortable, cold, hungry, thirsty, or sick, and experts and farmers continually worked to improve housing conditions, methods of care, and feed mixes, as well as ways to reduce labor. Between the 1910s and the 1960s, selective breeding, disease control, improved feeding, mechanization, and better housing resulted in huge productivity gains.

For more information on dairy cows, see these sections of this context study: "Dairy Barns;" "Milk Houses;" "Milking Barns;" "Silos;" "Diversification and the Rise of Dairying, 1875-1900;" "Development of Livestock Industries, 1900-1940;" "World War II and the Postwar Period, 1940-1960."

Farm Resources. Elements associated with raising dairy cattle include dairy barns, milk houses, milking barns, silos, combination or general-purpose barns, animal underpasses, bull barns, fences, fields and pastures, hay barns or sheds, icehouses, manure pits or bunkers, root cellars, springhouses and springboxes, stock tanks, and stockyards.

HOGS

Commercial hog production in Minnesota began about 1870, at the same time that commercial dairy farming began to develop. Milking cows and raising pigs were companion enterprises because dairy farmers sold their cream to the butter factory (also called creamery) and fed the byproduct, the skim milk, to the hogs. By 1900, Minnesota had 1.4 million swine (Anderson 1943: 333-334; Tweton 1989: 271).

Historically, hogs have been one of the most lucrative livestock enterprises, for several reasons: less capital was usually required to begin hog production, hogs converted feed into meat efficiently, and the turnover was fast because gestation was short (just under four months) and the animals matured quickly. The quick turnover helped farmers adjust the supply – the number of pigs they fed – more quickly than beef producers in response to feed and market prices (Britton 1983: 20).

Hogs could be a challenge, however. Historically herds were small because hogs were very susceptible to a variety of diseases including cholera. Minnesota farmers, animal scientists, and agricultural engineers continually experimented with types of housing, veterinary care, feed, and other husbandry methods to reduce losses. As late as 1950, one-third of Minnesota's piglets were still dying from disease and another one-third were stunted.

By 1880, a large part of Minnesota's pork production was going to stockyards in Chicago and Milwaukee, terminal markets that maintained buyers in Minnesota. After 1886, Minnesota hogs were sold live at the South St. Paul stockyards, which became one of the largest hog markets in the country. Farmers also sold hogs to local buyers, at local auctions, and directly to consumers and packers. Minnesota farmers also marketed pork cooperatively. By 1940, most hogs were being trucked to market (Anderson 1943: 369, 376, 381; Jarchow 1949: 199).

After 1900, hog production became linked with corn growing. Hogs furnished a profitable market for corn, which was usually Minnesota's most economical feed crop. In 1930, average Minnesota farms had about four to ten hogs. After Minnesotans began growing hybrid corn in the 1930s, corn yields rose, as did the number of hogs. By 1943, about half the nation's corn crop was being fed to swine (Anderson 1943: 330-331; Engene and Pond 1944).

Larger scale hog farming was established first in southern Minnesota, which is part of the Corn Belt, then expanded into central Minnesota as corn production moved northward with improved varieties. Between 1930 and 1964, the state added 1.7 million hogs, mainly in Rock, Nobles, Murray, Jackson, Martin, Faribault, Freeborn, Mower, Fillmore, Houston, Steele, Waseca, Blue Earth, Watonwan, Nicollet, LeSueur, and Sibley counties (Borchert and Yaeger 1969: 66). In 1948, hogs accounted for a quarter of farm income in southeastern Minnesota (Hady and Nodland 1951: 4).

The leading swine breeds were Duroc Jersey, Poland China, Chester White, Spotted Poland, China Hampshire, Berkshire, Tamwork, and Yorkshire. Minnesota's first swine breeders were particularly interested in Essex and Berkshire (Jarchow 1949: 197). Hog breeds improved rapidly after World War II, becoming leaner, more productive, and more fertile. By 1960, a pig ate five pounds of feed for every one pound of weight gain; a typical litter was five piglets; and a good sow averaged 1.7 litters per year (Britton 1983: 20; Anderson 1943: 337).

Hogs needed only crude shelter when full grown. But farrowing sows and piglets required more substantial homes. Some farmers used small, moveable hog cots, while others used a centralized hog house, or a combination of the two. After World War II, some hog producers switched to confinement facilities, raising pigs in large, specially-designed buildings. However, non-confined production was still widely practiced in the 1960s and later (Britton 1983: 21).

Minnesota ranked fourth in hog production in 1956 (Britton 1983: 20-21; Tweton 1989: 271-272). By 1964, Minnesota farmers were raising more than 3.4 million hogs a year. The greatest concentration of hogs continued to be in the counties bordering Iowa, where farmers were producing 25 hogs per 100 acres of farmland (Borchert and Yaeger 1969: 60). In 1980, Minnesota ranked third in swine production, with 5 million hogs, worth $750 million (Britton 1983: 20).

For more information on hogs, see these sections of this context study: "Hog Barns and Hog Cots;" "Development of Livestock Industries, 1900-1940;" "World War II and the Postwar Period, 1940-1960."

Farm Resources. Elements associated with raising hogs include hog barns, hog cots, combination or general-purpose barns, fences, fields and pastures, smokehouses, stock tanks, and stockyards.

HORSES

Horses were the main source of power on Minnesota farms until the 1930s. They were used for fieldwork, powering stationary machines, hauling farm products to market in wagons, and transporting people in buggies, carriages, and sleighs. Almost no horses were kept on Minnesota farms solely for riding. Minnesota farms needed one work horse for every 25 or 30 acres of cultivated land (Anderson 1943: 656). Before motor power, the average Minnesota farm had four to eight draft horses.

As with other livestock, the first draft horses on Minnesota farms were nondescript breeds. Morgans were popular in the 1850s. Later, the leading breeds were Clydesdale and Percheron. Other popular breeds of draft horses were Belgian, Shire, and Suffolk (Anderson 1943: 633). Farmers prized work horses with "a good set of legs, alertness, a fast walk, and ability to endure hard work in warm weather," according to Iowa State College livestock expert Arthur Anderson (Anderson 1943: 653). A farm draft horse could pull 1/10 to 1/8 of its weight and travel about 2.5 miles per hour for 20 miles a day. Draft horses had to work well in teams (which were often housed together in double stalls) and, with increased mechanization, had to tolerate the noise and commotion of a nearby tractor and other equipment. Horses were ready to work at age three. The average working life of a farm horse was about 12 years (Anderson 1943: 730-733).

Because good draft horses were expensive and difficult to train, most farms kept them in warm, dry quarters. Combination or general-purpose barns were most common, although some farms with more than eight or ten horses had dedicated horse barns. Mares were bred in the spring and summer. By the 1940s, artificial insemination of horses was being done successfully, according to Anderson (Anderson 1943: 723).

A farm horse working six months of the year needed to eat about 1 1/2 tons of feed grains and 2 1/2 tons of good quality hay per year, in addition to pasture and field crop residue (Anderson 1943: 720). Oats, corn, and barley were the most commonly fed grains. Of the hays, alfalfa, clover, timothy, soybean, wild, and grain hay were commonly fed to horses. Roughages such as straw, corn fodder, and sorghum fodder were also fed. Idle horses were fed mainly roughage or pasture (Johnson 1950: 714-716). The shift to tractor power freed up 100 million acres of farmland – about one-fifth of U.S. cropland. According to Anderson, "The diversion to other crops of land that formerly was used to produce horse and mule feed is regarded as one of the greatest changes in American agriculture" (Anderson 1943: 656; Johnson 1950: 59; McKibben 1953: 91; Rasmussen 1962: 578; Cochrane 1993: 108).

At first, draft horses were scarce in Minnesota, so oxen were used for heavy work. Between 1860 and 1870, horse numbers increased from 10,000 to 93,000. By 1880, Minnesota had about 47 horses for every 100 rural Minnesota residents (Jarchow 1949: 193, 199-200). The number of horses on U.S. farms climbed until about 1915, when the population reached 21 million head. After that, horse numbers fell steadily as the use of farm trucks and tractors rose. By 1940 farm horse numbers had dropped in half, to 11 million (Anderson 1943: 630).

But farmers were slow to get rid of their horses entirely. Horses were cheap to maintain compared to tractors, and could do some jobs better than early tractors. In areas where farms were small, the land hilly, fields small or irregular, and labor cheap, the shift to tractor power took longer (Anderson

1943: 658). As late as 1943, nearly three-fourths of American farmers still used horses or mules for some jobs.

In 1939, Minnesota had the second-highest horse population in the nation with 700,000 head. In the 1940s and 1950s, many Minnesota farmers used both horses and tractors to run their farms. By about 1955, however, farm draft horses had disappeared from the state (Anderson 1943: 559-660; Johnson 1950: 59; Fite 1989: 282-283).

For more information on horses, see these sections of this context study: "Horse Barns;" "Focus on Mechanical Technology."

Farm Resources. Elements associated with horses on Minnesota farms include horse barns, combination or general-purpose barns, fences, fields and pastures, granaries, hay barns or sheds, implement or machine sheds, stock tanks, and stockyards.

MULES

Mules – the cross of a male donkey and a female horse – were used for farm work, especially in the Southern states. Mules were larger, stronger, and more tractable than donkeys, and more surefooted, patient, and durable than horses. Because they could tolerate hot conditions, they were often used for heavy hauling in cities in hot climates, as well as for road, farm, and lumber work. However, according to Arthur Anderson, "the natural tendency of the mule is to be lazy and obstinate" (Anderson 1943: 744-745).

In Minnesota, mules were a minor source of farm power. The 1860 census, for example, reported 384 mules in the state, compared with 17,000 farm horses and 27,000 oxen (Jarchow 1949: 291). The mule population peaked in the U.S. about 1925, at 5.9 million animals, then declined (Anderson 1943: 621).

Farm Resources. See Horses above.

OXEN

Oxen, or adult castrated bulls, were the first draft animals on Minnesota farms. Calm in temperament, steady, and strong, oxen were used by settlement-era farmers to break the prairie in the 1840s and 1850s. Oxen were also useful when roads were poor or nonexistent. They were used for heavy fieldwork in Minnesota until the 1880s. Teams of oxen pulled plows and cultivating tools, tramped grain to separate straw and chaff, hauled wagonloads of wheat to market, and brought back supplies and manufactured items. After roads were developed, farmers switched to horses which were faster transport. Oxen were not much good, however, for powering stationary machinery like threshers that used a merry-go-round-style sweep arm because they would quickly get dizzy walking in a circle and lie down (Jarchow 1949: 129).

Oxen were replaced by horses and mules. In 1860, Minnesota's 27,000 oxen outnumbered draft horses by 10,000. But ten years later, horses outnumbered oxen by 50,000. In 1880, the state had only 36,000 oxen. "The introduction of farm machinery, which operated more efficiently with horses, plus an improved standard of living, are closely related to the disappearance of oxen," according to Jarchow (Jarchow 1949: 200; Anderson 1943: 21).

Farm Resources. See Horses above.

POULTRY (CHICKENS AND TURKEYS)

Many early Minnesota homesteaders kept chickens and other poultry on their farms. However "the average settler paid little attention to poultry, either as to breeding or as to care," wrote Jarchow. He quoted one settler who recalled, "the poor things had to get along as best they could. When evening came they were forced to find their own shelter, usually on a fence or up in a tree. Where such conditions existed, a chicken with two legs was seldom seen." Foxes were the major menace (Jarchow 1949: 234, 296).

In the 1870s, Minnesota farmers began providing poultry housing and improved care. Local poultry associations formed to advance the interests of chicken and egg production, and by 1880 the census listed 2.29 million head of poultry in the state – roughly 400 birds for every 100 rural residents. The old-fashioned barnyard fowl began giving way to purebred Brahma and Black Spanish chickens. Other important breeds included Silver Speckled Hamburg, Plymouth Rock, Partridge Cochin, White and Spanish Leghorn, Black and White Poland, Houdan, Bantum, Drahma, Dominick and Gray Dorking. Turkeys, which were more susceptible to disease than chickens, were harder to raise and therefore not as common in Minnesota until after World War II. Large flocks of ducks were also relatively rare in the state.

Raising chickens became nearly universal on Minnesota farms around the turn of the century. In 1914, at least 90 percent of Minnesota farms kept poultry, according to a University of Minnesota expert, who observed that "poultry pays the farmer in most cases better than any other farm enterprise when the small amount of money usually invested is considered" (Smith 1914: 170). The University of Minnesota urged every farmer to keep at least 100 hens, which could be fed for next to nothing: "The amount of waste grain, vegetables, fruit and milk found on the average farm will go a long way toward maintaining a flock of that size, or a larger one" (Smith 1914: 171). As farmers added chickens to their operations, they built specialized poultry houses to encourage productive egg-laying.

Women were often in charge of poultry raising on Minnesota farms. A 1951 University survey found that women generally gathered eggs, cared for the chicks, and handled sales, while men cleaned the hen house and moved the brooder house (Hady and Nodland 1951: 14-15). In 1920 the University of Minnesota Extension Service placed its major poultry program within its Home Demonstration division, whose programs were largely directed toward women. Minnesota was "apparently unique among the northern states" to do so (Hanke et al 1974: 65).

In 1930, most Minnesota flocks ranged from about 75 to 150 hens, with the average being about 100. Flocks were largest in the traditional dairying regions where farmers fed a mixture of skim milk and grain to both chickens and hogs.

Before World War II most chickens were raised for the sale of eggs, rather than meat. Eggs were sorted and sold by size or "grade" beginning in the 1910s and 1920s. In 1954, 46 percent of Minnesota eggs were picked up at the farm by a truck (e.g., by a buying station or produce company), 40 percent of eggs were delivered by the farmer to a buying station, 9 percent were delivered to a store acting as a buying station, 3 percent were delivered to a store for resale, and 2 percent were sold directly to an individual consumer, restaurant, hatchery, or other customer (Hjort and Manion 1955: 37). In 1953, 70 percent of Minnesota eggs were being sold outside the state (Dankers 1954: np).

In addition to being sold, eggs were an important source of food on the farm and, in fact, the number of eggs consumed on Minnesota farms increased from about 300 eggs per person per year in 1924 to 360 eggs per person per year in 1954 (Hjort and Manion 1955: 9).

In the early 20th century some farms added small incubators to hatch chicks, eliminating the need for broody hens. Even more farms switched to buying their newborn chicks from a commercial hatchery. (Farmers either picked up the chicks or they were delivered in the mail.) In the late 1930s, a new sexing technique enabled hatcheries to sell chicks by gender. This allowed farmers to purchase and feed only female chicks (which would then become laying hens), rather than wasting money and feed on chicks that had not yet been identified as male.

Farm flocks increased in the 1930s and 1940s. As feed mixtures, breeding, and husbandry methods improved – especially with farm electrification – production improved. Farmers installed lights and timed switches in hen houses to induce the birds to increase laying in late fall and winter. The use of commercial feeds increased during the 1940s and feed ,mixes became more sophisticated. Hens laid more eggs and birds grew faster. Egg production per Minnesota farm doubled between 1932 and 1948. Egg production tripled between 1924 and 1954 (Hady and Nodland 1951: 13; Hjort and Manion 1955: 4).

After World War II, American demand for poultry meat increased and farmers in both Minnesota and nationwide began to raise more chicken broilers (i.e., chickens raised for meat), as well as raising more turkeys. Relatively few turkeys had been produced in Minnesota before the 1940s, in large part because of the difficulty of controlling diseases such as the parasitic ailment nicknamed blackhead. In 1925 the University of Minnesota's W. A. Billings promoted practices such as keeping turkeys and chickens apart and frequently rotating turkeys to new ground to reduce infection, all with some success. (This was sometimes called the "Billings" or "Minnesota" plan.) Turkeys were later raised in confinement on wire or slatted floors so they never touched the soil. In the 1930s artificial insemination and the sexing of newly-hatched poults began. The National Turkey Federation, a federation of state groups, formed in 1939 and promoted research and support for the industry. Nationwide, turkey production flourished in the 1940s and flocks of 5,000-10,000 became common, with some flocks even larger. The market for turkey meat was boosted during World War II when turkey escaped meat-rationing rules, and when federally-funded school lunch programs began to purchase turkey beginning in 1940. Two decades of high market prices dropped suddenly in 1961, after which turkey producers were forced to operate with smaller profit margins. In 1964 Minnesota's turkey farms were clustered in Swift, Kandiyohi, Meeker, Stearns, Anoka, Otter Tail, Becker, Wadena, Crow Wing, and Aitkin counties (Hanke et al 1974: 443-454; Borchert and Yaeger 1969: 45, 61)

In the postwar years the development of new poultry breeds reduced costs and improved productivity. By the 1980s, chickens needed half the amount of feed per pound of meat as in 1940, and broilers reached market weight in only three months. Similar efficiency gains were made in turkey breeding. By 1980, the amount of feed needed to produce a pound of turkey had dropped 40 percent from 1910, and the time required to raise a turkey fell 25 percent. Large-breed turkeys reached market weight in about 12 weeks (Britton 1983: 21-22, 24).

In the 1950s and 1960s, poultry farmers continued to mechanize even more of their chores. Minnesota poultry production became concentrated on a smaller number of farms with larger flocks. These farms produced eggs, turkeys, and chickens in specialized buildings with controlled environments and automated operations. The farms purchased feed instead of growing it, and were located near major processing facilities. According to a 1955 report, “the practice of raising chickens for meat has become more specialized [in Minnesota] and is now largely done on a commercial scale rather than as part of a general farm operation.” The authors noted that commercial broiler production was fairly limited in Minnesota in 1955, but had been increasing since 1940 (Hjort and Manion 1955: 7, 20).

Between 1940 and 1955 Minnesota consistently ranked among the top four states in egg production. In 1955 Minnesota ranked fourth nationwide in the number of chickens (Hjort and Manion 1955: 2). In 1964, Minnesota’s chicken and egg industry was centered in the southwest and central regions, especially in Pipestone, Rock, Lyon, Murray, Nobles, Cottonwood, Redwood, Brown, Faribault, Freeborn, Waseca, Steele, Scott, LeSueur, Rice, Nicollet, Sibley, McLeod, Meeker, Anoka, and Isanti counties. In 1971 Minnesota was tenth nationally in number of laying hens (Borchert and Yaeger 1969: 45, 61; Hanke et al 1974: 771).

In 1955 Minnesota ranked fourth nationwide in the number of turkeys (Hjort and Manion 1955: 2). Minnesota was national leader in the number of turkeys in both 1970 and 1980, and in second place behind North Carolina in 1990.

Four Minnesotans are among the men and women who have been inducted into the “American Poultry Hall of Fame” by the American Poultry Historical Society:

- Billings, William A. (1888-1970), longtime University of Minnesota pathologist and Extension veterinarian, expert on turkey production, author of numerous bulletins and newsletters
- Ghostley, George F. (1889-1965), owner of Anoka’s Ghostley Poultry Farm from 1918-1957, leading breeder of Leghorn chickens, state leader in industry planning and promotion
- Niles, Kathryn B. (1898-1970), University of Minnesota graduate student and faculty member in the 1930s, later Chicago-based poultry industry home economist who developed and promoted ways to use eggs, chicken, and poultry; (Niles spent most of her career outside of Minnesota)
- Pomeroy, Benjamin S. (1911-2004), longtime University of Minnesota faculty member, expert on avian health and turkey production (Hanke et al 1974; Skinner 1996).

The University of Minnesota began teaching courses in poultry in 1912 and began conducting research in 1922 (Hanke et al 1974: 98). The University’s Cora Cooke was a longtime leader of its Extension poultry program, from approximately 1921-1958. According to the American Poultry Historical Society’s industry history, “[Cooke’s] leadership played a large part in putting Minnesota in the forefront of poultry states in the 1940s. In the period from 1940 to 1944, on the foundations which she had helped lay, Minnesota made a far greater percentage increase in volume (80 percent) of eggs produced than any other state and only one state equalled Minnesota’s record in increased rate of lay (26 eggs per hen)” (Hanke et al 1974: 74).

For more information on poultry, see these sections of this context study: “Poultry Houses;” “Brooder Houses;” “Development of Livestock Industries, 1900-1940;” “World War II and the Postwar Period, 1940-1960.”

Farm Resources. Elements associated with raising poultry include poultry houses and brooder houses.

SHEEP

One effect of the Civil War on Minnesota agriculture was a brief spike in sheep raising to provide wool for the Union army and to fill the void in Southern cotton production. Many of these sheep were raised in southeastern Minnesota. Jarchow wrote, "The height of the sheep craze came in 1866, after which there was a decline of interest, since the hopes of many farmers [to prosper through sheep] were not realized" (Jarchow 1949: 15, 194). In 1879 the Minnesota State Wool Growers' Association was formed to try to rebuild the industry. In 1895 the University of Minnesota's Thomas Shaw declared Minnesota ideal for sheep raising and predicted, "sheep husbandry will some day assume gigantic proportions" in the state (Shaw 1895: 249, 250, 259). A lucrative market for wool did not develop, however, and consumer demand for mutton never historically approached the demand for beef.

The University of Minnesota promoted sheep raising, and a 1914 publication recommended that the average Minnesota farms of 177 acres could add 30 to 50 breeding ewes to its operation (McKerrow 1914: 177). Like beef cattle, sheep needed only basic protection from the wind and fiercest winter weather. Some farms kept sheep in make-shift shelters, while others followed experts' recommendations and built sheep barns. They were usually simple structures with larger door openings.

Mature ewes were usually bred in the fall with a ram kept on the farm. Lambs were born in the late winter and early spring. The lambs nursed for several months and were weaned. Some were kept to replenish the flock, and most were fed and sold for slaughter at about 100 pounds. Sheep were usually sheared in the early spring. After shearing some sheep were sprayed with insecticides or immersed in diluted chemicals in livestock "dips" to prevent ticks and other pests.

Minnesota farmers fed their sheep wheat, oats, other grains, bran, corn silage, pasturage, and clover hay. Before World War I farmers and University experts were experimenting with feeding silage to sheep and getting generally good results. Sheep were often finished with grain before slaughter. In the 1930s South St. Paul was the country's seventh-largest sheep marketing center, with Denver and Chicago ranking first and second (Anderson 1943: 511-514).

In 1930, Minnesota farmers were keeping about 17 to 30 ewes per flock (Engene and Pond 1944). According to the University of Minnesota, most sheep in 1930 were raised in southwestern Minnesota where the most corn was raised, with the fewest sheep found in northeastern and central Minnesota and near the Twin Cities. In 1930 between 20 and 25 percent of farms in northwestern Minnesota were raising sheep. About 20 percent of the farms in west central, southwestern, and southeastern Minnesota raised sheep in 1930, with an average of 24 ewes per flock. In southwestern Minnesota during the 1930s, fattening lambs that had been shipped into the region from elsewhere was becoming increasingly common, just as farmers in southwestern Minnesota were beginning to finish beef feeder calves. In 1930 the least number of sheep were being raised in the cutover region of northeastern Minnesota, in south central Minnesota, and near the Twin Cities (Engene and Pond 1940: 63).

Statewide, sheep husbandry was not a cash-rich endeavor in the 1930s. In 1936, in fact, only about 2.5 percent of cash farm income in Minnesota was derived from the raising of sheep (Engene and Pond 1940: 63). Nationwide, Minnesota was not among the overall top 15 sheep raising states in the late 1930s, but it was ranked seventh nationwide in the number of lambs fattened and fifteenth in wool production (Anderson 1943: 557, 595).

For more information on sheep, see these sections of this context study: "Sheep Barns;" "Development of Livestock Industries, 1900-1940."

Farm Resources. Elements associated with raising sheep include sheep barns, combination or general-purpose barns, animal underpasses, fences, fields and pastures, granaries, silos, stock tanks, and stockyards.

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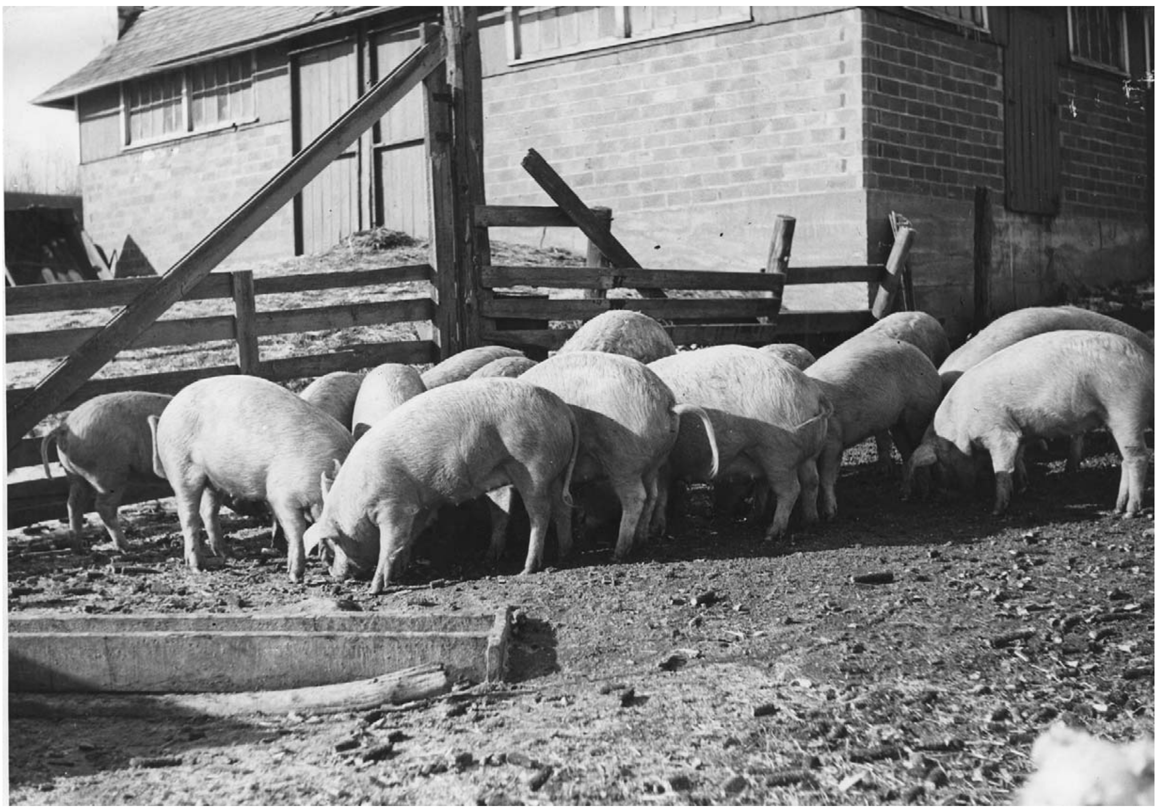
By 1880 Minnesota had 47 draft horses for every 100 rural residents, and the number was growing. The population of farm horses peaked in Minnesota around 1915, and in 1939 Minnesota had the second-highest number of farm horses in the nation. Some were still being used for farm work in the early to mid-1950s. Photo possibly taken in Meeker County, circa 1900. (MHS photo)

Horses and cattle on the Davidson Farm near Little Falls, circa 1910. (MHS photo)



Feeder pigs next to a structural clay tile barn. Location unknown, circa 1950. (MHS photo)

FOCUS ON MECHANICAL TECHNOLOGY

Some Milestones of Mechanical Technology

1837	–	Steel-bladed plow first made by Illinois blacksmith John Deere
1847	–	Single disk metal harrow invented
1850	–	Stationary farm steam engines first placed on wheels
1860	–	Widespread adoption of horse-drawn implements like riding plows, harrows, seed drills, mowers, rakes, reapers, and threshing machines
1867	–	First barn hay carrier invented by Louden
1880s	–	Large farms began using combination harvesters ("combines")
1890	–	Babcock butterfat tester developed in Wisconsin
1895	–	Stationary engines fueled with gas or kerosene available
1900	–	Factory-made manure spreaders in use by many farmers
1910	–	Gas engine tractors first adopted
1910	–	Gas engines replaced steam engines on some threshing machines
1910	–	5' horse-drawn mower used by most Minnesotans to cut hay
1912	–	Rotary hoe cultivator introduced
1915	–	Practical, reliable, gasoline milking machines introduced
1920	–	Two-bottom, horse-drawn plow used by most Minnesotans
1920s	–	Power take-off technology allowed tractors to power the implements they pulled
1920s	–	Farmers began buying new implements for their new tractors
1924	–	Farmall tractor introduced; wide proliferation of tractors began
1930	–	Tractor-pulled corn pickers being adopted
1930	–	Nearly 100 percent of Minnesota farms still used work horses
1930s	–	In-field pick-up hay balers introduced
1935	–	Small combines invented that were affordable for average farmers
1938	–	Self-propelled combines introduced
1939	–	87 percent of Minnesota farms had a car
1939	–	Only 18 percent of Minnesota farms had a truck
1940s	–	Barn gutter cleaners being adopted
1945	–	Potato harvesters being adopted
1950s	–	Corn picker-shellers introduced
1950s	–	Grain dyers purchased where picker-shellers were used
1950s	–	Sugar beet harvesters being adopted
1955	–	Last draft horses leaving Minnesota farms
1960	–	Silo unloaders becoming affordable

During the colonial period, about 90 percent of all U.S. workers were needed to produce the country's food and fiber. Two centuries later, less than ten percent of the work force sufficed to meet the country's needs and send America's agricultural bounty all over the world. Farmers no longer worked long hours walking behind a horse-drawn plow, cutting grain by hand, loading and unloading crops and waste with a fork and shovel, and carrying feed to animals in baskets. Hard physical work and drudgery had largely disappeared from farming. The principal reason: machines. In fact, in little more than 100 years, between 1850 and 1950, nearly every production process in farming was mechanized.

From the beginnings of mechanization, almost continuous progress was made in farm machinery design and construction. These new machines substituted animal power for human power, enabling farmers to do more work, more quickly, more safely, and with less physical labor. Farm machines also became increasingly safer to operate, although throughout the 20th century farming remained one of the nation's most dangerous occupations.

Many of the early machines were invented in the 1830s and 1840s. In the 1860s, Civil War labor shortages and favorable farm prices encouraged American farmers to buy large numbers of horse-drawn implements like riding plows, harrows, seed drills, mowers, rakes, and reapers for the first time. Another watershed occurred in the 1910s-1920s when farmers began to adopt gasoline tractors and the internal combustion engine that, according to economist and historian Willard Cochrane, "was, and remains . . . the centerpiece of mechanization on American farms" (Cochrane 1993: 199). Thirty years later, in the 1940s, the machines, chemicals, materials, and production methods perfected during World War II were applied to agriculture, bringing yet another transformation (Rasmussen 1962: 581; Cochrane 1993: 189-190; Barlow 2003: 5).

Wayne Rasmussen, an agricultural historian for the USDA, noted in 1962, "One of the interesting sidelights in such history is a characteristic time lag between an invention and its adoption. In fact, I have come to the conclusion that major changes in American agriculture have taken place only when farmers have had major economic incentives for adopting such changes" (Rasmussen 1962: 31). Adoption of the new, labor-saving machinery sped up in times of high commodity prices and during labor shortages including those caused by war (Cavert 1956: 19; Rasmussen 1962: 581-582; Cochrane 1993: 195-196; Barlow 2003: 5).

While new ideas came from blacksmiths, mechanics, scientists, and entrepreneurs, farmers themselves were responsible for much innovation through their constant adaptation and inventiveness. One retired agricultural engineer said he never ceased to be impressed by farmers' ingenuity. He recalled seeing modifications to buildings, implements, and other equipment develop on one farm and spread to nearby farms and eventually to a larger region. County agents, experiment station staff, salesmen, equipment and building contractors, and others who visited farms helped disseminate new ideas and problem-solving technology (Lindor 2004).

Between 1840 and the 1950s, farm machinery moved from wood and cast-iron pieces to pressed-steel, stamped-steel, and welded assemblies with high-speed shafts, bearings, gears, chains, and V-belts. By 1912, there were hundreds of farm equipment manufacturers and 50,000 farm machinery dealerships in the U.S. The state of Minnesota had numerous manufacturers of farm equipment, building materials, hardware, and supplies, as well as an army of wholesalers, retailers, salesmen, installers, and repairmen in every part of the state (McColly 1957: 404; Barlow 2003: 5).

In the early- to mid-20th century, advances came "so fast . . . and reduced human labor requirements so dramatically as to constitute a mechanical revolution in farming," according to Cochrane (Cochrane 1993: 126-127). Labor as a fraction of total agricultural inputs declined 26 percent in the 1940s, 35 percent in the 1950s, and 39 percent in the 1960s (Cavert 1956: 20; McKibben 1953: 91; Rasmussen 1962: 578).

In the 20-year period from 1933 to 1953, investment in machinery on U.S. farms increased by 350 percent (Ramser 1956: 403). By 1950, according to historian A. N. Johnson, "a fair minimum" of equipment for an average Midwest farm included a tractor, plow, disc cultivator, drag, grain drill, corn planter, manure spreader, corn binder, grain binder, milking machine, hay loader, silage cutter, cream separator, mower, and gas and electric chore motors. "A truly mechanized farm" had other labor-saving machines including a field silage cutter and blower, a barn gutter cleaner, a hay baler and elevator, and silage unloading equipment (Johnson 1950: 60-61).

EFFECTS OF FARM MECHANIZATION

Labor and Productivity. Steadily-improving machines helped let farmers produce more goods with less labor. In 1830, for example, it took about 300 man-hours to produce 100 bushels of wheat. By 1890, about 50 hours of labor were needed to produce the same 100 bushels. By 1930, 20 man-hours were needed, and by 1975, less than 3 man-hours. Farm mechanization achieved comparable productivity gains in most other crops as well. Farm output per man-hour rose 75 percent between 1910 and 1953 (Cochrane 1993: 199-200).

Farmers put their saved labor into expanded production, which resulted in greater farm revenues, and larger but fewer farms. A farmer in 1910 raised food and fiber for 7 people; in 1953, it was 19 people; and in 1960, it was 27 people. According to a review of technology in *Agricultural Engineering*, "The increased productivity has resulted largely from increased use of efficient and improved agricultural machines" (McColly 1957: 404).

At the same time, the number of workers employed on farms plunged, dropping from 13.6 million in 1910 to 8.6 million in 1953, and "freeing or forcing hordes of farm youth to seek city jobs," in the words of geographer John Fraser Hart (Hart *Rural* 1998: 372). "Redundant" or abandoned farmsteads were one of the results (Hart "Redundant" 1998). By the 1950s, just one in six American workers labored in agriculture, down from four out of six in 1850. According to Cochrane, "The rate at which labor was displaced in agricultural production by machines . . . certainly worked a great hardship on many of the people involved and created acute problems for the urban areas that received the rural migrants" (Cochrane 1993: 200; Cavert 1956: 25; McColly 1957: 404; Rasmussen 1962: 582-583, 588).

Farm Buildings. As farm machinery changed, the functional requirements of farm buildings changed. Farmers adopted new machinery more readily than they modernized buildings, however, which represented large, long-term capital investments. Over time, though, improved farm machinery prompted new types of structures, as well as alterations to existing structures.

The shift from draft horses to gasoline tractors, for example, required fewer horse barns and oat fields, but more implement sheds, garages, farm shops, and elevated gasoline tanks. The development of the silage cutter helped encourage more silos. Hay carriers led to large hay lofts. Hay balers led farmers to store the compact, but heavy bales in less-expensive and more convenient one-story barns. Mechanical barn ventilation reduced the need for passive vent systems. The use of corn picker-shellers decreased the need for corncribs but created a need for grain drying facilities, as well as more grain bins. Milking machines prompted the construction of milking parlors, loose housing barns, and improved milk houses (Reynolds 1945: 16; McColly 1957: 402; Johnson 1950: 60-61).

As farms became mechanized, traditional farm buildings were replaced with new structures better suited to larger operations (Hart *Rural* 1998: 373). Buildings were designed to specifically support mechanization, as well as anticipate inevitable production changes that were always on the horizon.

New designs allowed farmers to fine-tune variables like temperature and humidity to create optimal conditions. And all of this occurred in a competitive, high risk, changing arena with little room for error (Reynolds 1945: 16).

Land Use. Between 1920 and 1945, 60 percent of farm horses and mules disappeared from American farms, and the remaining 40 percent were gone by 1960. Farm mechanization freed 100 million acres of farmland that had been used to grow horse and mule feed – about one-fifth of U.S. cropland. The released acres were often shifted into higher-paying dairy, livestock, and crop production, increasing farm income (Johnson 1950: 59; McKibben 1953: 91; Rasmussen 1962: 578; Cochrane 1993: 108).

Demands for land also changed as modern machinery cut labor costs but raised capital costs. Farmers placed a premium on the best cropland as they made large investments in equipment and buildings and naturally wanted to put them into the safest place – the most productive land. With mechanization, agricultural production became "concentrated on the best farmland, and farmers on poorer land [were] no longer competitive," according to Hart (Hart *Rural* 1998: 375). Marginal land gradually fell out of production (Cavert 1956: 25; Hart *Rural* 1998: 375).

Farm Size. Because of the capital costs, the use of machinery increased the minimum size necessary for a viable farm, forcing farmers to enlarge their operations to stay in business. Between 1900 and 1950 the average American farm grew nearly 50 percent in size. Machinery and other technological advances changed agriculture from a low-volume enterprise with good profits per unit "to huge volumes with minuscule per-unit profits" (Hart *Rural* 1998: 289; Fite 1989: 286).

Even before the gasoline age, gang plows and other machinery designed for four or more horses had made the typical 160-acre Minnesota farm "somewhat inadequate in respect to the efficient use of labor and machinery," wrote a Minnesota expert (Cavert 1956: 26). As mechanization accelerated around World War II, the average Minnesota farm size jumped 11 percent, rising from 165 acres in 1940 to 184 acres in 1950. By 1964, the average farm size in Minnesota had jumped another 28 percent, to 235 acres (USDA 2005).

Specialization. Mechanization led to specialized farms. In 1998 Hart wrote, "the old general farm that produced a little bit of everything is as dead as the dodo." To stay in business, farmers had to concentrate their resources on intensive production of the commodities they could grow most competitively. Hart explained, "Some farmers specialize in growing crops, others specialize in feeding livestock, and both crop and livestock farmers buy their milk and groceries at the local supermarket" rather than producing their own (Hart *Rural* 1998: 373).

Specialization was apparent, for example, during the 1940s in the Minnesota cutover region. Until the 1930s, it was customary to base farming operations in the northeastern part of the state on dairy cows, potatoes, and hogs, with significant land in hay fields and permanent pasture. Farmers sold cream and fed their skim milk to their pigs, which could be raised with very little labor. Potatoes, usually five to ten acres, provided cash and a use for the dairy manure. The potato crop could be produced with family labor and little machinery, except for a horse-drawn digger. No cash outlays were made for fertilizer, herbicides, or pesticides, except possibly for some arsenic compound to kill potato beetles.

In the 1940s, the competitive arena changed with mechanization. The introduction of two-row tractor machinery, commercial fertilizers, irrigation, and new chemicals for potato diseases and pests greatly increased both potato input costs and yields. As a result, production shifted from the cutover region to the Red River Valley and other areas where 100- to 500-acre tracts of level land favored the new machinery. Likewise, when farm milk pick-up began in the 1940s, cutover-area farmers no longer had skim milk to feed the hogs. About the same time, farms were electrified, which prompted the use of electric milking machines that could handle many more cows. By the mid-1950s, those cutover-region farmers who survived the transition to mechanized agriculture had dropped potatoes and hogs and focused entirely on expanded dairy operations. Dairy barns were enlarged and milk houses added, but hog barns, corncribs, and potato warehouses fell into disrepair or were converted to other uses (Cavert 1956: 23-24).

Farm Management. Large, specialized, mechanized farms demanded skillful management. For some, in the words of Hart, farming changed from a way of life to a "complex business that demands a wide range of management skills, including the skill of money management. Modern farmers must be able to handle large amounts of money just as competently and efficiently as they handle powerful tractors and other large farm machines" (Hart *Rural* 1998: 373).

Mechanization introduced more financial risk into farming, for example. Farms became highly capitalized, substituting purchased inputs, such as machinery, fuel, and chemicals, for labor. Cash outlays, depreciation, and overhead expenses rose sharply. In 1913, for example, cash expenses among farmers in southwest Minnesota averaged 28 percent of receipts. In 1952, cash expenses had risen to 56 percent of receipts, and machinery and building depreciation averaged an additional 13 percent. Before mechanization, farmers had raised their own power source – horses – and their own fuel in the form of hay and oats. With the use of tractors and motorized equipment, farmers were spending hundreds of dollars a year on fuel and machinery repairs. New hybrid seeds, fertilizers, and chemicals placed additional pressure on farmers to increase their cash flow (Fite 1989: 293-294; Cochrane 1993: 137).

Living Standards. Before mechanization, farming was characterized by long hours and grueling physical labor. According to an author writing in the 1950s, machinery transformed farming from "long hours of drudgery to less arduous effort, yielding more time to enjoy good living in modern buildings equipped with modern conveniences" (McColly 1957: 398). Another wrote that, by freeing so many workers from the essential activity of growing food, farm mechanization also helped produce "a continuous rise in the general standard of living," making it possible for "all men to enjoy the benefits of citizenship in a cultured civilization" (McKibben 1953: 91). In 1957 an industry group called the Farm Equipment Institute declared, "High production per man with labor-saving, cost-cutting equipment has brought a better way of life for all. It has made America a Land of Plenty" (McColly 1957: 398).

Some economists argued that mechanization in the second half of the 20th century created chronic surpluses that kept commodity prices low. Low prices, in turn, forced farmers to adopt still more labor-saving machinery and more advanced technology to stay in business. That led to yet more output, which pushed prices even lower (Rasmussen 1962: 591; Fite 1989: 292-293; Cochrane 1993: 205-208). According to historian Gilbert Fite, "Many farmers found themselves caught in a harsh cost-price squeeze when their expenses grew and the price of farm commodities failed to rise or, in some cases, even fell" (Fite 1989: 293-294). As a result, government farm policies shifted from encouraging more food production to curbing production, and trying to stabilize farm income through a variety of methods (Cavert 1956: 26).

MAJOR DEVELOPMENTS IN FARM MACHINERY

Electricity. See the appendix of this report entitled "Focus on Farm Electrification."

Steam Engines. A few large farms and plantations in the U.S. were using stationary steam engines for power in the early 19th century. Farm steam engines were first placed on wheels around 1850, with horses used to pull them. They were primarily used for threshing. By the 1870s, the first "self-propelled" or "traction" steam engines – also called "tractors" – had left the experimental stages and were being used on farms in the eastern U.S. for threshing and some plowing. They still needed to be steered with horses. Steam engines on farms were also used for chores like silage cutting and corn shelling.

Stationary Gas Engines. Farm engines that burned gasoline or kerosene were available by 1895, and by 1912, there were many brands of engines providing one to ten horsepower. Stationary gas engines were often housed in a small power house. Farmers used these engines to run all kinds of machinery, including corn shellers, grinding mills, grain cleaners, feed choppers, silo fillers, hay balers, concrete mixers, water pumps, lighting plants, washing machines, butter churns, cream separators, tool grinders, saws, lathes, and post drills. While useful, early gas engines were unreliable, especially in cold weather. When farms were electrified, stationary gas engines were generally replaced with cheaper, safer electric chore motors (Barlow 2003: 131).

Tractors. Steam traction engines – or "tractors" – came into use in the Midwest in the 1890s and 1900s, but they were heavy, cumbersome, difficult to move, and consumed huge amounts of fuel and water. Most farmers didn't use them, and horses and mules continued to provide power (Cochrane 1993: 108).

Gasoline-powered tractors were developed from steam-powered tractors around 1890. Early gas-engine tractors were also heavy, unreliable, and poorly suited to most field work, so at first they were used mainly for plowing and harrowing. Throughout the 1890s and early 1900s, engineers worked to refine tractors and succeeded in making them smaller, lighter, and more powerful.

Still, "the horse as a farm draft motor had little competition," wrote one author (Ramser 1956: 404). Even as the tractor age dawned, efforts to improve and enlarge horse-drawn implements continued for many years. The number of draft horses on farms peaked in 1913 at 21 million nationwide. The typical Minnesota farm kept four to eight work horses – about one animal for every 25 or 30 acres of cultivated land.

In 1925, only 17 percent of Minnesota farmers owned a tractor while nearly 100 percent owned work horses (Cavert 1930). In 1940, 72 percent of farms in the U.S. still kept an average of 3.2 horses or mules in 1940 (Anderson 1943: 631). The period of 1920-1955 was a time of transition during which farmers increasingly used motorized equipment and at the same time used draft animals, but for fewer chores. Anderson wrote in 1943, "Thirty years ago [in 1913] tractors and motor trucks were comparatively rare on farms, but now we have a tractor to about every 3.8 farms and a motor truck to every 6.5 farms [in the U.S.]" (Anderson 1943: 657).

The transition from draft animals to mechanized equipment was slower in parts of the country where farms were smaller, the land more hilly, and fields irregularly-shaped. The shift was also slower in regions like Southern U.S. where human labor was very inexpensive, a factor that reduced the incentive to mechanize. The speed at which horses were replaced was also dependent on the type of crop being raised. Farms with crops that required a lot of hand labor to harvest, for example, were generally more difficult to mechanize. In 1943, ranches, livestock farms, and cash grain farms were using the greatest number of horses (Anderson 1943: 658). It wasn't until the mid-1950s that the last Minnesota farms retired their draft animals (Johnson 1950: 58-59; McColly 1957: 398; Fite 1989: 280; Barlow 2003: 5, 22, 121).

By 1910, tractors were being manufactured by at least 30 American companies using assembly line methods, and tractor usage grew from 25,000 in 1915 to 246,000 in 1920. The gas tractor was fuel-efficient and burned relatively cheap gasoline. The gas tractor could be operated by one worker alone – a big advantage over steam-powered equipment that required a crew of workers. Gas tractors also started easily, were simple to refuel, didn't need rest periods, and could do many different jobs. Because they were mass-produced, standardized parts made them relatively easy to repair (Cochrane 1993: 108-109, 199).

From 1918-1924 the leading tractor was Henry Ford's Fordson-F, launched in 1918 as the first mass-produced agricultural tractor. According to historian Ronald Stokes Barlow, "The 2,700-pound, $785 [Fordson] floored the competition with its low price and wide distribution" (Barlow 2003: 122; Cavert 1956: 18; Fite 1989: 280).

In 1924 International Harvester introduced the lightweight, maneuverable Farmall tractor, and "the tractor age really began in American agriculture" (Fite 1989: 280). Average Midwestern farmers began to buy the new technology. The nimble 13-horsepower Farmall was the first low-priced tractor built especially for row crops. Barlow writes, "Its high-wheel, tricycle-design straddled the crop and each of its 40-inch-tall rear wheels had its own brake, a design feature that allowed for very sharp turns in small fields. Truck farmers and dairymen from coast to coast lined up to buy them" (Barlow 2003: 122).

Adoption of the tractor was steady in the 1920s, then slowed during the drought and Depression of the 1930s. According to Barlow, "Few farmers had much experience with gasoline engines, or enough ready cash to purchase a tractor. Their horses were, on average, only about ten years old and could be maintained with leftover hay and grain, a few bushels of oats, and whatever else they could scrounge from pasture land" (Barlow 2003: 121).

In the 1930s, tractors were still improving. They became lighter, more fuel efficient, and faster, achieving road speeds of 20 miles per hour and field speeds of 3 to 5 miles per hour. The recently-invented hydraulic lift was added, which allowed the farmer to lift the plow out of the ground by pushing a lever on the tractor, instead of having to reach back and manually lift the plow. Rubber tractor tires were also introduced – a great improvement over cleated steel tractor wheels (Cochrane 1993: 126).

In the late 1930s and 1940s, the evolution from horses to tractors sped up, spurred by high commodity prices, strong demand for food and fiber at home and abroad, and severe labor shortages during World War II. Nearly half of Minnesota farms had a tractor in 1939. The highest usage was in southwestern and west central counties where about three-fourths of farms had a tractor. The lowest use was in the poor soils of the northeastern cutover, where there was a tractor on only 25 percent of farms in 1939 (Engene and Pond 1944: 28). Nationwide, there were 1.6 million tractors by 1940, and the number of farm horses had dropped to 11 million.

At first, farmers hitched their old horse implements to their new tractors, farming just as they had in the past except with a better power source. This was inefficient, though, because the old horse-drawn equipment usually required another worker to operate it, in addition to the tractor driver. Eventually the "power take-off" transferred power directly from the tractor to the implement that it towed. This spurred the replacement of horse-drawn implements with newer models and reduced the need for a second worker (Ramser 1956: 404; Cavert 1956: 19; Cochrane 1993: 197-198; Fite 1989: 281).

While it was soon clear that horsepower couldn't compete with tractor power, farmers were slow to get rid of their horses entirely. "As late as the 1940s, about 72 percent of our six million farmers still used horses and mules," according to Barlow (Barlow 2003: 121). Many Minnesota farmers used both tractors and horses in the 1940s and early 1950s, employing the horses for winter chores and for special jobs (Johnson 1950: 59; Fite 1989: 282-283). But by 1950, wrote Johnson, farmers were being urged to "Replace the last team of horses with a small second tractor" (Johnson 1950: 59).

Tractors also became more powerful. In 1951, 92 percent of tractors sold had less than 35 horsepower. By 1964, 92 percent had more than 35 horsepower. These stronger tractors pulled even larger implements. The new tractors could manipulate heavier soils, increasing the amount of tillable land a farmer could work, and reducing the need for artificial drainage in some locations. By 1960, there were 4.7 million tractors on U.S. farms (Cavert 1956: 20; Rasmussen 1962: 587-589; Cochrane 1993: 108-109, 126, 197-198; Barlow 2003: 121; Fite 1989: 296).

Farm Automobiles and Trucks. Cars preceded tractors on most Minnesota farms. As soon as cars became affordable in the 1910s, farmers began enthusiastically buying them. In 1913, about half of the state's more than 40,000 automobiles were registered in rural areas (Nass 1989: 139). Farm prosperity around World War I and the rising price of labor encouraged their purchase, and Minnesota farmers bought proportionally more cars than did city residents (Cavert 1930).

Automobiles contributed to farm efficiency, allowing farmers to get to town quickly for parts or repairs, thereby reducing "down time" during planting, harvesting, and other critical periods (Fite 1989: 287). Farmers used cars to bring eggs to market, and to buy groceries and other supplies. Cars and better roads "greatly enlarged the shopping area and widened the horizon of farm families" (Cavert 1956: 20).

In the 1910s, some farmers used their autos as a source of farm power. The Ford Motor Company and others sold conversion kits that turned the family car into a farm tractor (Barlow 2003: 122). For as little as $195, farmers could buy a kit to enable a Model T to tow a plow. Kits also ran a belt from the Model T's rear wheel to turn a pump, churn, feed mill, saw, washing machine, or electric generator (Barlow 2003: 122).

By 1939, 87 percent of Minnesota farms had an automobile. Cars were less common in northern Minnesota, where 73 percent of farms had a car in 1939. The highest level of car ownership was in southern Minnesota, where more than 90 percent of farms had a car that year (Engene and Pond 1944: 28).

More farmers owned cars than owned trucks. In fact, in 1939 just 18 percent of Minnesota farms had a truck. Trucks were most common on farms near the Twin Cities where fruit, vegetables, eggs, and potatoes were hauled to urban markets. About 37 percent of farms near Minneapolis-St. Paul had a truck in 1939. Farm trucks were scarce in east central and northwestern Minnesota in 1939, with only about ten percent of farmers owning a truck (Engene and Pond 1944: 28).

A University of Minnesota study of Minnesota farms found that between 1920-1927, truck use increased 480 percent, tractor use increased 203 percent, and the number of work horses declined by more than 25 percent on farms in a study group (Cavert 1930).

Trucks changed the way farmers marketed their products and allowed some to beat railroad shipping rates. "The transport of farm products to market had always been slow and expensive," according to Fite (Fite 1989: 287). If the farm was ten miles from town, it took five or six hours to make the round trip to the elevator in a wagon pulled by horses. In the 1920s, farm trucks began to ease this problem, enabling farmers to market their commodities more efficiently. Where roads were suitable and the trip was long, motorized vehicles had almost completely replaced horses for hauling agricultural products to market by 1940. Anderson reports that almost 90 percent of U.S. grain was hauled to market with an auto, truck, or tractor in 1940 (Anderson 1943: 659). Eventually, trucks and cars enabled farmers to bypass local elevators and crossroads stores in favor of more distant markets and trading centers. One effect was the decline of the farm service villages and towns in the second half of the 20th century (Fite 1989: 287, 302; Engene and Pond 1944: 28; Cochrane 1993: 197-199; Hart *Rural* 1998: 374).

Nationwide, farm truck numbers nearly tripled during the 1940s and 1950s, reaching 2.8 million by 1960.

Plows. Plows were the farmer's most important tillage implements, and as farm machinery evolved, the first major improvements were to the plow. There were plows for every type of soil, from tough prairie sod to sticky soil, and each plow bottom (the blade unit) was named for a specific soil condition.

Cast-iron plows with replaceable parts were developed in the early 1800s, followed in 1837 by Illinois blacksmith John Deere's one-piece wrought iron plow with a steel-edged blade. So effective was this plow at cutting through heavy soil that it became known as the "singing" plow. By 1859, there were at least 200 different steel-bladed plows being used west of the Appalachians.

Horse-drawn riding plows, also called "sulky" plows, came into use in the 1850s and 1860s. They had two or three wheels and a seat, letting the plowman ride on the plow instead of walking behind it. By 1875 there were more than three dozen brands of riding plows available, including two-bottom plows, also known as "gang" plows. According to Ronald Stokes Barlow, "The two-bottom gang plow doubled the number of acres that one man could plow in a day and by the 1920s was the most widely used implement in the country" (Barlow 2003: 36; McColly 1957: 398; Cochrane 1993:190-195).

When farmers bought gas tractors in the 1920s, some converted their horse-drawn plows for motor power by fitting them with a tractor hitch. But most soon bought larger, multi-bottom plows that took advantage of the greater speed and power of the tractor. Improvements to tractor-drawn plows in the 1920s included heavier construction, wider-spaced bottoms, better lift clutches, and shock-absorbing devices in the hitch. In the 1930s and 1940s, plows were improved with more bottoms, larger blades, and hydraulic controls. During the same era, the industry perfected two-way plows that could turn all furrows in one direction, and disc plows that could move tougher, drier soil (McColly 1957: 398; Cochrane 1993: 126).

Tilling. Harrowing was a type of tilling done after plowing to pulverize dirt clods and smooth the soil for planting. (Sometimes a field was harrowed twice, and harrowing was sometimes followed by dragging with a heavy plank or roller to make the seed bed more even.) The first practical harrow was made from a sturdy, twiggy tree branch, and some branch harrows were still used in the late 1880s. The first single-disk metal harrow was invented in 1847. Multi-disk harrows came into use in the 1870s, and by the 1880s self-cleaning models with a dozen disks were available. Flexible, deeper-penetrating, spring-tooth harrows came on the market in 1877. They were used in stony soil and to eradicate weeds. Other specialized tillage tools were introduced about 1900 (McColly 1957: 398).

Planters. Until the 1840s, farmers planted grain by hand, tossing the seed as evenly as possible and covering it with a hoe. In the 1850s and 1860s, mechanical broadcast seeders became available, including wheelbarrow-style and wagon-mounted models.

About the same time, force-feed mechanical seed drills (also called planters or seeders) were developed, which dropped seeds into a depression and covered them with soil. Seed drills improved germination by providing consistent spacing, planting depth, and soil contact. There were many types of mechanical seed drills, each designed for a particular crop and region of the country. During the 1880s and 1890s, large-scale growers, such as bonanza farms, used huge grain drills up to 16′ wide, pulled by four-horse teams. Later, special attachments were developed for grain drills. Attachments could, for example, deliver fertilizer during planting or plant a second type of seed. In the 1940s and 1950s, average-sized farms replaced single-row planters with 6′- or 8′-wide drills that planted multiple rows (Ramser 1956: 405; McColly 1957: 400; Cochrane 1993: 126).

Early corn planters dropped the seeds in hills. An 1860 advancement was the check row planter, which planted corn in a checkered pattern that allowed beneficial cross-cultivation. The first tractor-powered corn planters, which were horse-drawn implements adapted with a tractor hitch, were replaced in the early 1930s with tractor-mounted two- and four-row planters. These fast, accurate planters played a key role in increasing corn yields by the farmer increased control over the timing and technique of planting (Ramser 1956: 405).

Cultivators. Many crops were cultivated while the plants were small to suppress weeds, aerate the soil, and to scatter a fine dust mulch that reduced moisture evaporation. Cultivation was especially necessary for so-called cultivated or inter-tilled crops such as corn, potatoes, and soybeans. (Most small grains were planted so thickly they didn’t need cultivation.)

Early cultivators were heavy, plow-like walking implements without wheels or depth adjustments. In the 1840s and 1850s, many new cultivators were developed, and by the 1860s they were made by hundreds of manufacturers. Cultivators came in many styles, but most had shovels, sweeps, surface blades, spring teeth, disks, and other features for particular types of crops, soil conditions, and plant sizes.

In the early 1900s, row crop cultivators were usually one-row or two-row implements drawn by two to four horses. A farmer with a riding cultivator and two horses could cultivate about 15 acres a day. The rotary hoe was introduced in 1912, giving farmers a wide, fast tool for early cultivation of corn, soybeans, potatoes, and small grains. Three- and four-horse, two-row cultivators became common between 1910 and 1924. Horse-drawn cultivators continued to be widely used until the late 1940s, but in the mid-1920s, some farmers were buying tractor-drawn models. One-, two-, and four-row cultivators were used for wide-row crops like corn and potatoes, and one- to six-row cultivators for closely-spaced crops like sugar beets and beans (Ramser 1956: 405; McColly 1957: 399; Barlow 2003: 53-55).

Reapers and Binders. Until the mid-19th century, farmers harvested grain by standing in the grain field with a cradle scythe, cutting the grain by hand, and scooping the cuttings into a pile. The grain was then bound into sheaves and several sheaves were stacked upright to form a shock to dry. The shocks had to be carefully built to shed water and resist tipping over in the wind.

The mechanical reaper was invented in the 1830s, and came into wide use on American farms in the 1850s. Called by Wayne Rasmussen "probably the most significant single invention introduced into farming between 1830 and 1860," the mechanical reaper made harvesting easier at a stage in the process where the work had to be finished quickly to save the grain crop from rain (Rasmussen 1962: 580).

The first reapers were pulled by one horse. A sickle-type cutting bar cut the grain near the ground and pushed it onto a platform; the farmer raked it off by hand into loose heaps. The grain bundles still had to be tied into sheaves by hand and the sheaves stacked in shocks. The mechanical reaper, however, halved the time needed to harvest grain (Cochrane 1993: 195). Two workers with two horses and a mechanical reaper could cut about 20 acres of grain a day – a tremendous labor savings compared to a worker with a cradle scythe, who could cut only one to four acres a day.

In 1875, reapers with automatic binders were invented. These machines cut the grain and tied it into sheaves with wire. Twine (which was easier on cattle when eaten) replaced wire in 1881. Horse-drawn binders with 8' cutter bars were common by 1920. The use of gas tractors prompted the sale of 10' binders. When combine harvesters were adopted in the 1930s, binders were no longer needed and reapers were replaced by windrow harvesters that cut the grain and laid it on the ground in swaths (or windrows) to dry before being picked up by the combine (Barlow 2003: 56-63; McColly 1957: 401; Cochrane 1993: 195).

The first factory-made windrow harvesters sold in 1927, and their introduction helped speed acceptance of combines in the Midwest (Anderson 2002: 679; Fite 1989: 292; Isern 1979: 110-111).

Threshing. The process of separating grain from stalks is called threshing. The grain shocks that had been standing in the field were hauled to the barn for threshing, with the sheaves of grain that had formed the caps of the shocks kept separate so that this weathered grain would not be mixed with the better-quality harvest (Moore et al 1920: 90-91). Until about 1850, the most common method of threshing was flailing grain on the barn floor with a long leather strap fastened to a pole. With a flail, one worker could thresh about 15 bushels of grain a day.

The first mechanical threshing machines appeared on farms in the 1830s. Grain sheaves were gathered up and fed into the thresher. Early threshers consisted of two units: the power unit, which was either a treadmill or a merry-go-round-style sweep arm (both powered by horses), and the threshing unit, which consisted of a horizontal threshing cylinder. The first threshers simply removed the grain from the husk. The farmer still had to rake off the straw by hand and then winnow the chaff to separate it from the grain. Eventually blower fans were added to threshers.

In the 1840s and 1850s, combination threshers were developed that did all three operations – thresh the grain, separate the straw, and remove the chaff. They were first powered by horses and, by the 1880s, by steam engines. Productivity gains were stunning: steam threshers could process 1,000 bushels of grain a day, compared to about 15 bushels a day threshed by hand (Cochrane 1993: 195-196; Johnson 1950: 61).

Threshers were large, expensive machines that were usually jointly owned by neighboring farmers in a threshing ring, or by farmers who did custom threshing for others. A large group of workers (usually family, neighbors, and hired help) gathered to feed the threshing machine, shovel the grain from wagon beds into granaries for storage, and stack the straw in outdoor piles. The crew moved from farm to farm over several weeks to thresh each farm's grain. The women on each farm worked to feed the hungry crews with several meals each day (Johnson 1950: 61; Fite 1989: 292; Anderson 2002: 669-670; McColly 1957: 401; Barlow 2003: 70-73).

Some threshing machines were still being powered by steam in the 1930s. Most of the steam engines, however, were replaced by gas engines in the 1910s.

Threshing machines became obsolete in the 1940s and 1950s after small combine harvesters became affordable for farmers.

Combines. Combines – that is, harvesting machines that "combine" both harvesting and threshing operations – were used in the 1880s on the Great Plains. These monster, horse-drawn machines cut, threshed, separated, and winnowed the grain in the field. Pulled by as many as 40 horses, they cut swaths up to 35' wide. In the 1890s, the horse power was replaced with great steam tractors.

In the grain fields of the West, combines powered by gas tractors were widely adopted in the 1920s. But they were not common in the Midwest until the 1930s when smaller models adapted to local conditions became available (Cavert 1956: 19; McColly 1957: 401; Isern 1979: 105).

Combines cut labor dramatically. Historian A. N. Johnson wrote, "Instead of a large crew to thresh out the grain, two workers with a combine, an elevator [to fill the granary], and a couple of trucks can cut and thresh the grain in one operation without employing hand labor" (Johnson 1950: 61). From field to bin, one or two people could handle the entire harvest, and women were freed of the burden and expense of feeding ravenous threshing crews. Combines also let farmers harvest their crops more quickly, and at the right time, dramatically cutting crop losses (Johnson 1950: 61; Ramser 1956: 404-406; Fite 1989: 292; Anderson 2002: 682).

Gas-tractor-powered combines were first used in Minnesota in 1927. By 1931, about 250 tractor-drawn combines had been sold in the state. Nationwide, there were about 61,000 combines in use. Owners usually did custom work for other farmers to help offset the expense of the new equipment.

In 1935, a smaller, lighter, one-man combine powered by a smaller tractor became available. These "baby" combines cut a 5′ to 8′ swath, making them practical for average Minnesota farmers.

Combines could harvest small grains, grass, legumes, beans, and grain sorghums. During the transition to the new harvesting technology, combines and threshing operations coexisted on many farms: for example, farmers used combines to harvest soybeans, flax, and wheat while continuing to bind and thresh oats. But by about 1940, according to Johnson, "you couldn't give a binder away; the market was gone" (Anderson 2002: 672, 686).

In 1938, self-propelled combines were introduced. These machines didn't need to be pulled by a tractor, making them faster and easier to operate. According to *Agricultural Engineering*, "The self-propelled machines and the great number of pull-type one-man [combines] did much to help meet World War II needs for food. A U.S. Department of Commerce bulletin said, 'Without the combine, bread rationing in the United States would have been inevitable'" (McColly 1957: 402).

By 1950, most grain on Midwestern farms was being harvested by combine, and binders and threshing machines disappeared. Nationwide, there were more than one million combines in use in 1960 (Fite 1989: 296; Cochrane 1993: 126, 197-198; Anderson 2002: 671-673; Barlow 2003: 74).

Hay-making. Hay was an important crop wherever livestock was raised. Hay had to be cut at optimal time, but even more importantly, it had to be handled very quickly and moved into storage before it became wet. Hay was cut with a mower or swather and left to dry for a short amount of time. It was then raked into long swaths or windrows and gathered by hand into cone-shaped cocks (which were usually smaller than grain shocks), where it dried again briefly. Rainy weather could threaten the crop at any stage of the harvest. Hay also had to be handled gently or the plants would lose their protein-rich leaves.

Before mechanization, the stressful, backbreaking work of making hay involved scythes, hand rakes, and pitchforks. Mechanical hay mowers appeared in the 1830s, although hand tools continued to be used on many small farms until 1900. Many of the early mowing machines of the 1850s and 1860s were combination reapers and mowers that could be adjusted to cut either hay or grain. The first practical two-wheeled metal mower, the Buckeye, was marketed in 1854. By 1860, a two-horse mower with a flexible 4′ to 8′ cutter bar had been perfected. In the 1910s, a standard 5′ horse-drawn mower was widely used.

In the 1930s and 1940s, tractor-drawn mowers became common in the Midwest. These machines had much greater mowing capacity than horse-drawn mowers and were equipped with safety devices that protected the sickle in case it clogged or hit an obstruction (Ramser 1956: 406; McColly 1957: 403; Barlow 2003: 65).

The use of the mowing machine demanded a faster way of raking hay. This led to the development of a variety of wheeled rakes, including riding dump rakes, tedders, side delivery rakes, and sweep rakes (McColly 1957: 403).

Mechanical hay loaders that moved the hay from the ground to the wagon became available about 1880 but were not common until the early 1900s. Hay loaders, according to Barlow, "were one of the best labor saving machines a farmer could buy. Grateful owners remembered the 'not-so-good-old-days' when they spent all day tossing loose hay from the ground to the top of a wagon with pitchforks." The hay loader worked well with the side delivery rake, and "was needed on every farm where hay was gathered in the field and transported to a hayloft, or hauled to stacks" (Barlow 2003: 67).

There were also hay stackers that moved the hay from the wagon bed to the hay stack. The overshot stacker threw the load of hay directly back upon the stack with the help of horses, ropes, and pulleys. The swinging stacker raised the load from the ground, swung it to one side of the stack, and dumped it.

Moving hay into the barn was handled by several machines, depending on the type of hay. Among the first was the Louden hay carrier, invented in 1867, which attached to the barn's interior ridge pole and allowed hay to be distributed throughout the barn. These carriers led to the construction of two-story barns with large hay mows. By the 1960s, loose hay was handled with slings, baled hay with mechanical elevators, and chopped hay with blowers (Ramser 1956: 406; Cavert 1956: 19; McColly 1957: 404; Cochrane 1993: 126; Barlow 2003: 64-69).

Forage harvesters also became available in the late 1930s. These machines cut the hay, chopped it, and delivered it into a wagon. In the 1950s, self-propelled forage choppers and self-unloading forage wagons gained popularity.

Balers. Mechanical hay and straw presses became available in the 1860s. But it wasn't until the late 1880s that these machines could compress hay into a bale that could be tied and stacked. Early hay presses required a two or three-man crew and a couple of horses or a steam engine for power.

The first field pick-up hay balers were introduced in the 1930s. These tractor-powered machines could gather, compress, and tie hay into square bales while moving through the field, completing the whole baling task with just one operator. In the 1940s, round bale equipment was developed.

In the 1940s, some farmers hired custom balers to follow the combine and bale the grain straw. Other farmers used a field chopper to cut the grain straw and then blew it into a barn, or made a temporary straw storage structure out of snow fence (Anderson 2002: 680-681).

Silage Choppers, Loaders, and Unloaders. Silos were not widely accepted until about 1900, but within 15 years, most dairy farms had adopted the technology. The perfection of silage cutters and silo loaders helped encourage the silo's spread. Corn and other crops were harvested from the field, cut up, and packed into silos. Specialized crews were often hired to fill silos, or neighboring farmers helped each other.

Silage cutting machines of the 1890s ranged from hand-operated choppers to large rotary cutting machines powered by horse-powered treadmills or steam engines. In the 1920s and 1930s, tractors were used to power silage cutters and to run chain conveyors, or blowers and chutes that elevated fodder to the top of the silo (Barlow 2003: 75).

Silos were unloaded by hand with a pitchfork. Although engineers began to experiment with silo unloaders immediately after World War II, it wasn't until the late 1950s and early 1960s that automatic unloaders were widely used.

Corn Harvesting and Shelling. Corn picking (like hay baling) was a major harvesting job that was mechanized fairly late. Before mechanization, corn in the Midwest was generally picked and husked by hand from standing stalks. Some farmers also cut the stalks with a corn knife, cutting and binding into shocks about one acre a day.

After self-binding grain reapers were introduced in 1875, many attempts were made to design a similar cutting and binding machine for corn. The first horse-drawn cornstalk cutters were sled-like implements mounted on small wheels. Angled knives cut the stalk as it was grasped by two workers riding on the sled. When each worker had an armful, the sled was stopped and the cornstalks were set into shocks. According to Barlow, "These cheap harvesters had a much larger capacity than hand cutting and could cover six or eight acres a day" (Barlow 2003: 76).

The harvested corn stood in shocks until it could be fed whole to livestock, husked by hand, or shredded with a mechanical husker-shredder for feed and bedding. Corn could also be chopped when green with a mechanical fodder cutter and loaded into a silo. Ear corn was stored in corncribs and shelled in batches as needed. Hand-cranked cast-iron shellers came into use in the 1840s. They were followed by steam-powered shellers (about 1900) and then gasoline and electric-powered shellers (Ramser 1956: 406; Barlow 2003: 76; McColly 1957: 402).

Another mechanical corn harvester appeared in 1890. It cut the standing corn and elevated it into a wagon beside the machine. An improvement, the McCormick corn binder, soon followed. This machine could cut and automatically bind about seven acres of corn a day. The bound stalks were easier to handle than loose stalks, and by 1900 there were several brands of corn harvester-binders available. Farmers still husked the corn by hand, or used a husker-shredder, or chopped the corn for silage (McColly 1957: 403; Barlow 2003: 76).

"In the early 1900s," Barlow writes, "a growing scarcity of farm labor . . . encouraged many manufacturers to redouble their efforts to mechanize this labor-intensive process" (Barlow 2003: 76). By 1909, mechanical corn pickers had been developed, but they were troublesome and unreliable, "and many hand-huskers longed for the day of the successful operation of the machine" (McColly 1957: 403).

By the late 1920s, one- and two-row tractor-pulled pickers had been finally developed that could snap the ears from the stalks and husk them cleanly. Corn pickers were widely adopted by farmers in the 1930s and 1940s. Farmers sometimes towed shelling machines in tandem with corn pickers. In the 1950s, corn combine equipment became affordable so that farmers could pick, husk, and shell corn in a convenient, one-man operation. Nationwide the number of corn pickers and combines (picker-shellers) grew from a few thousand in 1930 to 800,000 in 1960.

Crop Dryers. Because of the high moisture content of shelled corn, picker-shellers adopted in the 1950s increased the need for crop dryers. After farmers invested in drying equipment, many used machines to dry all their major crops – hay, small grain, and shelled corn (Ramser 1956: 406; McColly 1957: 402; Fite 1989: 297; Cochrane 1993: 126; Barlow 2003: 76).

Potato Growing. In the early 20th century, potatoes were generally machine-dug, but then had to be picked up by hand from the field and placed in wire baskets. From the baskets they were transferred to cloth sacks, and then moved into a cool dark place for storage.

Potato harvesters (or "diggers") evolved from horse-drawn, potato-raising plows that had been used for decades. Harvesters first became available in 1886, but did not work well and were rarely used until the 1940s. By 1945, potato harvesters could dig the crop and elevate the potatoes to mechanical sorting and bagging equipment (Ramser 1956: 405-407; McColly 1957: 400-403; Barlow 2003: 42-48, 84).

Mechanical potato planters were invented in the 1870s but didn't come into use in the U.S. until the late 1890s. By 1910, there were at least three dozen companies making horse-drawn potato planters. Potato planters eliminated a slow, laborious job. The machines opened a furrow, dropped and spaced the seed pieces, placed fertilizer, and covered the fertilizer and seed to the proper depth.

Sugar Beet Growing. In 1924 a Minnesota Extension expert reported that labor comprised 80 percent of the cost of growing sugar beets and wrote, "It is apparent that the profit from this crop is largely dependent upon the supply of cheap labor" (McGinnis 1924: 10-11).

Sugar beets had to be cultivated several times. They had to be "blocked" by hoe in preparation for thinning, and then thinned by workers on hands and knees. When mature, the beets were lifted, and then pulled from the field by hand, knocked together to remove the dirt, and then tossed in piles about 15' apart. Workers then topped the beets by cutting off the leaves with a knife and hand-loaded them into wagons so they could be hauled to a processor's collection station (Rasmussen 1967: 33, 35).

Mechanization of sugar beet planting and harvesting took place in the late 1930s to the mid-1950s, with single-seed sugar beet planters developed in the late 1930s.

The development of sugar beet harvesters was slow – it was difficult to create a machine that could top the beet, dig it out of the ground, remove the excess soil, and raise the beet into a wagon or hopper (Ramser 1956: 407). In 1945, only 12 percent of the U.S. crop was harvested mechanically. It wasn't until the late 1940s that harvesting equipment was improved to the point that Minnesota farmers could begin to invest in these machines. By 1958, it took only 2.7 man-hours to grow one ton of sugar beets, compared to 11.2 man-hours in the 1910s (Rasmussen 1967: 33, 35; McColly 1957: 400-403; Barlow 2003: 42-48; Ramser 1956: 407).

Spreading Manure. Before mechanical manure spreaders were available, farmers generally shoveled manure into a wagon by hand, hauled it out into the field, and pitched it out of the wagon in "irregular, wasteful heaps" (Barlow 2003: 51). Manure spreaders let farmers apply manure evenly over fields and were a great labor-saving tool.

Some farmers made crude, homemade manure spreaders out of perforated barrels, boxes, and other contraptions. The first factory-made, wagon-mounted manure spreaders were introduced in the 1850s and 1860s. Many refinements were made to manure spreaders in the 1870s, and by the early 1900s, most farmers who used more than 100 wagon-loads of manure a year owned a factory-made spreader (Barlow 2003: 51).

In the 1920s, two basic types of spreaders were being used. Apron spreaders had a moving bed that fed manure to a mechanical "beater" mounted on the rear wagon axle that shredded the manure. Tight-bottom spreaders worked on the same principle, but had three beaters instead of one. A spiral beater at the end of the conveyor spread the manure evenly over the entire width of the wagon tracks.

Barn Chores. The mechanization of barn chores began well before World War II, but sped up after the war. Electricity enabled automation of many barn jobs including watering the stock; collecting eggs; moving livestock feed, bedding, and manure; and milking cows, cooling milk, and separating cream.

Many Minnesota farms bought their first milking machines between 1915 and 1925, although "experimental" machines had been commercially available since the 1890s. Johnson wrote in 1950, "With a good milking machine, one man . . . can milk 25 cows in less time than three men can do the job by hand" (Johnson 1950: 61). By 1960 virtually all milk was produced with modern automated methods (Cochrane 1993: 126).

Important developments in barn technology included:

- First barn hay carrier, invented by Louden in 1867
- Centrifugal cream separator available circa 1885
- Babcock butterfat tester developed in 1890
- Feed carriers on overhead tracks, appearing in the 1890s
- Automatic drinking cups in stalls, invented in 1912
- Experimental fans in dairy barns, used in 1910s
- Practical, gas-powered milking machines, developed about 1915; electrified in the 1930s and 1940s
- Hammermill feed grinders, introduced in 1920
- Tractor-powered manure loaders, appearing in the late 1930s
- Mechanical gutter cleaners, appearing in the 1940s and 1950s
- Electric poultry brooders, invented in the 1910s
- Electric fan ventilation, becoming common around 1950 (Ramser 1956: 407; McColly 1957: 404; Barlow 2003: 49-52).

Many of these advances resulted in changes to barn design.

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The development of silo loading equipment encouraged silo construction. Pictured above, men chop bundles of cornstalks and blow them into a silo. The chopping and blowing equipment was powered via a belt from a steam traction engine or "tractor". The silo was built of horizontal wood and was incorporated into the massing of the barn. Location unknown, circa 1910. (MHS photo by Harry Darius Ayer)

Harrows prepared the seedbed by breaking up clods and smoothing the soil after it was plowed. This harrow, a common type, consisted of a wooden frame with projecting hardwood or steel teeth that were dragged through the dirt. Most horse-drawn implements were adopted by farmers in the mid-19th century and improved and replaced over the next 50 years. Photo taken near Brandon, Douglas County, circa 1911. (MHS photo by Johnson and Olson)

Farm building design responded to mechanization. Threshing machines made three-bay threshing barns obsolete. Mechanized hay carriers and hay forks allowed farmers to handle more hay, and hay lofts – like this barn's upper story – grew larger. Threshing machines, like the one shown here, and their large crews were replaced beginning in the mid-1930s by relatively small, tractor-pulled combines that individual farmers could afford to own. Koochiching County, circa 1935. (MHS photo by Russell Lee)

An electric pump being used near the base of a steel windmill tower. After farms electrified and modern water pumps were installed, windmills were eventually phased out. Location unknown, 1938. (MHS photo)

It was not until the 1940s that potato harvesting equipment became reliable. Before this time, most potatoes were brought to the surface with a potato plow. Machines like these led to the enlargement of fields and farms, and to the reduction of the state's farm labor force. Polk County, 1959. (MHS photo)

FOCUS ON BIOTECHNOLOGY AND AGRICHEMICALS

Some Milestones of Biotechnology and Agrichemicals

1885	–	Minnesota Agricultural Experiment Station established
1887	–	Hatch Act established federally-funded agricultural experiment stations
1915	–	Hogs being vaccinated for cholera; herds increased
1922	–	Haralson apple introduced
1926	–	Hybrid corn introduced commercially
1945	–	Herbicide 2,4-D introduced
1946	–	Insecticide DDT became available to farmers around 1946; livestock dips built
1953	–	Frozen semen became available for average dairy farmers
1950s	–	Anhydrous ammonia first used in Minnesota in early 1950s

Between 1820 and 1915, improved machinery was the main form of technological advancement on the farm. About 1915, another kind of farm progress began, arising from the new scientific understanding of plant and animal genetics, plant and animal diseases, pests, nutrition, and soils. In the 1940s a whole new arsenal of chemicals became available to help farmers cut losses from weeds, insects, and diseases, and to improve the productivity of the soil (Cochrane 1993: 200; Hart 1998: 373). According to agricultural historian Wayne Rasmussen, farmers carried these discoveries into their fields and barns, adopting improved practices such as "greater use of . . . fertilizer, widespread use of cover crops and other conservation practices, use of improved varieties, the adoption of hybrid corn, a better balanced feeding of livestock, the more effective control of insects and disease, and the use of . . . weed killers and defoliants" (Rasmussen 1962: 587-589). In addition, "Artificial breeding brought major changes to the dairy industry. . . . Hybrid sorghums, chickens, and pigs, after the great success of hybrid corn, brought production to new heights" (Rasmussen 1962: 587-589).

As crop yields increased, Minnesota farms needed more and larger corncribs, granaries, grain bins, and other crop-related structures. As livestock diseases were understood, animal housing was redesigned to permit greater control of germs and parasites.

These new technological developments came along slowly before 1920, gathered momentum between 1920 and 1940, and poured forth after 1940. According to economist and historian Willard Cochrane:

> In the period 1940-1970 there were really three technological revolutions going on concurrently. . . . There was a mechanical revolution that led to the mechanization of almost every production process in farming. There was a biological revolution that led to drought-resistant and disease-resistant varieties, and greatly increased crop yields. There was a chemical revolution that did many wondrous things: controlled plant and animal diseases, as well as pests and weeds, and provided soil fertilization (Cochrane 1993: 202).

CROP BREEDING

Plant scientists and breeders, including those at the University of Minnesota's Agricultural Experiment Station (established 1885), developed improved varieties of every agricultural crop. Oats were among the first crops researched at the University, and the Station released its first improved variety in 1895. Seeds of new crop varieties were often grown at the regional experiment stations and distributed to farmers in each region.

New crop varieties were bred to produce higher yields; to resist insects, drought, and diseases; to ripen at an optimal time; to contain desired oil, water, or protein content; and to exhibit specific or consistent characteristics of root, stalk, stem, leaf, or grain. Developing varieties of corn that didn't fall over and had ears at consistent heights, for example, was important to inventing machines that could most effectively harvest. Scientists selected seed corn that bore ears high – yielding more stalk for silage – and low – creating stronger stalks that didn't fall while ripening. As a result, researchers were able to raise ear height from 4' to 8'3" and lower ear height from 4' to less than 10" over the 23-year period from 1902-1925 (Dunham 1928: 3).

Plant breeding and selection began early. One source explained that by "1919, well before the usual dating of the onset of the biological revolution, roughly 80 percent of U.S. wheat acreage consisted of varieties that did not exist in North America before 1873, and less than 8 percent was planted in varieties dating earlier than 1840" (Olmstead and Rhode 2002: 14). The first known record of seed certification in the United States occurred in 1906, when a few small bags of Grimm alfalfa seed with documented proof of varietal purity were shipped from the Minnesota Agricultural Experiment Station in St. Paul to a Colorado seed firm.

Examples of important crop-breeding developments include:

- Grimm alfalfa, the first Minnesota-hardy variety. It was selected in the 1850s-1860s and spread statewide in the early 1900s.
- New varieties of wheat resistant to drought and stem rust. They included 'Red Fife' of the 1850s, 'Marquis' of 1912, and 'Thatcher' of 1934.
- Hybrid corn, "undoubtedly the most significant development in crop production in the twentieth century" (Shaw 1956: 423). Early corn hybrid varieties, introduced commercially in 1926, often doubled or tripled the yield per acre and increased farm returns by 300 percent. The Depression years slowed adoption of hybrid corn: in 1936, just two percent of the corn acreage in the north central states was planted in hybrid varieties. But by the early 1940s, hybrids were widely planted, becoming the standard in the Upper Midwest. In 1946, 91 percent of corn acreage was seeded with hybrid varieties. In the 1960s new hybrid introductions increased yields even more.
- Soybeans, introduced in the 1920s, and "one of the major triumphs of the agronomist" (Cavert 1956: 20). The crop was virtually unknown among farmers in the 1910s when the University of Minnesota and other agricultural colleges first began doing soybean plot trials in the hope that "the crop might be of some future importance" (Cavert 1956: 20). First planted by Minnesota farmers for forage in the early 1920s, soybeans became the second most important cash crop in Minnesota by the 1950s.
- Sugar beet varieties resistant to mosaic disease and curly top – two diseases that at one time threatened the entire industry – and sugar beets that required less expensive labor to grow.

- Fruits such as the Latham raspberry (1920), the Haralson apple (1922), and the Beacon apple (1936) well suited to Minnesota's short growing season (Cavert 1956: 21; Cochrane 1993: 137).

FERTILIZERS

Until the 1850s, American farmers used fertilizers such as animal manure, "green" or plant manure, ashes, soot, lime, and gypsum. Green manure crops included rye, buckwheat, cowpeas, and clover, which were grown to be plowed under to enrich the soil.

The first commercial fertilizer was South American guano (a specific type of dung), sold in the 1850s to cotton and tobacco farmers in southern states. Use of guano and other fertilizers including sodium nitrate, lime, dried blood, slaughterhouse waste, hoof meal, bonemeal, dried fish, and linseed oil meal increased rapidly in the East and South, especially after farmers began to diversify and embrace "scientific" agricultural practices (Rasmussen 1962: 581; Cochrane 1993: 109).

In Minnesota, the state's regional experiment stations conducted the first-ever comprehensive soils survey of the state, and encouraged farmers to add fertilizers and other additives based on their specific soil types. However the use of commercial fertilizers was still uncommon until World War II.

In the 1940s, Midwestern farmers began adding commercial nitrogen, phosphorus, and potash to their fields. Farmers' use of both nitrogen and potash more than doubled between 1940 and 1950; and nitrogen use tripled between 1950 and 1960. Local anhydrous ammonia storage and distribution facilities appeared in Minnesota in the early 1950s (Cavert 1956).

Increased fertilization helped crop yields soar after 1940. Average per-acre corn yields, for example, jumped at least ten bushels a decade between 1935 and 1965 (Cochrane 1993: 128). Soil fertility was also significantly improved through better utilization of crop residues and manure, and improved erosion control, drainage, and irrigation (Cavert 1956: 20; Cochrane 1993: 127-128).

CHEMICAL HERBICIDES AND PESTICIDES

Weeds were generally a more serious problem for farmers than insects. They reduced yields, harbored crop diseases and insect pests, and competed for water, sun, and nutrients. Until the late 1920s, tillage and crop rotations were the main methods available for controlling weeds. Development of chemical herbicides began in the 1920s. Chemical controls included contact herbicides, which were applied to the top growth of plants, killing the parts they touched, and selective contact herbicides, which killed only certain plants. Other types of herbicides killed deep-rooted perennial weeds. Soil sterilants destroyed weeds through contact with the roots.

The use of chemical herbicides to control mustard and other grassy weeds in small grains and in vegetable crops became common in the 1940s. The herbicide 2,4-D, which was especially effective in controlling broadleaf weeds in cornfields, was introduced in 1945. More than 30 million acres of cropland nationwide were being sprayed for weeds by the 1950s (Cavert 1956: 20).

Farmers historically fought a host of insects including grasshoppers, army ants, mealybugs, and corn borers that reduced yields and sometimes destroyed entire crops. Methods for controlling insects included cultural practices such as crop rotation and cultivation, as well as some chemical agents and biological controls. Among the oldest insect poisons were arsenic compounds. Chemical insecticides were usually applied to crops in the form of liquid sprays, fogs, or dusts. Biological control methods used parasites, natural predators, and disease organisms to suppress crop pests.

The insecticide DDT was developed just before World War II and used during the war to protect U.S. troops from malaria and typhus. The Minnesota Agricultural Experiment Station first used DDT during the 1943 and 1944 growing seasons, testing it on potatoes, apples, and truck farm crops (Granovsky 1945: 8). DDT and similar compounds were introduced to American farmers around 1946. In addition to killing pests that ravaged corn, potatoes, and other crops, DDT killed the flies that harassed beef cattle and dairy cows, resulting in improved weight gain and increased milk flow. Potato yields increased 50 percent after 1946 due to insecticides and improved spraying equipment. One of the most effective and widely used crop pesticides ever, DDT was banned in 1972 (Cochrane 1993: 127).

Herbicide and pesticide chemicals were applied with equipment that included hand and power-operated spray machines, and applicators for injecting chemicals into the soil. Most equipment was developed after World War II. Tractor-drawn spray rigs with booms of 40’ were in use by the 1950s. They could spray about 120 acres a day. Orchard sprayers often had metal towers that could reach the tops of the trees. Some orchards also had stationary spraying systems with pumping stations and a network of pipes.

Herbicides and pesticides were also applied by crop-dusting airplanes. Crop-dusting began in the early 1920s but became common after chemical herbicides and pesticides were introduced in the 1940s. Early rigs could be as simple as a chemical-filled tank sitting on the airplane seat next to the pilot, but eventually consisted of more sophisticated equipment.

CONTROL OF PLANT AND ANIMAL DISEASES

Minnesota crops were susceptible to numerous fungal, bacterial, and viral diseases with nicknames like rust, bunt, smut, wilt, blight, scab, and rot. Minnesota wheat crops were repeatedly wiped out by wheat rust, including infamous devastations in 1904 and 1914.

Knowledge of the causes of plant and animal diseases accumulated rapidly after 1900. In most cases, tools to control those diseases became available not long after the causes were discovered (Cochrane 1993: 109).

In 1907 the University of Minnesota established a new Division of Vegetable Pathology and Botany, now called Plant Pathology. By 1920, Minnesota farmers were using resistant seed varieties and more careful cultural practices including correct handling of seed, eradication of hosts, and proper crop rotation. Some farmers were also chemically treating with substances such as formaldehyde, lime sulphur, and Bordeaux mixture (copper sulphate and quicklime). By the 1950s an array of new chemicals were supplementing and replacing these old standbys.

Progress in controlling livestock diseases included:

- Understanding the causes of many animal diseases including hog cholera, tick fever, tuberculosis, and brucellosis. This led to the adoption of concrete barn floors, colony pig and chick housing, etc.
- Developing vaccines for hog cholera. Before about 1915, heavy losses from hog cholera made it risky for farmers to raise large numbers of pigs. In 1907, a successful vaccine for hog cholera was developed, and by 1915, hogs were being routinely vaccinated against the disease. This allowed farmers to increase their herds, leading to new and larger hog barns.
- Nearly eradicating tick-borne diseases in cattle by 1914.
- Controlling bovine tuberculosis, which was passed on to humans. Extensive testing programs, quarantine, disinfection, and education reduced the extent of the disease from five percent of the national cattle herd to less than one-half percent by the 1950s.
- Testing for brucellosis, or Bang's disease, in cattle, and developing vaccines.
- Learning the life cycles of parasitic worms that infected hogs, poultry, cattle, and sheep. Studies demonstrated that infection could be cut by preventive measures. Housing, bedding, pasturing, and husbandry methods changed to permit better sanitation, which allowed farmers to enlarge herds.
- After World War II, using modern vaccines, drugs, and antibiotics in farm animals. For example, penicillin helped farmers cure mastitis, the most prevalent and expensive bacterial infection in dairy cows. Vaccines were developed for deadly cattle diseases including anthrax and blackleg.
- Developing insecticide dips, washes, and dusts to control parasites in cattle, sheep, and pigs. This led to structures like hog wallows and sheep dips (Cochrane 1993: 109; Cavert 1956: 22-23; Price 1956: 50b-51).

FEEDING REGIMENS

Shortly after the turn of the century, land-grant universities began establishing departments of animal nutrition to study livestock feeding, to analyze the effects of various components on animal health and growth, and to develop optimized feeding regimens for various animals at specific stages of their lives. Understanding of animal nutrition increased and feeding practices improved. In 1913 the University of Minnesota's T. L. Haecker published the ground-breaking Haecker Feeding Standard. It was the first feeding guide that provided specific amounts of energy and protein necessary to feed a dairy cow based on factors such as the cow's weight, the amount of milk produced, and the percentage of butterfat, and became the industry's "bible" for decades.

Advances in feeding changed farm building requirements. For example, root cellars and feed rooms with choppers and mixers became less important as farmers bought ready-mixed feed with special additives. Feed cookers and swill pits for heating hog food were abandoned as the importance of more careful feeding was emphasized. Barn scales, mixing equipment, and steel feed bins were added to barns to support the best regimens.

Combined with livestock breeding and disease control, advances in nutrition brought a dramatic rise in farm productivity, including increases in the quantity and quality of milk, eggs, and meat (Price 1956: 50b; Cochrane 1993: 128-129).

LIVESTOCK BREEDING

Some Minnesota cattle farmers were actively improving their herds through livestock breeding as early as the Territorial period. As farmers diversified around the turn of the century, they were encouraged to use specialized dairy breeds of high milk-producing cows, or cows bred with "dual-purpose" traits so that they would be good milk producers while their calves could be finished for meat.

As the state's regional system of agricultural experiment stations was built, animal scientists began to develop high quality flocks and herds at the stations, and to provide animals to local farmers so they could introduce these desirable qualities into their own herds.

The first cooperative breed improvement associations in the U.S. were organized around the turn of the century to promote herd improvement and help members obtain the services of registered sires. The Minnesota Holstein Breeders Association, for example, organized in 1910. These associations kept detailed progeny records and did milk production testing. Later, breed associations educated farmers about artificial insemination.

By the mid-century breeding research was producing better livestock that were adapted to modern, mechanized production methods. For example, cattle growers learned to breed beef cattle that produced heavier calves that matured faster on less feed. By the mid-1950s, finished cattle could be marketed three months earlier than before World War II. Hog producers developed new hybrid strains of hogs with less fat and more lean meat. Poultry growers developed improved strains of chickens and turkeys with higher feed efficiency and vastly improved disease control. By the mid-1950s, farmers could produce a 3-pound broiler chicken in ten weeks on eight pounds of feed – a savings of three weeks and three pounds of feed from the prewar period. Egg production improved, too, jumping from an average of 82 eggs per hen in the early 1900s to 145 eggs per hen in 1951. These increases convinced some farmers to invest in new animal housing and housing that best supported new production methods.

Artificial Insemination. Artificial insemination of farm animals was first developed in the 1920s in Russia, and was widely adopted around the world, especially for cattle production. Artificial insemination permitted extensive use of superior sires, resulting in more control of desirable genetic traits. Artificial breeding associations were organized throughout the U.S. and became a primary means by which farmers accessed the new technology.

Significant artificial insemination research began in the U.S. in the 1930s, particularly at Cornell University and at research facilities in Minnesota and Wisconsin (Foote 2002: 3). The Minnesota Agricultural Experiment Station produced its first dairy calf through artificial insemination around 1936. In 1939 Minnesota's first artificial insemination cooperative breeding association formed in Floodwood. In 1940, about 35,000 dairy cows in the U.S. were artificially inseminated. Within a decade, that number soared to 2.6 million cows, and by 1954, some 5 million dairy cows were artificially inseminated – roughly one-fifth of the U.S. dairy herd. By 1952, breed improvement associations were artificially breeding an average of 1,800 cows to a single sire, and as many as 25,000 cows a year to some outstanding bulls. (With natural mating, a bull could be expected to inseminate only about 50 cows a year.) In 1953 frozen semen became available commercially for on-farm use (Wayne 1977: 209; Cavert 1956: 22).

Average Minnesota dairy farmers began using artificial insemination in the late 1940s, according to retired University of Minnesota animal scientist Harley Hanke. Artificial breeding of beef cows began about five years later, he estimates, but artificial breeding was more common in dairy herds than beef herds. Hanke explained that dairy cows, who were accustomed to stanchions, were more tame than beef cows and, therefore, easier to inseminate. Dairy farmers who used artificial insemination also saved the expense and trouble of keeping dairy bulls, which generally had more aggressive temperaments than beef bulls, and were thus harder to handle. In addition, dairy herds needed to be bred several times a year, while beef herds were usually bred just once a year. As dairy farmers began adopting artificial breeding, the need for bull barns decreased. Farmers who did not use artificial insemination sometimes owned a bull together, or rented a bull. Renting was more common among beef producers and small farmers (Hanke 2005).

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Minnesota farmers continually fought weeds, insects, and diseases that reduced yields and sometimes wiped out entire crops. Around the turn of the century, new academic fields such as agronomy and plant pathology were organized, and through this research scientists began to understand disease processes and to recommend improved farming methods. As a result, farm productivity increased and larger buildings were often constructed. Location unknown, circa 1910. (MHS photo by Harry Darius Ayer)

Improved feeding regimens for dairy cattle encouraged farmers to feed cows the best combination of protein, carbohydrates, and roughage, and to keep careful records to track progress. Specialized equipment like scales, feed mixers, and feed bins were installed in barns. This farmer is weighing hay for each cow. Location unknown, circa 1915. (MHS photo by Harry Darius Ayer)

FOCUS ON FARM ELECTRIFICATION

Some Milestones of Farm Electrification

1912	– An estimated 200,000 U.S. farms used acetylene gas
1914	– 26 farms near Granite Falls received electricity in a very early distribution system
1924	– Five-year farm electricity demonstration project began near Red Wing
1930	– About 7.6 percent of Minnesota farms had electricity
1930	– About four percent of U.S. farms generated their own electricity
1935	– Rural Electrification Administration (REA) established
1940	– About 17 percent of Minnesota farms had electricity
1955	– Nearly all Minnesota farms had electricity

Farm electrification took place in Minnesota primarily between 1935 and 1955 through the efforts of the Rural Electrification Administration (REA). The REA helped farmers organize into cooperatives and provided low-cost loans to build rural power lines. The REA and other agencies also taught farm families how to use electricity in their homes and farming operations.

Electricity transformed Minnesota agriculture and farm life. For the first time the majority of farm families could enjoy modern conveniences, such as electric lights, running water, indoor bathrooms, washing machines, irons, and radios – amenities that had been available only in towns. Electric lights and machinery also made farmers more productive, increasing the efficiency of their farm businesses. In addition, electricity set the stage for important social changes, such as farm expansion, agricultural specialization, and new roles for farm wives.

EARLY METHODS OF FARM LIGHTING

First Lighting. The only light in the homes of Minnesota's first pioneer farm families – apart from the dim glow of the fireplace – was from homemade candles of mutton or beef tallow. When describing the early settlement era, Jarchow writes, "Every home had its tallow dip or was supplied with the candle mold." Primitive oil lamps, which "emitted some smoke, much odor and a little light" were also used. They were made by melting lard, goose grease, or venison fat, and placing the oil in a dish or hollowed out turnip or beet along with a rag wick (Jarchow 1949: 84).

Kerosene Lights. In 1859 kerosene lamps were introduced. "We had our first kerosene lamp in [18]61," a Minnesota farm woman recalled. "We were terrible frightened of it. It did smell terrible but this did not keep us from being very proud of it" (quoted in Jarchow 1949: 84). Kerosene lamps were an improvement over candles and oil lamps. Well-cared-for lamps were quite reliable, if sooty and bad smelling. Some oil lamps were equipped with a mantle – a sheath of fine-mesh filaments that gave off brilliant illumination when heated by a flame. These lamps produced good light at a low cost; however, the mantles were fragile, and when they broke, the flame could flare up dangerously. Outside and in the barn, lanterns (i.e., light sources in protective glass enclosures) were used. At first candles were used in the lanterns but later lanterns had kerosene reservoirs and wicks (Musselman 1912: 131; Mowry 1915: 2; Jarchow 1949: 84).

Gasoline Lights. Gasoline-powered stoves, refrigerators, washing machines, and irons saved labor, and hollow-wire, gravity-fed gasoline lamps gave a brilliant white light, superior to kerosene. One commentator remarked in 1912 that the light was actually too bright – more appropriate for "a department store than a cozy home" (Musselman 1912: 132). Gasoline for the small appliances was stored in tanks outside the home or farm building. However, the burners on gasoline appliances were often troublesome, prompting the caution "considerable danger attends the handling of gasoline in small quantities. The great danger from gasoline is the liability to explosions due to exposure to open flames" (Musselman 1912: 132). For that reason, the use of gasoline-powered lights and appliances was never widespread among farmers (Musselman 1912: 132; Wolfe 2000: 517, 527).

Oil-gas Lights. Oil-gas, also called air-gas and coal-gas, was a fuel for lighting and heating made by distilling oil or coal. Oil-gas systems delivered a mixture of pressurized vapor and air to mantle light fixtures. The most common air-gas was gasoline vapor, which gave good light. However gasoline air-gas was not widely used in homes because the gasoline had to be piped under pressure through the walls and floors of the building and "is, therefore, not in high standing with the insurance companies," according to one source. Safer denatured alcohol could also be used in air-gas systems but was very expensive (Mowry 1915: 2).

Blau-gas, made from distilled mineral oil, was much less explosive than gasoline, and gave good light and heat. It was stored in liquid form in 20-pound pressurized bottles. A Blau-gas home plant consisted of a steel cabinet with room for two bottles of gas and a reducing valve. The gas was delivered to the light fixtures through standard gas pipe (Mowry 1915: 2-3).

Acetylene or Carbide Gas Lights. Acetylene (also called carbide gas) was a colorless gas that could be made on the farm using an acetylene generator. It was piped through standard gas pipes to buildings where it fueled household lighting, cooking stoves, water heaters, and irons. Acetylene generators, located either in farmhouse basements or in outdoor pits, produced the gas by introducing granular calcium carbide into a chamber holding water. A by-product, slaked lime, was deposited in the chamber and was used by farmers for whitewash or for a soil additive or a disinfectant. While an acetylene system was not expensive, the gas had a very pungent odor and was highly flammable (Musselman 1912: 132-135; Woolworth 1928: 217-218; Mowry 1915: 3-5).

An estimated 200,000 farms in the U.S. had installed acetylene systems by 1912 (Kline 2000: 98). In the 1920s an article in *Agricultural Engineering* indicated that safety improvements in carbide gas technology and appliances made acetylene "worthy of serious consideration in connection with the lighting of practically all buildings and premises which are located out of range of low-priced and satisfactory service from central electric and city gas plants" (Woolworth 1928: 217-218).

Farm lighting was expensive, and lighting improvements were a major capital investment. In Michigan in 1912, for example, the value of the average farm was $5,261, including land and buildings. Implements and machinery represented about five percent of the farm value, roughly $270. Installing an acetylene gas lighting plant cost as much as all the rest of the farm machinery, and a farmstead electric plant cost twice as much. "For investment, then, a lighting plant on the average Michigan farm would scarcely be considered profitable," wrote one university farm educator in 1912. "On the other hand, the aesthetic value of light cannot be measured in dollars and cents, and it is perhaps this factor that will decide the purchase of a plant" (Musselman 1912: 131).

THE FIRST FARM-GENERATED ELECTRICITY

Before the mid-1930s, when national rural electrification began, some farmers generated their own electricity right at home. Historian Ronald R. Kline explains, "Prosperous farmers [in the early 20th century] bought dynamos and yoked them to turbines powered by water flowing over homemade dams, to windmills that normally pumped water for the livestock, and to gasoline engines. . . . Manufacturers soon capitalized on this inventiveness and started selling complete home-plant sets" (Kline 2000: 102). Home generators offered lights and some of the comforts and labor-saving conveniences of high-line electricity for less money. But home generators tended to be unreliable, and they could not be used to run machinery 24 hours a day. And home electric plants rarely powered major home appliances because their capacity was too low, and because electrically-powered barn equipment generally took priority (Wolfe 2000: 517; Jellison 1993: 99).

The most popular farmstead electric power plant was the gasoline engine and generator combined with a set of storage batteries (Musselman 1912: 136; Mowry 1915: 4-5; Keilholtz 1921: 109; Kline 2000: 99-104; Wolfe 2000: 522).

The purchase price for on-farm electric generating equipment ranged from $300 to $800 in 1921 and the operating costs were about twice as much as acetylene gas lighting systems, according to a 1921 University of Minnesota estimate. By another measure, a 1926 USDA report estimated that the cost of providing one horsepower of electricity for one hour from an individual farm electric plant was 25 cents. By comparison, an equal amount of windmill power cost five cents, and belt power from a gasoline tractor cost six cents (Stewart "Electricity" 1921: 112; Kline 2000: 104; Schaenzer 1957: 444).

About 200,000 home electric plants had been sold by 1919, and by 1929 some 600,000 had been purchased. In 1923 the number of home plants probably outnumbered the estimated 180,000 farms receiving high-line electricity. In 1930 the Census Bureau estimated that 250,000 home power generation plants were then in use, supplying about four percent of American farms (Schaenzer 1957: 447; Kline 2000: 105).

Several surveys in the 1920s and 1930s showed that farm families used home power plants primarily for household tasks such as lighting, ironing, and running the washing machine and cream separator. The plants could also power small electric motors for running a grinding stone, corn sheller, fanning mill, root chopper, meat grinder, or other one-man power machines. Home generators were not recommended for pumping well-water. Rather, the Minnesota farm specialists advised farmers to buy a small gas engine just for pumping water for the stock, thus preserving the life of the larger and more expensive home electric plant (Stewart "Electricity" 1921: 116; Kline 2000: 104).

After 1935, as service from central power stations grew, the number of farm electrical plants began to decline. By 1954 the USDA estimated that there were about 28,000 home power plants in use on American farms (Schaenzer 1957: 445, 447).

USING THE AUTOMOBILE

Farmers also used the gasoline engines of their automobiles to provide electricity and general-purpose stationary power, just as later they would use belt power from their gasoline tractors. Most Minnesota farmers owned an automobile long before they had either a tractor or high-line electricity (Kline 2000: 77; Jellison 1993: 54-55).

Though car manufacturers at first discouraged the practice, farmers quickly learned that the automobile could be belted up to a variety of farm machines. Farmers would jack or block up the rear axle and run a belt over one wheel of the car and around the wheel of any barn or home machine the car engine was capable of running. These included corn shellers, ensilage cutters, washing machines, and cream separators. Car engines even powered electric generators "so the up-to-date farmer could read by electricity," according to Kline (Kline 2000: 67, 74).

Responding to farmers' ingenuity, auto and farm equipment manufacturers sold accessories to facilitate farm use of automobile power. Beginning about 1917 several companies, including a St. Paul firm, sold kits that took power directly off the crankshaft in the front of a car without jacking up the wheels. Before long the Ford Motor Company began to encourage this practice, publicizing stories about how farmers were harnessing their cars to help with the chores (Kline 2000: 72-75).

WATER-GENERATED ELECTRICITY

Farms that had a flowing stream, spring, or artesian well could use water power to generate electricity for lights, pumping water, milking, or small household appliances. "The tiny unconsidered brook that waters the farm pasture frequently possesses power enough to supply the farmstead with clean, cool, safe light in place of the dangerous, inconvenient oil lamp," wrote F. I. Anderson in his 1919 book, *Electricity for the Farm*, which explained inexpensive methods of generating light, heat, and power. "A small stream capable of developing from 25 to 50 hp will supply a farmer (at practically no expense beyond the original cost of installation) not only with light but with power for even the heavier farm operations such as threshing; and in addition will do the washing, ironing and cooking, and at the same time keep the house warm in the coldest weather" (Anderson quoted in Schaenzer 1957: 447).

A 1921 Minnesota Farmers' Institutes publication showed examples of Minnesota farms that were operating motors of up to three horsepower from water power, and explained how to assess the feasibility of using the farm's water resources to produce electricity (Stewart "Water" 1921: 122-124).

WIND-GENERATED ELECTRICITY

On Minnesota farms, wind power was used almost exclusively to pump well water. About 1910, however, "some electrically minded farm boys started experimenting with windmill wheels belted up to discarded light plant generators," as one agriculture engineer wrote (Hawthorn 1938: 7). By 1920 farmers lacking access to high-line service were using wind power plants to generate electricity for the household (Stewart "Water" 1921: 125).

A 1921 *Minnesota Farmers' Institutes* article described wind-powered electric plants operating on farms in Minnesota, North Dakota, and Wisconsin. It reported that the Aerolectric wind plant, available in 1922, consisted of a 14' steel wheel and generator, mounted on a 50' tower. Another successful wind electric plant was the heavy-duty Wyndmere. The windmill and generator were combined with a large storage battery, which had a capacity to store the farm's electricity requirements for up to two weeks. "There isn't any part of this state where the windmill will not run some during every week of the year," the author wrote, adding that "the future possibilities of wind driven electric plants appear to be good" (Stewart "Water" 1921: 125-126). Some farmers even built their own wind power electric plants, consulting technical guidebooks on the subject (Kline 2000: 103).

In a 1936 article an Iowa farmer described his wind power plant, which included a 1500-watt generator, powered by a 14' three-blade wind propeller. Energy was stored in 12-kilowatt lead batteries. The maximum output of the plant was 1500 watts from the batteries alone and 3000 watts when the wind was blowing more than 18 miles per hour. This farmer's wind power plant generated between 105 and 300 kilowatt hours per month, providing an uninterrupted supply of electricity for 44 lamps in the barns and house, a washing machine, iron, vacuum, fan, heating pad, corn popper, toaster, hot plate, two 1/2-hp motors, a radio, a 5' refrigerator, and an electric poultry brooder. The annual operating cost of the 1500-watt wind plant, including depreciation and interest, was about $66, or 5.5 cents per kwh (Hawthorn 1938: 7-8).

A 32-volt wind generator was standard for farm lighting plants, although 110-volt wind generators were also available for locations where current had to be carried long distances. In 1936 the smallest 32-volt farm wind plant was a 650-watt generator that sold for about $250, including the mast and batteries. A plant this size could supply a typical farm's lighting needs, as well as some additional light-duty service, such as the washing machine and radio (Hawthorn 1938: 7, 8).

Radio Windchargers. Thousands of small, six-volt windchargers mounted on roofs were used to run farm radios before rural electrification. These units cost between $5 and $15 when purchased with the radio. One popular model was the Zenith windcharger which stood about 7' tall on a tripod mount. In the Midwest a battery-operated radio was often the first piece of modern equipment in farm homes, and even impoverished families frequently had a radio. In Minnesota in 1930, for example, 39 percent of farm families owned a radio while only 12 percent had electricity or running water (Hawthorn 1938: 8; Kline 2000: 116; Jellison 1993: 55, 61, 93-95).

THE BEGINNINGS OF RURAL ELECTRIFICATION

The first central electric power station was built by Thomas A. Edison in New York City. It opened in September, 1882, and furnished direct current to 59 customers. By 1900 the steam turbine, the transformer, and alternating-current transmission had become practical. Just 20 years later, large, efficient, steam-powered generating stations were supplying 24-hour electricity to almost every city and town in the nation over a vast network of transmission lines (Schaenzer 1957: 442; Golding and Neff 1956: 305).

As urban America passed into the electrical age, the nation's farms remained dark. In 1930, 85 percent of nonfarm households in America had electricity compared to just 10 percent of farms. It was not that farm families didn't desire electricity – on the contrary. Historian Katherine Jellison has written, "During the early decades of the twentieth century, the very nature of farm women's work convinced most of them that mechanization was a good thing. In their kitchens, farm women washed the dirty field clothes worn by family members and hired help. They canned fruits and vegetables, preserved meat, baked bread, separated milk, and churned butter – all work that farm women largely performed without the use of electric- or gas-powered mechanical equipment" (Jellison 1993: xx [Introduction]).

In most of the nation, farm electrification was hindered by the high cost of distributing electricity to scattered farmsteads in thinly-populated rural areas. Private electric companies did not believe they could make money in rural areas, claiming that running poles and high wires to isolated farmsteads was a losing business proposition. In fact the utility industry asserted that revenues from farm customers would not even pay the interest on the capital investment needed to extend high-lines into the countryside. As one Minnesota agricultural engineer wrote in 1923, rural service "has proven to be a liability more often than an asset to the utility companies" (Stewart 1923: 171; Kline 2000: 100).

If farmers wanted to buy electricity, they could generally get service from utility companies only if they paid to build high-lines out to their farms. But few farmers could afford the costs. Aside from the high initial investment, even the monthly charge for electricity was beyond the reach of many farmers. "High rates thus created a Catch-22 situation by keeping usage (and revenue) low" wrote historian Ronald Kline (Kline 2000: 100; Childs 1952: 42).

In scattered locations in the Midwest, farmers did get together and build line extensions for themselves but this phenomenon was rare (Childs 1952: 39; Stewart 1923: 172). In 1914, for example, a group of farmers from Stony Run Township in Yellow Medicine County organized a company to distribute power from the Granite Falls municipal plant to 26 farms. In 1926, another group in Dawson built its own power lines and purchased electricity from Otter Tail Power Company in Fergus Falls. In the decade after World War I, some three dozen rural electric distribution cooperatives were formed in the U.S. – eight in Minnesota and Wisconsin. These co-ops were generally quite small – most managed less than 15 miles of high wire – and all were located near a source of public power (Kline 2000: 101).

A related barrier to rural electrification was hard economic times on the farm. Farm income plummeted in the early 1920s beginning a 20-year agricultural depression. It was no surprise, therefore, "that less than three percent of the nation's six million farms were connected to the high-line in the early 1920s" (Kline 2000: 100).

ELECTRICITY AND THE COUNTRY LIFE MOVEMENT

In the early 20th century, progressive reformers such as those involved in the Country Life Movement – the rural arm of American Progressivism – argued that the farmer "has just as much a legitimate right to have electricity to make his home a happier, more healthy, more modern place in which to live as does the city man" (Stewart 1923: 171).

These reformers wanted to make agriculture more efficient by encouraging farmers to mechanize. They also sought to "elevate" rural society by improving churches, schools, health care facilities, culture, voluntary organizations, and family life. They saw electricity as a progressive social force that could help accomplish these goals, thereby lifting farmers' standard of living, and halting the worrisome migration to the cities (Jellison 1993: 2-4; Kline 2000: 147).

Reformers concerned with improving the quality of rural life were especially focused on the burdens of the overworked farm wife (Jellison 1993: 1-32; Kline 2000: 88-112). In many cases, wells and other infrastructure and labor-saving devices were located near the barn – not the farmhouse – so that the burden of carrying water and similar chores was heavy as well as continual. A 1919 survey of farm women revealed that 13-hour work days were common for farm women while, according to Jellison, "more young women than men were drifting away from the farm" (Jellison 1993: 34). Jellison found that a 1930 farm magazine advertisement for modern stoves asked: "Why do farm girls leave the farm? Is it because these farm children know the conveniences that city women enjoy, and move to towns and cities to escape the slavery of old-fashioned kitchens?" (Jellison 1993: 45).

Arguing that the success of country life "depends in very large degree on the woman's part," the Country Life Commission recommended in 1909 that "the mechanization of women's housework keep pace with that of men's field work" (Jellison 1993: 3). "Better and more permanent agriculture requires that the farm home be equipped with modern conveniences and labor-saving appliances quite as much as that there be improved equipment in the barn, better livestock, and more thorough cultivation of the soil" said an agriculture official in 1919 (Jellison 1993: 36-37).

COMMITTEE ON THE RELATION OF ELECTRICITY TO AGRICULTURE (CREA)

In 1921 the National Electric Light Association (NELA), a group of private utility companies, organized a rural electric service committee to study what was needed to electrify rural areas. The Association "soon discovered that rural electrification entailed more than building lines along the highways; a new line of farm machinery had to be developed, and methods of farming had to change if electric service were to fulfill its function in agriculture" (Golding and Neff 1956: 305).

To help solve these problems, NELA set up a national committee, which included representatives of the private power industry, farm groups, federal agencies, agricultural engineers, and equipment manufacturers. The Committee on the Relation of Electricity to Agriculture, or CREA, was organized in 1923 and disbanded in 1939 after the federal government took the lead in rural electrification.

The electric power industry, through the national CREA, recognized that "electrical service on the farm offers great possibilities for improving living conditions, lightening the work of the household, and reducing the cost of production, but before these can be realized there are many economic and engineering problems to be solved" ("Committee" 1923: 166). CREA promoted and funded research by agricultural colleges and equipment manufacturers. It also published and distributed many publications explaining the latest developments in farm applications for electricity, including an important reference book, *Electricity on the Farm and in Rural Communities* (Golding and Neff 1956: 305; Schaenzer 1957: 446).

CREA also organized similar statewide committees in 24 states to develop new and profitable ways to use electric power in local farming operations. The first state committee was organized in Minnesota in September of 1923. The chair was James F. Reed, President of the Minnesota Farm Bureau Federation. Other members were W. C. Coffey, Dean of the University's Department of Agriculture; Herman Schmechel, state senator and farmer; Isaac Emerson, state representative and farmer; A. C. Bryan, farmer; C. S. Kennedy, representing Otter Tail Power Company; Charles F. Stuart, representing Northern States Power Company; and E. A. Stewart, engineering faculty of the University's Division of Agricultural Engineering. Stewart served as committee secretary. Prior to its formation, the University's Division of Agricultural Engineering had begun a study of rural electric service and rates. The state committee was organized in part to support the University's study and analyze its findings ("Rural Electrification Number" 1925: 245; Golding and Neff 1956: 305; Schaenzer 1957: 444-446; Wolfe 2000: 518; Roe 1942).

Because the national CREA organized and funded much of the research on electrification and its implications at the state agricultural colleges, strong ties formed between the private power industry and the land-grant universities. As a result, the state extension services later resisted the public approach of the federal Rural Electrification Administration (REA), maintaining that private utilities, not the federal government, should develop rural electricity. Ronald Kline explains, "At the local level, many county agents opposed the REA" (Kline 2000: 155-157). However, critics of the private power industry pointed to the utilities' reluctance to extend power lines into the countryside – by 1930, just 13 percent of U.S. farms had high-line electricity. Critics complained that the CREA was merely "a smoke screen to make it look like the electrical industry was addressing the farm problem," and that it was an organization "set up to fool the farmers and their leaders and the county agents and the extension people in the land grant colleges," says Kline (Kline 2000: 136, 287).

MINNESOTA'S RED WING PROJECT

In 1924 the Minnesota CREA began a five-year demonstration project to show how electricity could improve farm life. Eight farms located about three miles west of Red Wing were fully electrified. CREA, the University of Minnesota, Northern States Power Company, and 79 electrical equipment manufacturers paid for a six-mile high-line in Goodhue County. It was "the first experimental rural electric line in the world," according to University of Minnesota researchers (Stewart et al 1928: 1-2). Participating farmers paid for wiring their houses and farm buildings and installing water and sanitation systems. Iowa journalist Marquis Childs explained in 1952 that the Red Wing project farmhouses were equipped with "practically every electric appliance then existing. Electricity was installed in the farmers' barns, chicken houses, and milk sheds. Electric motors were installed for dehydrating hay. An electric motor saw for cutting wood . . . . An electric pump brought running water into the houses" (Childs 1952: 40). Each electric tool was separately metered and farmers kept detailed operating records.

Childs explained, "As the experiment progressed, electric bills rose sharply. But at the same time the individual farmer found his operating costs decreasing. Electricity was saving months of labor each year" (Childs 1952: 40). Just three farm tasks – pumping and carrying water, turning the cream separator, and cleaning the kerosene lamps – each required about 30 eight-hour days a year, according to the Red Wing project report (Stewart et al 1928: 27). Electricity freed farm families from these labor-intensive jobs so they were able to use their energy profitably for other work, thereby increasing the farm's revenues and profits (Childs 1952: 40; Stewart et al 1928: 25, 27).

The productivity gains on the Red Wing test farms were dramatic. Electricity boosted "gross and net revenues even after paying electric energy bills and overhead charges on this large amount of equipment," according to a 1928 source (Stewart et al 1928: 26). Net profits rose 46 percent in 1925, 47 percent in 1926, and 80 percent in 1927, according to the project report. Average net income per farm grew from $936 in 1924 to $1,679 in 1927. Even after adjusting for higher market prices in 1927, dairy revenues on the electrified farms jumped about 85 percent over four years, and poultry revenues about 76 percent. On one farm, baby pig losses from the cold were cut from 40 percent to zero with the use of an electric glow heater, with rates and conditions profitable to the power company ("Four Years" 1928: 348; Stewart et al 1928: 24-26, 128; Childs 1952: 39-40; Schaenzer 1957: 446).

Beyond the financial benefits "it was abundantly clear that life on the experimental farms was happier and healthier. The whole level of farm living had been raised by abolishing some of the back-breaking tasks of farm life," according to Childs (Childs 1952: 40).

In part inspired by the Red Wing project, the private utility industry, farm groups, and later, the Rural Electrification Administration, sponsored similar farm demonstrations that enabled farmers to see electricity at work in the barn and house through such chores such as milking, cream separation, threshing, and grinding feed. For example, in 1928, an Illinois electric company built an 80-acre working model farm with livestock, near Chicago to demonstrate the utility of electric and gas appliances (Boonstra 1929: 94; Schaenzer 1957: 447; Wolfe 2000: 518).

THE RURAL ELECTRIFICATION ADMINISTRATION (REA)

In 1935 the federal government organized the Rural Electrification Administration, or REA, as part of President Franklin D. Roosevelt's New Deal. The program was designed to provide low-cost electricity to some six million farms, put unemployed people back to work, and pump money into the economy through low-interest loans to cooperatives and nonprofit groups. The REA was the major force in rural electrification. When REA formed, about 800,000 American farms had high-line electricity – or slightly more than one in ten farms. By 1954 more than 97 percent of occupied farmsteads – nearly five million farms – had electricity. During the two decades it took to fully electrify America's farms, the REA loaned nearly $2 billion for rural electrification (Brinkman 2002: 9; Schaenzer 1957: 449; Golding and Neff 1956: 305).

REA had a ten-year mandate, later extended, to electrify the nation's farms by loaning federal funds at low interest rates – usually three percent for 25 years – to power distributors. Most REA loans were made to nonprofit cooperatives, which then built the transmission lines and bought electricity through wholesale contracts with power generating companies (Meier 1937: 199; Golding and Neff 1956: 305; Schaenzer 1957: 448; Jellison 1993: 99; Wolfe 2000: 528; Brinkman 2002: 4).

In order to establish REA electricity in an area, farm neighbors had to guarantee that an average of three families per mile would hook up to the REA lines. Construction of a mile of REA line cost about $1,000 – half as much as the cost of private power company high-lines (Jellison 1993: 99). Through the REA cooperative, farm families could take out loans to pay for their share of the construction costs. Individual families could also obtain REA loans for wiring their houses and farm buildings and for purchasing appliances and equipment. The REA estimated that the combined cost of REA power-line construction, wiring, and appliances averaged about $600 per farm. At three percent interest, a farm family could pay off its debt to the cooperative over 25 years by paying about $3.50 a month (Meier 1937: 199; Golding and Neff 1956: 305; Schaenzer 1957: 448; Jellison 1993: 99; Wolfe 2000: 528; Brinkman 2002: 4).

The REA promoted the formation of rural electric cooperatives and oversaw their organization, as well as the design, construction, and operation of the cooperatives' power lines. According to historian Ronald Kline, "Field representatives explained the program to local leaders, encouraged them to form a board of directors, helped them select an attorney and project superintendent, and told them how to conduct membership drives, make project maps, submit loan applications, and write bylaws that satisfied state laws. The engineers at the REA helped select project engineers and contractors, approved the design of the system, and monitored its construction. . . . The REA taught co-op personnel standardized accounting and management techniques . . . and monitored accounts, operational reports, and minutes of meetings of boards of directors" (Kline 2000: 154).

Along with all this assistance came close – and often unwelcome – federal supervision of local co-ops. Rural electric cooperatives did not gain much autonomy until after World War II, when REA expanded rapidly and the loans were paid down (Kline 2000: 150, 153-154).

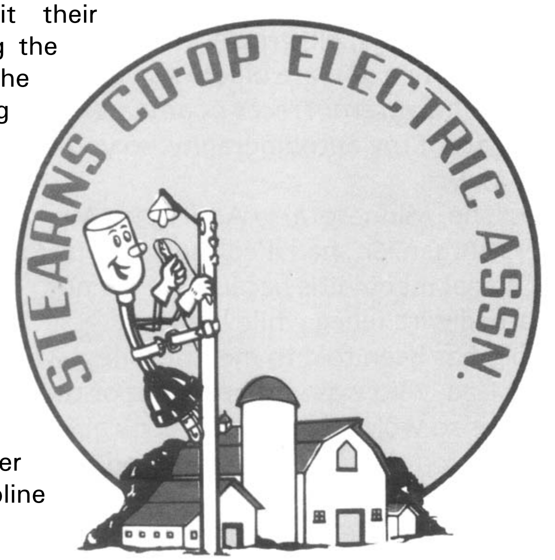
After the power lines were built, REA agents worked with the cooperatives to enroll more farms and persuade members to use more electricity by buying more appliances and electrical farm equipment. It was essential to "build up a high average use," said the REA's first director, "because . . . co-ops would not be able to pay off their loans in time if farmers purchased only lights, irons, and radios, which they tended to do" (quoted in Kline 2000: 150). In addition to lights and small domestic appliances, the REA wanted every farm family to use at least one of three major current-consuming household appliances – a refrigerator, a range, or an electric water heater – or a piece of electric farm equipment, such as milk cooler, feed grinder, or utility motor (Kline 2000: 150-154).

COST AS A BARRIER

Farm families wanted electricity, yet when REA agents tried to recruit members for a new local co-op, many farm people were cautious. Usually, "the forbidding factor" was cost, according to Jellison (Jellison 1993: 111-112; Kline 2000: 160).

Some farmers worried that they might forfeit their membership fees if the cooperative failed. During the Depression, many farm families could not afford the minimum monthly electric bill or the costs of wiring and appliances. Owners worried that they might lose their farms if they borrowed money to electrify and then could not make the payments. Landlords were usually unwilling to electrify their tenant farms. And in the wheat-growing plains areas, including western Minnesota, wide-spaced farms made it hard to obtain the required three customers per mile (Jellison 1993: 102-111, 151; Kline 2000: 161-164).

For many farmers new field machinery was a higher priority than electrification. The cost of a gasoline tractor, for example, was about the same as the cost to subscribe to REA power. Even in the prosperous post World War II period, low-income farmers often had other priorities. An Iowa woman, for example, wrote in 1946: "We are supposed to get electricity thru this section . . . but I am not one bit enthusiastic about it. I need a better chicken house and a fence" (quoted in Jellison 1993: 151-152).



"Willie Wirehand" was created in 1950 by the National Rural Electric Cooperative Association and displayed by rural electric cooperative members throughout Minnesota. From Brinkman's "Lanterns to Lightbulbs" (2002).

After the power lines were built, it was common for farmers to renege on their pledge to connect to the lines. According to Kline, "The practice was widespread early in the program." The Steele-Waseca Electric Cooperative in southern Minnesota sent out an urgent plea in October, 1939, asking its members to persuade their neighbors to sign up for electricity. The statement reminded, "You were told over and over again that the low rates . . . are only possible with three users to a mile and an average of 100 kilowatts being used each month per member." This co-op had connected fewer than two farms per mile and its members averaged only 64 kilowatt-hours per month (Kline 2000: 161-164).

MARKETING ELECTRICITY

Across the country from the late 1920s through the 1940s, "a great educational campaign was carried out to show the farmer how he could put electricity to work," according to Childs (Childs 1952: 41). Extension agents, home economists, agricultural engineers, private power companies, rural cooperatives, equipment manufacturers, and government agencies all helped educate farmers about the benefits of electricity and worked to overcome the economic barriers to rural electrification ("Committee" 1923: 166-167; Stewart 1923: 171; Schaenzer 1957: 442; Wolfe 2000: 518).

Government bulletins and farm magazines explained how to select, operate, maintain, and repair all kinds of electric appliances, and even how to wire the home. Farm scientists taught farmers how to change their farming practices to make successful use of their new electric tools. For example, electrically-heated soil beds, used in market garden hothouses, required different watering practices and seeding times than traditional manure-heated soil beds. Likewise, electric chick brooders required different ventilation methods than gas incubators. The same was true of the use of electric fencing and many other electric tools (Wolfe 2000: 524). Without training on the sound application of electricity to farm practices, wrote an agricultural engineer in 1937, "the end result of [the farmer's] efforts will be unsatisfactory, consequently he is likely to be soured on the whole process [of electrification]" (Meier 1937: 200).

One of the most popular educational programs was the REA Farm Tour, an entertaining farm equipment show on wheels that exhibited farm and home applications for electricity. The show, which traveled from 1938 to 1942, was part of the REA's aggressive marketing campaign to persuade farmers to buy and use more electricity. The Farm Tour also tried to "convince appliance manufacturers and dealers that farmers were potential customers," according to historian Ronald Kline (Kline 2000: 190). In a carnival atmosphere of tents and trailers, the traveling show – informally known as the REA Circus – demonstrated all types of farm and home electric appliances. The electric chicken plucker was a real crowd pleaser. The popular caravan made 260 stops in 27 states and played to an audience of 1.3 million people (Kline 2000: 181, 190; Schaenzer 1957: 448).

FARMERS ADOPT ELECTRICITY

Rural electrification under REA started slowly but picked up speed as the Depression ended. At the end of 1936, REA's first full year, 29 borrowers had constructed 3,000 miles of "high-line" wires in nine states serving 7,500 consumers. By the start of World War II, one-third of American farms – and 40 percent of Midwestern farms – had electricity. Power line construction slowed again during the war, but surged in the long period of agricultural prosperity that followed. Stearns County historian Marilyn Brinkman explains that many servicemen returning to their farms after the war "asked for electric service . . . at once. They had become used to electricity while in the armed services and did not want to return to darkness in their homes – or depend on power from horses" (Brinkman 2002). Congress expanded REA services in 1944 and liberalized REA loan policies, making it easier for low-income farmers to qualify (Kline 2000: 287; Jellison 1993: 150).

In 1949 REA was authorized to make loans for telephone improvements, which were lagging behind electrification. In Minnesota, for example, more farms had electricity in 1950 than had phone service: 84 percent with electricity compared to 60 percent with phone service. The gap continued to 1960 when 80 percent of Minnesota farms had telephones, while more than 90 percent had electricity (Jellison 1993: 154, 169).

The peak year for power line construction nationwide was 1949 when 194,000 miles of line were built and more than 500,000 consumers connected. By 1956 the electrification of rural America was nearly complete; 1,026 REA borrowers – mostly cooperatives – were operating 1.4 million miles of power lines serving 4.3 million rural consumers. Kline explains, "By 1960, the REA, Congress, manufacturers, and farm people had reached most of their goals in rural electrification. . . . Their combined efforts electrified nine out of ten farmhouses . . . " (Kline 2000: 270-271). The REA was abolished in 1994 and its functions were assumed by the Rural Utilities Service (Schaenzer 1957: 448-449; Kline 2000: 215).

In Minnesota electricity was little used on farms before 1917, although "an occasional farm had electricity as early as 1909," according to the Minnesota Agricultural Experiment Station (Cavert 1930: 8, 67). In 1920 just 7.6 percent of Minnesota farm homes had electricity. That number crept up to 12.6 percent in 1930, and 17 percent in 1940 – significantly behind the national average (Jellison 1993: 55, 103, 154, 169). The first REA electric pole in Minnesota was erected near Litchfield in 1935 (Wayne 1977: 24).

After 1940 the pace of rural electrification in Minnesota picked up rapidly. By 1945 half of Minnesota farms had electricity, by 1950, 84 percent. In 1960 more than 95 percent of Minnesota farms had electric power (Jellison 1993: 55, 103, 154, 169).

Larger and more prosperous farms in Minnesota were the first to adopt electricity – a pattern that was repeated throughout the country where prosperous farm people first modernized their homes in the 1920s and 1930s. In a 1936 USDA survey, for example, 19 percent of low-income farm families nationwide had electricity, compared to 44 percent of high income farm families (Kline 2000: 96, 288). A 1929 University of Minnesota survey polled 541 "of the more intelligent and prosperous farmers" in Minnesota; their farms were 56 percent larger than the average Minnesota farm. The survey found that 39 percent of these prosperous farms used electricity, either from power lines or private farmstead plants. By comparison, University faculty estimated that about five percent of all Minnesota farms had electricity in 1929. The larger the farm, the more likely it was to have electricity (Cavert 1930: 11, 70).

ELECTRIC LIGHTS

The most important and first use of electricity on the farm was for lights. Kerosene and oil lights were labor intensive, dirty, and dangerous. Electric lights – clean, reliable, and safe – were one of the biggest benefits of farm electrification. By lighting the house and barn, farmers could work faster and more safely after dark, children could study at night, and families could read and socialize in the evenings. In addition, church services and rural meetings could be held after dark (Stewart "Electricity" 1921: 112; Golding and Neff 1956: 305; Brinkman 2002: 6).

The house was usually the first farmstead building to be electrified. Yards and dairy facilities were usually the next areas to get electric lights. A 1927 survey of CREA demonstration projects, for example, found that the dairy barn and milk house were the most frequently lighted farm buildings (Brown and Boonstra 1927: 213). This made sense because much of the work done in dairy barns and milkhouses took place before and after daylight hours (Golding and Neff 1956: 305; White 1936: 17; Wolfe 2000: 520-523). A 1927 survey of CREA demonstration projects found that more than 80 percent of demonstration farms had yard lights, suggesting that "the farmer is apparently well sold on the desirability of yard lighting" (Brown and Boonstra 1927: 213).

Farmers were slower to light the poultry house, perhaps because it was generally within the sphere of the farm wife, even though electric lights could significantly increase winter egg production and profits. Among CREA demonstration farms raising poultry, fewer than a third had lights in their hen houses in 1927. "This [is] a subject worthy of considerable missionary work on the part of agricultural engineers," researchers concluded (Brown and Boonstra 1927: 213).

At first, farm homes and buildings were often minimally lighted. The 1927 CREA demonstration project survey, for example, found that the average wattage per barn was about one-third the amount recommended for good practice. The same was true in the lighting of project homes, the survey found (Brown and Boonstra 1927: 214).

HOUSEHOLD ELECTRICITY

It was the household uses for electricity that appealed most to farm families. Power companies and appliance makers recognized this and aimed their sales pitches primarily at farm wives. The typical farm family first installed lights, then bought an electric iron, a radio, and a washing machine (Wolfe 2000: 520-523; Kline 2000).

Laundry, which the farm wife did both for her family and for the hired workers, was the heaviest household chore. Agricultural engineer Stewart advised in 1921, "The power washing machine will save about one-half the time and most of the hard labor required to do the washing. . . . There are very few machines on a farm that will save as much time for the same cost as a washing machine" (Stewart "Electricity" 1921: 112).

By 1941 about 90 percent of REA-serviced farms nationwide had an electric iron and a radio, in addition to lights, and about half had a washing machine. Minnesota REA cooperatives reported that 93 percent of their members had electric washing machines in 1941 – the highest percentage in the country; but only 20 percent of electrified farms in Minnesota had refrigerators in 1941– the second-lowest rate in the country. Midwest REA farms also led the nation in ownership of electric water pumps and cream separators, perhaps reflecting the concentration of dairy operations in the region (Kline 2000: 199; Jellison 1993: 102).

Before the end of World War II few farmers had purchased a full complement of household electrical appliances or installed running water and a modern bathroom. Only 12 percent of Minnesota farms had running water in 1930, partly because of inadequate water and sewage systems. Even as late as 1960 only eight out of ten Minnesota farmhouses had running water and indoor toilets. Electric stoves, which were expensive to buy and to operate, were also rare (Jellison 1993: 55, 169; Kline 2000: 196, 293).

After World War II, Midwest farm families reported that they intended to use increased incomes to pay off debts and buy more electrical services. However, even in this prosperous postwar period from 1945 to 1964, the REA was "impelled . . . to continue its prewar efforts to convince farmers to use more electricity once they were hooked up. . . . Electrical modernization still had to be carefully nurtured and vigorously promoted" according to Ronald Kline (Kline 2000: 241). An Iowa REA study in 1944 reported that longtime REA customers were more likely to buy an electric refrigerator after the war than any other appliance. As wartime shortages of consumer goods ended, a 1946 federal study reported that "purchases of electrical appliances are now expected by [middle-class] rural families in about this order: refrigerators, washing machines, irons, radios, deep freezer units, brooders, churns" (Jellison 1993: 145, 150).

ELECTRICITY FOR FARM OPERATION

When it was first adopted, electricity supplied only a tiny portion of Minnesota farmers' total power needs (in 1929 just 1.5 percent). Farmers with high-line service had an average of 2.3 electric motors per farm and did an average of 6.5 farm operations with electric motors. Aside from barn lighting, the most important uses of electricity in crop and livestock operations were for operating barn and farmyard machines, dairying, poultry production, pumping water for livestock, ventilating barns, and drying grain (Cavert 1930: 9, 12).

In 1929, the most frequent farm business use for electricity was separating cream, followed by pumping water, milking cows, fanning grain, and operating grindstones and emery wheels (Cavert 1930: 8-9).

However, farmers were slow to incorporate electric technology in their farming operations. According to Kline, "All data indicate that electrical farm equipment found little favor with the majority of farmers" (Kline 2000: 208). For one thing, many of the more prosperous farmers had already invested in oil-powered chicken brooders or gas-engine-powered pumps, milking machines, and milk coolers, and felt that discarding working equipment would be wasteful and foolish (Kline 2000: 198, 208).

By 1953 most farms were still far from making efficient use of electricity, according to agricultural engineers. Most farms were using only about one-half horsepower of electricity per worker in 1953. One engineer estimated that "six horsepower [of farm power needs] can be supplied better by electricity than by other means. . . . This means that there should be a twelve fold increase in the farm use of electricity for just doing the work that is now done by less efficient power" (Pringle 1953: 330). Adoption of electricity for a broad range of tasks was in part slowed by high prices for electric farm tools such as feed grinders, a lack of equipment standardization, and undeveloped equipment distribution networks (Pringle 1953: 331).

Electricity was critical to the development of dairying and poultry operations in Minnesota. Dairy farmers were among the first to use electricity in their farm operations. In the dairy barn, electricity was "largely responsible for the rapid development of the milking machine," according to one source (Golding and Neff 1956: 305). In addition to lighting and milking machines, electricity was widely used for cooling milk, heating water, sterilizing dairy equipment and utensils, and to keep the milk house above freezing (Golding and Neff 1956: 305).

Electricity transformed poultry production and led to large-scale, automated production in the 1960s. One effect of this change was to displace Midwest farm women from one of their traditional jobs, according to Katherine Jellison (Jellison 1993: 156-157). In the 1930s farmers began using electric lights in the poultry house to increase egg production by artificially lengthening the day during autumn and winter. Farmers also used electricity to warm drinking water, heat incubators and brooders, and improve ventilation with fans (Golding and Neff 1956: 306).

In other areas of animal husbandry, farmers used electricity to warm animal food and to provide artificial heat for rearing spring pigs in cold climates. Electric fences, introduced just before World War II, were widely adopted, especially for rotational grazing. Other livestock applications for electricity included sheep shearing and horse mane clipping (Golding and Neff 1956: 306).

In crop production, electric machines shelled corn, cleaned and elevated grain, ground and mixed feed, cut and loaded silage, and sorted, washed, and graded produce. When combines came into use, it became necessary to dry crops after harvesting them, rather than letting them dry in the field. Electric grain dryers and bin ventilators allowed farmers to preserve quality and store grains for longer periods, expanding opportunities for marketing. Electric ventilation also allowed longer storage of other crops including potatoes, onions, and apples. Electric insect traps were often used in orchards and truck gardens. In irrigated areas electric water pumps were widely used. There were innumerable other farm uses for electric chore motors, from welding and mixing cement to sawing wood and pumping water (Golding and Neff 1956: 306-307).

In the 1950s rates and rural power company service restrictions discouraged the use of electricity for many large-horsepower farm jobs, according to one writer in *Agricultural Engineering*. The author explained, "A lot of rural power suppliers still will not serve a motor larger than 5 horsepower without so-called 'penalty rates'" (Herriott 1960: 632). For power requirements above 7.5 horsepower, most farmers used the internal combustion engine. Most farm machinery such as the tractor was equipped for power take-off operation because of a lack of adequate electric power (Herriot 1960: 632; Stapleton 1960: 631).

CHANGES IN FARMSTEAD DESIGN AND BUILDINGS

Electrification changed farmstead building design and layout. Wrote University of Minnesota agricultural engineer H. B. White in 1936, there were "more than 250 applications of electricity on the farm" and "With this number to consider it is evident that every structure . . . must be planned differently if they are to be well planned for electrification" (White 1936: 18-19). White suggested, for example, that electrified farm buildings could dispense with some windows, and that fence design would change because electrified fences would need fewer posts than standard fences (White 1936: 18). He predicted in 1936 that "every building on the farm will be redesigned in the next few years, and electrification will undoubtedly have much to do with the new arrangements" (White 1936: 19).

Electricity brought other changes to barn designs. For example, electric fan-ventilated barns had to be well-insulated to retain heat and avoid frozen pipes and drinking cups, and doors needed to be tight-fitting. Barn windows needed to be raised so there was no wall space between the stable ceiling and the tops of the windows to collect frost. Using electric fans to force air through the corn storage bins, instead of leaving them open to the weather, made it possible to incorporate the bins with the rest of the granary (Stewart et al 1928: 51-55, 123).

The implement shed, garage, and farm shop were also "wonderfully improved the moment two or three wires extend into them," according to White (White 1936: 19).

Wiring was a major farm investment. From the beginning of farm electrification, experts advised that putting together a safe and correct farm wiring plan was considered a job for an agricultural engineer or electrical contractor, although many farmers undoubtedly did the job themselves (White 1936: 18; Fox 1940: 64).

SOME SUMMARY EFFECTS OF ELECTRIFICATION ON AGRICULTURE

Electricity revolutionized agriculture, transforming farm and household work. The shift to gasoline and electric power increased farm families' output per hour and the efficiency of their farm businesses. It increased the acreage a farm family could operate; shrank the number of U. S. farms, farmers and hired farm workers; raised the capital and machinery requirements for successful farming; and forced farmers to specialize (Cavert 1930: 14-15; White 1931: 301; Golding and Neff 1956: 305). A 1953 REA survey of farms in Ohio and Indiana, before and after electrification, showed these trends. Within five years of electrification:

- average planted acres per farm increased 27 percent
- irrigated land increased 50 percent
- acres planted to corn increased 176 percent
- beef cattle raised increased 21 percent
- number of milk cows increased 46 percent
- laying hens increased 55 percent and chicks hatched increased 130 percent
- turkeys raised increased 109 percent
- the farm labor force dropped 6 percent (Pringle 1953: 330).

For the farmer, electricity was as good as another hired hand (Brinkman 2002: 6-7). "One kilowatt-hour will do the work of eight men on certain tasks," wrote one agricultural engineer in 1953. "It will mix a ton of feed or lift 500 gallons of water 100 feet" (Pringle 1953: 330).

In the house, electric pumps relieved women of the back-breaking work of hauling and heating water for cleaning, cooking, and laundry. Just pumping and hauling water was estimated to consume 30 days a year (Stewart et al 1928: 27). The advent of running water allowed indoor bathrooms to replace outhouses, smelly chamber pots, and chilly baths in a tub in the kitchen (Brinkman 2002: 6-7). Electric refrigerators and freezers replaced messy, inconvenient ice boxes, icehouses, and springhouses, keeping food fresher and safer. Electric washing machines reduced the back-breaking work of laundry; and electric irons eliminated the drudgery of long days in front of a hot stove, wielding seven-pound flat or sad irons. Electric cream separators and butter churns eliminated hours of daily hand labor (Brinkman 2002: 6-7). During the Progressive era, electricity was often presented as a panacea for farm women's problems, one that would practically eliminate housework, set women free from hard, dirty work, and give them more leisure (Brinkman 2002: 5; Jellison 1993: 103, 184).

Some aspects of farm wives' traditional work did change after electrification. There was a gradual decline in farm women's home food production activities since home freezers and refrigerators made large scale canning of vegetables, fruits, and meat unnecessary. Rising farm incomes allowed women to buy some of the foods, such as bread and butter, that they had traditionally produced themselves (Jellison 1993: 154-156).

But overall, farm women did not spend less time working after electrification. Instead, they simply did more and different work in the same length of time – becoming, like farm men, more productive. Farm wives' standards for housework rose, for example, and many also spent more hours working in the farming operation. A 1935 Maytag washing machine advertisement, for example, told women: "Let the Maytag give you more time for your garden and chickens" (quoted in Jellison 1993: 112). In fact, farm women – plus power machinery – often took the place of hired men. According to Jellison, "When modern appliances were first introduced it looked like an end to the old adage, 'Women's work is never done.' But along with the time-savers inside [the farmhouse], came the increased use of machinery outside and women were right back where they started" (Jellison 1993: 103, 112, 140, 166, 168; Kline 2000: 268, 277).

Labor-saving electric appliances also enabled farm wives to work off the farm for wages. For the first time, farm women took jobs in town as teachers, nurses, hairdressers, factory workers, and retail and office clerks. A 1956 portrait of one small Iowa town, for example, showed that farm women made up 25 percent of the community's female work force (Jellison 1993: 166-167).

As electricity and other technological advances reduced the labor of raising livestock and crops, farmers with capital modernized and expanded their operations. Many smaller farmers could not compete with their larger, more efficient neighbors, and in the first five years after World War II, about ten percent of Midwestern farm families left the farm, with electrification playing a part. Continuing a trend that began in the 1890s, the farm population as a percentage of the total population nationwide dropped steadily, from 23 percent in 1945 to 7 percent in 1964 (Brinkman 2002: 6-9; Jellison 1993: 152; Kline 2000: 285).

In Minnesota there were fewer farms after electrification, but the remaining farms were larger and more prosperous than before. The number of farms in the state dropped five percent from 1945 to 1950, while average acreage per farm grew five percent, to 184 acres. Meanwhile, the average value of a Minnesota farm jumped two-thirds between 1945 and 1950, to about $15,000. Farms became more specialized, too. The phenomenon of nearly all Minnesota farms milking cows died out by the 1960s and dairy production became concentrated in fewer, larger herds. Likewise, the number of farms raising poultry declined in the 1950s and 1960s, until egg production moved almost entirely to large-scale, automated farms that could produce eggs very cheaply. Hog and cattle farmers also moved to large-scale, capital-intensive, confinement feeding operations (Jellison 1993: 153, 155, 159-60; Hart 1998: 280).

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This farm's electrical transmission line is coming in along the driveway. Near Rapidan, Blue Earth County, circa 1972. (MHS photo)

FOCUS ON FARM JOURNALISM

Some Milestones of Minnesota Farm Journalism

1860 – Minnesota's first farm journal, *Minnesota Farmer and Gardner*, began
1882 – Influential, national publication *The Farmer* founded in Fargo by Webb; moved to St. Paul in 1890
1905 – *The Farmers's Wife* established in St. Paul
1920 – Minnesota's foreign language farm papers were among 19 published in U.S.
1921 – Minnesota's first radio station (and farm radio station) began broadcasting
1922 – WCCO established as WLAG
1940 – Seven of eight Minnesota farms had a radio

AGRICULTURAL PERIODICALS

While a few farm journalists were writing in the mid-1700s, the beginning of American farm journalism is usually set at the launch of the *American Farmer* in Baltimore in 1819. Between 1820 and 1910, some 3,600 different farm periodicals appeared in the United States and Canada. Though often short-lived, farm journals and newspapers were widely read and influential, particularly before agricultural colleges and county extension agents became major purveyors of information. "In fact, most authorities maintain that prior to 1914 [the start of federal support for extension], it was through the medium of an expanding farm press that the majority of farmers came into contact with ideas originating outside their own communities," according to historian Roy V. Scott (Scott 1970: 17-19).

Before about 1860 relatively few farmers subscribed to farm publications. In 1853, 33 farm periodicals in the northern U.S. reported total circulation of 234,000 – a tiny fraction of the farm population. But circulation surged after the Civil War and continued to grow robustly in the 20th century, particularly after Rural Free Delivery was established around 1900.

A 1913 survey by the USDA found that two out of three farmers surveyed took one or more farm papers, and more than 40 percent subscribed to two or more. This, at a time when very few farmers owned books about agriculture: according to the survey only 1 farmer in 24 possessed any farming books. Furthermore, the survey suggested that farm publications were influential. About 40 percent of farmers in the 1913 survey considered farm periodicals their most valuable source of information. Among farmers who took farm papers, received extension bulletins, and attended Farmers' Institutes, 66 percent said the farm periodicals were their most helpful resource (Smith and Atwood 1913: 18-25; Scott 1970: 20-21). (The value of periodicals to farmers continued into the 1950s and 1960s when, according to one source, "dozens" of surveys provided evidence that American farmers "continued to rank farm publications as their major source of information" (Evans and Salcedo 1974: 87).)

Farm journals often cooperated with farmers' groups, printing their news and business. The farm press also covered educational events like the Farmers' Institutes and printed concise, readable summaries of new research (Smith and Atwood 1913: 23). By the mid-1910s, the agricultural press had increased its coverage of material from agricultural colleges, experiment stations, and extension services. A successful relationship developed whereby the press carried "distilled versions" of station bulletins and similar materials, making "the findings of scientific experimentation available to a larger number of farmers in language that the ordinary reader could understand," according to Scott (Scott 1970: 20-21). This provided the papers with a steady stream of content, and helped institutions disseminate their data.

Throughout the U.S., farm publications from *Country Gentleman* to *Prairie Farmer* carried advice about, and plans for, the design and construction of farm buildings. The *Livestock Journal* and other publications, for example, are credited with helping propagate round and polygonal barns in the Northeast and Midwest. With articles like "The Plank Barn Frame," "The Louden Hay Carrier," "Barn Cellars Free From Posts," and "Hay Barracks," farm journals introduced and critiqued a spectrum of building ideas over many decades (Soike 1995: 96-98). In addition, farm papers were thick with illustrated advertisements that helped introduce farmers to new building materials and technology.

In the Midwest, Des Moines' *Successful Farming* magazine frequently carried articles about farm buildings. Longtime editor Kirk Fox was a staunch supporter of the Midwest Plan Service, the organization established in 1932 by Midwestern land-grant colleges (and the American Society of Agricultural Engineers) to supply farmers with low-cost plans for well-designed farm buildings. *Successful Farming* lent money to the Plan Service and in 1933 ran a series of monthly articles promoting Plan Service designs. Each article had an editor's note encouraging readers to contact their local extension agent, agricultural college, or the magazine for help in obtaining plans.

Many farm journals were published in the Midwest, "the region that has been predominant in agricultural publishing since the mid-nineteenth century," according to one source (Brunn and Raitz 1978: 281). Those with the largest circulation were broad in focus: a single issue might contain articles on marketing, farm building construction, improving land, animal husbandry, several types of crops, cooking or housekeeping, and a feature for children. Examples read by Minnesota farmers included *Successful Farming* (est. 1896, pub. in Des Moines), *Farm Journal* (est. 1877, pub. in Philadelphia), *Wallace's Farmer* (est. 1895, pub. in Ames), *Capper's Farmer* (est. 1919, pub. in Topeka), *Prairie Farmer* (est. 1841, pub. in Chicago), *The Farmer* (est. 1882, pub. in St. Paul), and *Farm, Stock and Home* (est. ca. 1884, pub. in Minneapolis) (Brunn and Raitz 1978: 239). There were also numerous specialized journals such as *Hoard's Dairyman*, published in Wisconsin beginning in 1855 (and still being published).

Minnesota Publications. Historian Theodore Blegen wrote in 1975, "from first to last, Minnesota had more than a hundred farm journals" (Blegen 1975: 395). The first was the *Minnesota Farmer and Gardener*, whose run of 16 issues appeared in 1860-1862. It was founded with the help of an early farmers' group, the Minnesota State Agricultural Society. Other early periodicals included the *Farmers' Union* (1867-1873), *Minnesota Monthly* (mouthpiece of the Grange, published 1869-1870), *Minnesota Farmer* (est. 1877), and *Independent Farmer and Fireside Companion* (est. 1879) (Jarchow 1949: 12).

Among Minnesota's most influential and long-lasting publications was a national paper, *The Farmer*, founded in Fargo by Edward A. Webb in 1882. Webb moved the magazine to St. Paul in 1890. *The Farmer* was a strong proponent of agricultural diversification, urging wheat farmers to incorporate dairying, livestock, and new crops into their operations. It contained a mix of scholarly articles on new developments in agriculture, strongly-stated opinions on farm policy, news and gossip, and feature stories. *The Farmer* is still published today.

Another Minnesota periodical, *Farm, Stock and Home*, was published in Minneapolis from 1884-1929. The paper "did notable pioneering service in advocating that Minnesota specialize in dairying" and called itself "The Paper that Founded the Farmers' Creameries," according to historian Everett Edwards. In 1929 it was purchased by Webb Publishing and merged with *The Farmer* (Edwards 1937: 410).

The Farmer's Wife, designed for farm women and published in 1905-1939 by Webb of St. Paul, was the largest publication of its kind in the U.S. *The Farmer's Wife* was active in the building plan business, sponsoring a nationwide model farm home contest in 1926 and establishing its own farmhouse plan service in 1930. When the magazine was sold to *Farm Journal* in 1939, it had more than one million readers and subscribers in every state (Baker 1982: 13, 52).

Also originating in Minnesota were numerous specialized newspapers and journals. For the poultry industry, for example, was *Poultry Herald*, published by St. Paul's Webb Publishing from 1888-1962.

Foreign language farm papers read by Minnesota farmers included *Der Deutsche Farmer* (published in St. Paul from 1910-1937 for German speakers), *Der Haus und Bauernfruend* ("House and Farm Companion," published in 1924-1927 in Winona and later in Wisconsin), and *Pelto Ja Koti* ("Farm and Home," published from 1911-1921 in Superior, WI, for Finnish farmers). These were among about 19 foreign language farm journals published in the U.S. in 1920 (Evans and Salcedo 1974: 190).

A journalist reported in 1900 that the U.S. Post Office in Farmington, Minnesota, handled about 40 regular subscriptions of *Farm and Stock and Home* (Minneapolis), about 40 of the *Northwestern Agriculturist* (Minneapolis), about 50 of *The Farmer* (St. Paul), and two of *Hoard's Dairyman* (Wisconsin).

LOCAL PRESS

General newspapers also carried agricultural news and information, crop reports, weather statistics, and market data. Some became powerful advocates for farming improvements and strong supporters of institutions like the University of Minnesota's agricultural college (Scott 1970: 22).

Beginning in 1909 the Minnesota Extension Service produced a news sheet that was sent to all newspapers in the state "to supply them with useful and timely bits of information about farm matters," according to an extension historian (McNelly 1960: 23). County extension agents also wrote columns for the local papers. There was strong demand from weekly newspaper editors for original local extension materials, and by 1935 news stories written by extension agents averaged nearly 200 per year per county (McNelly 1960: 81).

A quick perusal of several decades of the *Morris Sun* and *Morris Tribune*, two rural newspapers in west central Minnesota, reveals agricultural information in virtually every issue. Articles like "Corn for Silage [advocacy of silos]" (1910), "Plant Windbreaks" (1913), "Plan Purebred Sire Campaign" (1931), and "First 'Farm Pond' Built in County" (1959) reported new methods and explained physical improvements for farms. Also prevalent were illustrated advertisements like "Hogs Get All the Feed on a Concrete Floor" (1915), a promotion of concrete barn floors and concrete block buildings by the Universal Portland Cement Company (Universal 1915). A 1919 article, entitled "Provide Building Plans," informed local farmers that blueprints prepared by the University of Minnesota's Division of

Agricultural Engineering had been provided to all county extension agents "to help them in meeting the demand for advice as to better farm buildings." Plans for farmhouses, barns, implement sheds, a hog house, and a poultry house were available for 10 cents each ("Provide" 1919).

FARM RADIO

Americans began listening to radio in November 1920 when KDKA in Pittsburgh went on the air. As soon as the first word was transmitted, agricultural colleges, extension agents, federal agencies, and political organizations were eager to use radio to disseminate information on agricultural topics. Radio became a major medium of education and entertainment for farm families, reaching people who were isolated by poor roads, slow mail, and lack of telephones, and who didn't participate in other agricultural extension programs. Radio provided farmers with almost instantaneous information. Because the news in print media might be weeks or months old by the time farms received it, farmers were reliant on local grain and livestock buyers for market information with no ability to independently verify the quoted market prices.

Some of the country's first radio stations started at land-grant colleges. The University of Wisconsin's WHA and the University of Minnesota's WLB (established in 1920 and 1921) were two of the earliest and were among the first to broadcast the basic essentials of farm radio – weather forecasts and market reports. Iowa State University's WOI emerged soon after in 1922 (Baker 1981: 164; Wik 1981: 341-343).

While radio was an influential part of farm life by World War II, farmers only slowly acquired sets. In 1925, for example, only 4.5 percent of U.S. farms had radios. Cost was a major factor, especially during the hard times of the 1920s. A 1923 USDA survey found farmers spent an average of $175 for radios – a hefty $1800 in 2003 dollars (Craig 2001: 340). Before electrification, farms were also challenged by a lack of power and some farmers went to great lengths to secure power to recharge radio batteries.

In 1927 a USDA survey "of 910 extension agents found that 87 percent of them believed that farmers in their area who owned radios regularly listened to agricultural programs and 91 percent of them said that farmers spoke favorably of such broadcasts," according to journalism historian Steve Craig (Craig 2001: 334). Radio's popularity steadily grew and by 1930, 21 percent of U.S. farms had radios. In 1940 the percentage of farms with radios – 60 percent – exceeded the percentage with telephones, electricity, or indoor plumbing (Kline 2000: 114-115). In Minnesota seven out of eight farms had a radio in 1940 – the ninth-highest rate in the country (McNelly 1960: 84).

Programming. In Minnesota, the Minnesota Extension Service – a cooperative effort of the USDA and the University of Minnesota – was an important supplier of farm radio content customized to the state. It presented its first program in 1923. By 1951 county extension agents were doing regular radio shows in 76 Minnesota counties (McNelly 1960: 84).

The United States Department of Agriculture (USDA) also entered radio programming in the early 1920s, becoming "probably the most enthusiastic advocate of radio for the farm audience," according to Craig (Craig 2001: 332). Not only did the USDA generate content for broadcast by others, but by 1926 it had its own radio service with the "United States Radio Farm School" and other features heard by hundreds of thousands of listeners. Some 1920s programs such as

"Noonday Flashes" and "Household Chats" were still aired in the 1950s (Craig 2001: 333; Kline 2000: 120).

The USDA and other federal agencies used radio during the Depression to convey information about New Deal programs, the electrification of rural areas, and policies to introduce price supports. Former farm broadcaster John C. Baker explained:

> For several years, whatever the new government programs, or changes in established programs might be, the officials responsible for them used radio to spread the word. Secretary [of Agriculture Henry A.] Wallace was a frequent speaker on [NBC's] 'National Farm and Home Hour,' and so were the heads of the new 'action agencies' created by the USDA, the Agricultural Adjustment Administration, the Soil Conservation Service, the Farm Service Administration, the Rural Electrification Administration, and others (Baker 1981: 31).

Programming was also supplied by the farm press and by organizations like the American Farm Bureau Federation and the Farmers' Union. A more powerful force in farm radio was agri-business, which directly owned stations, sponsored programs, and spent millions in advertising. These entities included the Chicago stockyards, the Chicago Board of Trade, Ralston Purina, Westinghouse, Montgomery Ward, International Harvester, and Sears and Roebuck whose "Sears-Roebuck Agricultural Foundation" started station WLS in Chicago (Baker 1981:10-13).

Farmers found radio's music and entertainment as important as informational programming. Radio's potential to improve the quality of life for rural residents was embraced by rural reformers who saw radio as a way to bring farm families into closer contact with the rest of the nation and, hopefully, to keep young people on the farm by reducing their isolation. Instead of making them more content, however, some historians believe radio helped young people leave rural areas by psychologically linking them with the cities in which most radio broadcasts originated. Wrote one author, "Radio failed to save the family farm, and perhaps even accelerated its demise by making the city seem more attractive" (Patnode 2003: 305).

Minnesota Stations. Minnesota's leading farm station was WCCO, which began in 1922 as Minneapolis' WLAG. The station was renamed WCCO in 1924 when it was purchased by a Minneapolis flour milling giant, the Washburn Crosby Company. The first Minnesota Extension Service radio shows were broadcast on the station in 1923. WCCO's extensive farm programming included daily market reports (soon broadcast from grain exchanges and the South St. Paul stockyards), USDA offerings, farm news, weather forecasts, and interviews with farmers, experts, and government officials. WCCO's reach was so wide that farm leaders successfully used WCCO to help launch the Land-O'-Lakes and Farmers Union Grain Terminal cooperatives, according to John Baker (Baker 1981: 165). Among WCCO's principals were Larry Haeg, farm director from 1942-1952, and Maynard Speece, farm director from 1952-1977. Speece had been a University of Minnesota College of Agriculture graduate, county extension agent, and broadcaster with the Minnesota Extension Service and the USDA. Joining Speece on the air was Joyce Lamont, a celebrated figure who appeared several times each day from 1946-1989 with market buys, recipes, community events, and interviews (Baker 1981: 164-165). WCCO ended its regular farm broadcasts in 2004.

Minnesota's other leading farm radio stations included KSTP of Minneapolis (with David Stone as farm director for 35 years from 1943-78), KDHL in Faribault, WJON and WWJO in St. Cloud, and KWOA in Worthington (Baker 1981: 166-169).

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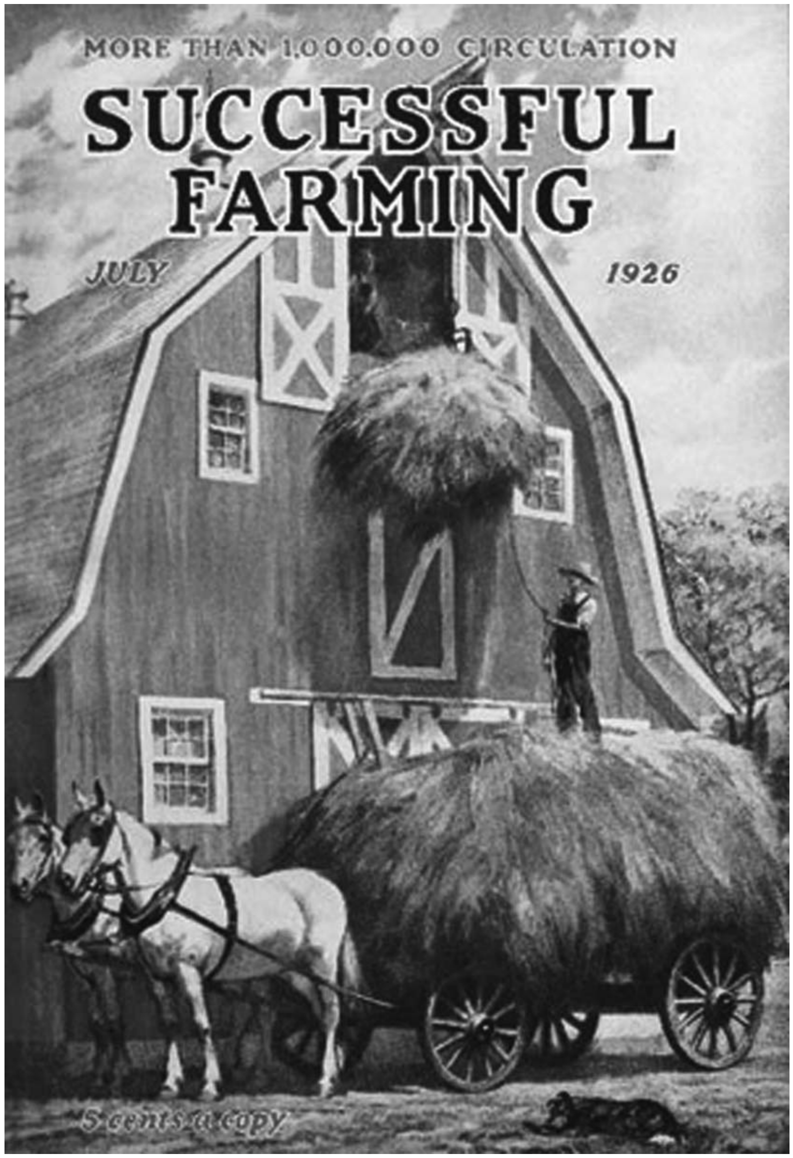

Successful Farming magazine was published in Des Moines beginning in 1896. The magazine was a strong proponent of the work of the land-grant colleges' Midwest Plan Service, established in 1932, and of the efforts of the American Society of Agricultural Engineers to promote good farm building design. Magazine cover, July 1926.

The farm press was an important way for Minnesota farmers to learn about building designs, construction techniques, and new methods and equipment. A USDA survey found that two-thirds of American farmers subscribed to at least one farm publication in 1913. Location unknown, circa 1910. (MHS photo by Harry Darius Ayer)

FOCUS ON UNIVERSITY OF MINNESOTA PROGRAMS

Some Milestones of University of Minnesota Programs

1862	–	Congress passed Morrill Land Grant College Act
1869	–	College of Agriculture opened
1885	–	Minnesota Agricultural Experiment Station established, branch stations to follow
1886	–	Minnesota Farmers' Institutes operated 1886-1925
1887	–	Hatch Act established federal funding for agricultural experiment stations
1888	–	*Minnesota Farmers' Institutes Annuals* published 1888-1925
1888	–	School of Agriculture opened, regional schools to follow
1895	–	College-level courses in agricultural engineering began
1907	–	Fruit Breeding Farm established in Excelsior
1909	–	Division of Agricultural Engineering established
1909	–	Minnesota Extension Service established
1910	–	Extension Services began to publish bulletins that continue today
1912	–	Minnesota's first county extension agent placed
1914	–	Extension Service became a federal-state cooperative program
1958	–	Minnesota Landscape Arboretum established in Chaska

UNIVERSITY OF MINNESOTA COLLEGE OF AGRICULTURE AND SCHOOLS OF AGRICULTURE

From territorial days, the University of Minnesota has played a pivotal role in shaping Minnesota agriculture. The University was founded in 1851 in Minneapolis, seven years before statehood, when Minnesota had a population of 10,000 pioneers – mostly farmers. The territorial legislature called for a school of higher education composed of five departments: science, literature and the arts, medicine, elementary education, and agriculture. In its early years, the University struggled with debts and even had to close for a time. It was rescued by the Morrill Land Grant College Act of 1862.

The Morrill Act granted to the states public lands to benefit a college that would teach agriculture and mechanical arts. There were moves to establish an agriculture college in Glencoe, but in 1868 the Minnesota Legislature awarded the Morrill land endowment to the University of Minnesota (Jarchow 1949: 62). At the time of the act there were agricultural colleges in four states, and within ten years of Morrill there were agricultural colleges in 26 more. Congress subsequently provided annual grants to the Morrill Act colleges.

In 1868 the University acquired land east of the campus to start an experimental farm to supplement the new two-year agricultural program. The University offered its first agriculture classes in 1869, but unhappily, no students showed up. In 1873, University President Folwell complained, ". . . it was humiliating to the University that 'not a single young man has come here desiring to learn the Science of Farming'" (Gray 1951: 57). In 1874, after stern warnings from President Folwell about "the necessity of developing . . . the genuine agricultural education called for by the act of 1862," University Regents formally established the College of Agriculture (Gray 1951: 57). Director Charles Lacy offered several classes, but never had more than one or two students at a time, "and these tended to be picked off by various ailments of apathy and inconstancy" (Gray 1951: 55-61).

Other land-grant agricultural colleges were also having these same struggles to become viable. According to economist and historian Willard Cochrane, "For many years after the opening of the new colleges, . . . very little was done toward training rural youth to become expert agriculturalists" (Cochrane 1993: 242). There were few qualified agriculture teachers then, and those that were competent were badly overworked; rural students were not adequately prepared for college-level work; academic men were contemptuous of agriculture; farmers were hostile to the University; and there was very little real scientific knowledge about agriculture to teach, anyway. Beyond that, agricultural colleges were confused about their proper mission: Should instruction be classical or practical? Should the faculty be concerned with plowing a straight furrow or studying plant genetics? Should the College be educating ordinary farmers, or professionals who would work with farmers? (Scott 1970: 26-33; Cochrane 1993: 242-245).

In 1882, the University sold off its sandy-soiled Minneapolis farm at a profit. The proceeds were used to buy the 155-acre J. W. Bass farm in St. Paul and established what came to be called the Farm Campus. The Bass farm became the state's first experiment station in 1885, as well as the home of the agricultural college and the state's first agricultural high school. (See "Minnesota Agricultural Experiment Stations" below.) To draw support to the College of Agriculture, its new director, Edward D. Porter, began in 1882 offering a Farmers' Lecture Course which drew 250 people in 1882, 308 in 1883, and 1,100 in 1884. These classes developed into the Minnesota Farmers' Institutes – traveling lectures that brought news of agricultural experimentation to farmers all over the state (Folwell 1930/rpt. 1969: 89).

Meanwhile, enrollment in the fledgling College of Agriculture continued to be embarrassingly low. The farming community regarded the University's efforts at agricultural education as "inadequate to the point of absurdity," and charged that the Morrill Land Grant funds were being misused for programs that offered no practical help to farmers. There were furious calls to separate the agricultural college from the University (Gray 1951: 95-96; Strom 2003: 130).

In 1888, this criticism led the University to embark on a program of practical agricultural education for high-school-age boys. The new School of Agriculture – so-called to distinguish it from the unsuccessful College of Agriculture – offered a two-year course of instruction for boys and, after 1897, girls. The high school was located on the University Farm Campus in St. Paul, where the state experiment station and the College of Agriculture were also headquartered.

The high school program proved far more popular than the college-level program, and remained so for many years. By 1891 enrollment had grown to 300 students and the curriculum had been extended to three years.

In 1903, the Minnesota Legislature authorized the University to establish additional schools of agriculture. The University's Schools of Agriculture – all boarding high schools – were founded in:

- St. Paul (1888-1960)
- Crookston (1906-1968)
- Morris (1910-1963)
- Grand Rapids (1926-1965)
- Waseca (1953-1973)

The five in Minnesota were among more than 100 residential agricultural high schools established in 14 states between 1900 and 1940. Like Minnesota's, many were affiliated with land-grant universities and experiment stations – in fact this arrangement became known as the Minnesota model (Granger et al 2002/2003: 8.5-8.8). The direct impact of these schools on the development of Minnesota farming is not known, but circumstantial evidence includes this statement by a 1921 Minnesota reader of *The Farmer's Wife* magazine who wrote, "My boy came home this spring from the School of Agriculture and the first thing he did was to install a drain in the kitchen. I never knew how much extra work it required to carry the dishwater until this convenience was placed in my kitchen" (quoted in Lundquist 1923: 5).

Agricultural schools and colleges finally came of age during the first two decades of the 20th century. Their primary mission was now clear: "The development of the agricultural sciences as the means of making available to farmers new and improved technologies and production practices," according to Cochrane (Cochrane 1993: 253). The standard agricultural disciplines such as soils, agronomy, and livestock husbandry were established and a substantial body of knowledge was developed to teach and to use as a basis for research (Cochrane 1993: 105, 253). In 1909 the University formally established its Division of Agricultural Engineering, the department charged with farm building research and outreach. (See "Agricultural Engineering" below.) By the 1930s, the agricultural colleges, along with the USDA, had become "the science-producing base upon which the modern highly productive agriculture of the United States was built" (Cochrane 1993: 106).

In 1909, the Minnesota Legislature enabled the University's Minnesota Extension Service to help transmit the knowledge being produced by the College and the experiment stations to farmers. This outreach work was advanced by the Smith-Lever Act of 1914, which established funding for a federal-state Cooperative Extension Service, resulting in a network of county agricultural agents throughout the state. (See "Minnesota Extension Service" below.)

In the 1920s and 1930s, the College of Agriculture participated in many farm relief projects, cooperating with the USDA. The College made important advances in grain breeding, developing new disease-resistant varieties of wheat, stiff-strawed oats and barleys, and corn hybrids. New varieties of apples and other fruits were developed. Dairy science advanced rapidly under T.L. Haecker, known as the father of Minnesota dairying and widely considered "one of the best minds of all time in his field" (Gray 1951: 403). The livestock division did world-renowned work on dairy sperm preservation and artificial insemination (DeVries 1997).

In the late 1930s agriculture college enrollment – which had dropped in the 1920s – surged. The curriculum was expanded, and new agriculture courses were offered in cooperation with the University's Institute of Technology, business school, and journalism school (Gray 1951: 395-405). World War II again emptied out classrooms, but after the war ended, enrollment rebounded. Responding to strong farm demand for veterinarians, the University created a school of veterinary medicine in 1947. Colleges of forestry and home economics were also established. In 1949, new experimental programs were begun at the University's Rosemount Research Center in livestock, poultry and dairy husbandry, agronomy, agricultural engineering, plant pathology, and soils. The College continued to be a leader in fields such as butter quality and the bacteriology of milk (Gray 1951: 405-411).

By the 1950s the College of Agriculture had become a large, complex institution with three distinct, but complementary functions – resident instruction, research, and extension outreach. The College's mission also broadened to include work on the social problems associated with advances in farming technology; environmental problems; use of agricultural resources; and international agricultural problems (Cochrane 1993: 254).

AGRICULTURAL ENGINEERING AT THE UNIVERSITY OF MINNESOTA

Agricultural engineering encompassed the design, construction, and operation of physical components of farms including fields, drainage, roads, power, and buildings – in other words, the entire physical infrastructure that made possible the growing of crops and the raising of livestock. Agricultural engineering was also the field that covered farm mechanization including the evolution of animal-powered, steam-powered, and gas-powered vehicles and machinery. Nearly every day farmers grappled with physical problems or sought to improve productivity through agricultural engineering. To be successful, a farmer needed to be able to read blueprints, draw plans, grade roads, pour concrete, construct buildings, install feeding equipment, plan and install drainage, forge or weld steel, plan water and sewage systems, wire buildings for electricity – not to mention investigate and purchase numerous pieces of machinery and then keep it running with constant maintenance and repair.

The University of Minnesota's high-school level School of Agriculture, founded in 1888, provided farm engineering instruction from the very beginning. College-level course work in agricultural engineering was added in 1895. In 1906, the School of Traction Engineering was established to teach short courses in power machinery.

In 1909 the Division of Agricultural Engineering was formally established within the College of Agriculture. That same year, agricultural engineering research was begun at the University experiment stations.

As farm technology advanced, the Division of Engineering added new courses to its curriculum. In 1913, for example, "owing to strong and growing popular interest in automobiles and tractors," a class was offered in farm motors (Roe et al 1942). In 1920, classes on electricity and land clearing with explosives were added. Course work in the Division of Agricultural Engineering included topics such as:

- the physics of agriculture
- shop work and mechanical drawing
- surveying
- systems of farming
- planning farms
- farm layout
- roads
- fences
- drainage
- land reclamation
- land clearing with explosives
- irrigation
- erosion control
- subduing new soils
- tillage
- farm buildings
- building materials
- structural design
- ventilation and sanitation
- farm implements and machinery
- power systems
- hydraulics
- farm lighting and heating
- rural electrification
- carpentry
- blacksmithing and welding
- cement work
- rope work
- pipe work

In 1925, the University of Minnesota established a four-year degree in Agricultural Engineering. Course work for the new professional degree began with a solid foundation of mathematics and physics, followed by detailed study and practice. The program's mission was to educate professional engineers to work in a variety of agriculture-related fields.

The Engineering Division began offering graduate courses in 1930. In 1939, the agricultural engineering curriculum was reorganized to bring the program up to the professional standards required for other branches of engineering at the University. In 1947 a PhD program in Agricultural Engineering was added. The first PhD degree was awarded in 1959 (Roe 1925: 299-300; Roe et al 1942).

From 1906 to 1942, the engineering division also published more than 450 reports, bulletins, papers, newsletters, pamphlets, books, and lesson plans. It published 111 issues of its *Agricultural Engineering News Letter* between April 1932 and June 1941.

Farm Buildings. Division of Engineering staff drew many of the farm building plans distributed by the University of Minnesota and county extension agents. Books of blueprints developed by the Division were sent free to Minnesota high school teachers and county extension agents, and were also sold for $3.50 a book. The series, first published in 1918, "contained plans of practically every kind of building needed on a farm plus a considerable list of related equipment" (Roe et al 1942).

Other Research. Researchers from the Division of Engineering began doing research at the state experiment stations in 1909, the year the Division was established. The first research project was in farm tile drainage, which "was practically unknown in Minnesota. Its value in Minnesota soils, especially in flat topography like the Red River Valley, was questioned" (Roe et al 1942). From 1908 to 1916, Division staff also made many preliminary tile drainage surveys on private farms – part of an effort to build interest in properly-designed and -installed tile drainage that would increase yields and expand acreage (Roe et al 1942). The Division's Tile Testing Lab was a national leader in tile materials research, operating until the late 1970s, when plastic tile replaced other materials. The Lab's work also led to important improvements in concrete for agricultural uses.

Other major research projects through the mid-1920s included work on farm hydro-electric plants, farm electrification, and land clearing methods in cutover woodlands. After World War I, land clearing became an important activity, especially using cheap, surplus war explosives. The Division helped organize and sponsor an educational train that traveled around Minnesota demonstrating land clearing to some 10,000 people. In 1921, the engineering division began distributing surplus explosives and training farmers in their use for clearing woodlands. In 1939, the first extension specialist in agricultural engineering was appointed (Roe et al 1942).

Major engineering research projects between the mid-1920s and World War II included the use of electricity in agriculture, wind-powered electric lighting plants, farm building heating and ventilation, hydraulic rams for pumping, plow performance, tractor use, tile drainage, and optimum soil moisture.

After World War II, engineering research included dairy cattle housing, farm mechanization, and forage storage and handling. In the 1960s engineering research expanded into areas such as food processing, agricultural waste management, and water quality.

MINNESOTA AGRICULTURAL EXPERIMENT STATIONS

The need for scientific information about agriculture led to the creation of a nationwide system of experiment stations. The Minnesota stations played a leading role in the development of Minnesota farming and helped fuel a phenomenal increase in agricultural productivity during the 20th century.

Minnesota was one of the first states in the nation to establish an agricultural research facility (Cochrane 1993: 244). The University of Minnesota had operated a farm since 1869, when it first began offering classes in agriculture. In 1885, the state legislature established the Minnesota Agricultural Experiment Station at the University's 155-acre farm in St. Paul. Two years later, in 1887, Congress passed the Hatch Act, which established agricultural experiment stations at land-grant colleges and provided funds for their support. The experiment stations had a twofold mission: to do agricultural research and to disseminate practical agricultural information to farmers.

In 1888, the Minnesota Agricultural Experiment Station, under the direction of Edward Porter, hired its first scientists in horticulture, entomology, and soil chemistry (Gray 1951: 96). Many of the faculty in the University's College of Agriculture, and in the University's Schools of Agriculture, also worked on Experiment Station research. Over the next several decades, the University established five branch experiment stations across the state:

- Northwest Experiment Station, Crookston (est. 1895)
- North Central Experiment Station, Grand Rapids (est. 1896)
- West Central Experiment Station, Morris (est. 1910)
- Southern Experiment Station, Waseca (est. 1912)
- Northeast Experiment Station, Duluth (est. 1912, closed 1976)
- Southwest Experiment Station, Lamberton (est. 1959)

The St. Paul, Crookston, Morris, and Waseca stations were operated in association with agricultural high schools. Additional facilities in the University's agricultural research network included:

- Fruit Breeding Farm (now Hort. Research Center), Excelsior (est. 1907)
- Cloquet Forest Research Center, Cloquet (est. 1909)
- St. Paul Experiment Station (expansion), Rosemount (est. 1949)
- Minnesota Landscape Arboretum, Chaska (est. 1958)

Note: The name "Minnesota Agricultural Experiment Station" is often used to identify the collective institution and to encompass the work and staff of all branches.

Experiment Station research facilities were located in diverse farming regions, helping University scientists to do a wide variety of research under local conditions. Because of this diversity, each station "developed its own character and strengths" (MAES ca. 1995). The experiment stations worked with the Minnesota Extension Service and other rural educational agencies to bring the results of their research to farmers.

Key Research. The experiment stations conducted considerable research that ultimately resulted in changes to Minnesota farms and farm buildings. Among the most important early crop research was the development of superior corn varieties, which made corn a viable crop in Minnesota. In the early 20th century University researchers did extensive trials on winter-hardy Grimm alfalfa (which helped encourage the construction of silos); began fruit-breeding experiments; reforestation research; and crop disease studies. In 1915, Experiment Station scientists began a cooperative effort to develop wheat varieties that would be resistant to the rust that was causing catastrophic epidemics in Minnesota and throughout the Northern Plains. Crop research in the 1930s resulted in winter-hardy chrysanthemums and in improved corn hybrids. The latter allowed both corn-growing and livestock-raising to profitably occur farther north in Minnesota.

In the 1940s the experiment stations began soybean breeding programs. Soybeans, then a minor forage and green fertilizer crop, soon became an important cash crop. Soybean growing helped encourage the state's livestock industries. While the experiment stations had been testing windbreak trees for decades, in the 1950s cold-climate trees and shrubs became a major research focus. The University developed bluegrass varieties that launched the grass seed industry in northern Minnesota in the 1960s. In all, more than 400 new crop varieties have been developed at Minnesota experiment stations, including wheat, corn, alfalfa, barley, sugar beets, potatoes, soybeans, wild rice, and many others (Granger et al 2002/2003: 8.18; MAES ca. 1995).

In livestock research, the experiment stations did the nation's first dairy cow feeding studies in the 1890s and early 1900s, under the leadership of dairy scientist T. L. Haecker. This work resulted in scientifically-based feeding standards that remained the standard for feeding dairy cattle until 1940. Haecker also helped launch the cooperative creamery movement in Minnesota. In 1901, the University built a slaughterhouse and meat lab on the St. Paul campus – the first at an American university – to relate carcass traits to live-animal traits, important for livestock farmers. Other early livestock research focused on diseases of cattle, sheep, and swine, and on feeding and breeding of sheep.

In the 1930s the experiment stations did groundbreaking work in artificial insemination, achieving the first-ever birth of a calf through this method. This work helped Minnesota farmers improve the genetic quality of their dairy herds and nearly tripled the average milk production per cow between 1940 and 1984. In the 1940s poultry scientists developed sex determination methods for day-old birds, which saved Minnesota farmers millions of dollars. In the 1950s the experiment stations developed methods for year-round turkey egg production, which helped Minnesota become a leading turkey-raising state. In swine research, scientists introduced new cross-breeding concepts. In the 1960s experiment station sheep scientists developed milk replacement formulas that cut Minnesota lamb mortality rates by half (MAES ca. 1995).

Experiment station agronomy work included experiments on fertilizers, crop rotation, and phosphorus in soils. In 1914 the experiment stations began statewide surveys of soil types, and in 1950, a soil testing lab was established (Granger et al 2002/2003: 8.18-8.19; MAES ca. 1995).

The experiment stations also did pioneering work in a new field called "farm management." In 1906 the Station published the first data on the costs of producing farm products in Minnesota. Home economics research began in 1926, focusing on foods, textiles and clothing, and home management. In 1930, researchers began a decade-long study of basic nutrition (MAES ca. 1995).

Farm Structures. The experiment stations influenced farm structures in the state by encouraging the construction of silos and by building demonstration silos made of various materials at the stations. Station staff made numerous farm visits where they advised on the placement of windbreaks and the arrangement of fields or drainage. The stations began to distribute farm building plans beginning in 1915, working with the University's Division of Agricultural Engineering. Station staff also helped propagate buildings such as emergency or short-term straw buildings and portable brooder houses and colony hog cots.

In the field of agricultural engineering, the experiment stations did extensive work in drainage and were influential in the construction of drainage tile throughout the state. In the 1920s the stations made Minnesota a national leader in drain tile durability research, helping to determine the types of tile that farmers installed.

In the 1920s the Experiment Station helped build the first experimental rural electric line near Red Wing, to study farm uses for electricity.

In 1933 Minnesota experiment stations began to disseminate plans drawn by the newly-organized Midwest Plan Service, of which the University was a cooperating member. After World War II the Minnesota Experiment Station intensified cooperative farm structures research carried on with other North Central experiment stations and land-grant colleges.

Outreach. The Hatch Act directed experiment stations to disseminate practical agricultural information to farmers. One method was through the University's agricultural high schools, which were operated in conjunction with the experiment stations. The University operated combined agricultural boarding high schools and experiment stations in St. Paul, Morris, Crookston, and Waseca. Staff ran taught students during the winter, and conducted research and visited students' home farms to monitor individual student projects during the summer months (Granger et al 2002/2003: 8.17-8.20).

The experiment stations organized a variety of extension and outreach activities, and each hosted a constant stream of visitors including farmers and their families, agricultural journalists, special workshop participants, community groups, boys' and girls' clubs, and others. Experiment Station staff answered large volumes of letters and calls from farmers needing information and advice. Stations held Farmers' Short Courses, one-day seminars, special clinics, and annual field days, which drew large crowds. Special retreats such as Homemakers' Week and a 4-H Club Week were held annually for many decades. Station visitors could study field test plots and hardy trees and shrubs, have their seed grain treated against disease, learn about livestock feeding studies, and examine model farm buildings (Granger et al 2002/2003: 8.17-8.20).

Since the first year of operation in St. Paul the experiment stations have published their research in scientific journals, bulletins, and reports. The Minnesota Extension Service and the agricultural press published concise versions of Experiment Station reports, making the work of scientists accessible to ordinary farmers. The Experiment Station staff often worked with local extension agents to educate farmers about crop rotation, livestock diseases, new seeds, and other topics.

MINNESOTA FARMERS' INSTITUTES

The Farmers' Institutes was a nationwide movement that began in the 1860s. Institutes were offered in Minnesota for 39 years, between 1886 and 1925, and for much of that time served as a precursor to the agricultural extension service.

The Institutes were traveling lectures that served as a forum for farmers to learn about new techniques and methods – the new scientific agriculture – "from trained scientists and from progressive and successful farmers," according to historian Roy V. Scott (Scott 1970: 93). Pioneered in the Midwest by the Kansas Agricultural College and eventually offered in 41 states, Farmers' Institutes were the first popular technique – other than agricultural fairs – for directly reaching large numbers of ordinary farmers. In 1913 at the peak of the movement, nearly 3 million rural people attended sessions nationwide (Scott 1970: 21, 58, 73, 93).

The University of Minnesota's College of Agriculture operated the Farmers' Institutes program in Minnesota as a way to reach ordinary practicing farmers – and bolster the College's credibility. Just prior to beginning the Institutes, the College held a series of one- to four-week courses at the Minneapolis campus in 1882-1884. Attendance was good, but most participants were from the Twin Cities area. Authorities concluded "somewhat reluctantly that lecture courses conducted on campus constituted no final answer to the problem of reaching common farmers," according to Scott (Scott 1970: 71).

In 1886, reacting to scathing criticism by the Minnesota Farmers' Alliance and the Grange, the University Board of Regents funded the first traveling series, beginning with 31 lectures and demonstrations around the state (Scott 1970: 82). The next year the Minnesota Legislature began to contribute funding.

The Minnesota Farmers' Institutes was governed by an independent board of directors which appointed a superintendent to manage the program. O. C. Gregg, who made his own Coteau Farm available for agricultural experimentation, led the Minnesota Farmers' Institutes for two decades. He put together a cadre of successful farmers and agricultural experts who traveled the state. By the end of Gregg's tenure in 1907, the Minnesota Institutes had become tremendously popular, and more than 150 meetings a year were being held in scores of communities. Attendance grew from 20,000 per year during the early 1890s to 67,000 per year in 1906-1907 (McNelly 1960; Scott 1970: 83, 105).

Early Farmers' Institutes were often two- or three-day affairs, although later, one-day meetings known in Minnesota as "schoolhouse institutes" became common. Each day, there would be five or six lectures, each followed by a discussion period that gave audience members "valuable insights into the methods of successful neighborhood farmers," writes Scott. Participants shared a noon meal, and there was "considerable socializing among neighbors and members of the lecture force." In Minnesota the Institutes were usually held in late fall and winter, when farmers had more leisure to attend. Later, summer Institutes were added (Scott 1970: 93-94, 96, 104, 108).

Topics covered the spectrum of state agriculture. Early Institutes stressed farm diversification, teaching farmers about the benefits of crop rotation and raising livestock. They often included hands-on sessions with livestock judging, butter churning, demonstrations of technology such as milk testers and cream separators, and scale models of well-designed farm buildings (Scott 1970: 96, 108).

In the late 1880s programs were added for farm women and youth. Farmers' Institutes programs for women never caught on like those for men, however. After 1900, Minnesota Institutes officials helped organize women's clubs as an alternative method of reaching women (Scott 1970: 117-119, 120-121).

For the first 20 years, most Minnesota Farmers' Institutes presenters were successful farmers whose abilities were widely respected. In fact, the first director, O. C. Gregg, "insisted upon the use of purely 'practical' lecturers, men who had actually performed on the farm the tasks and methods they described," according to Scott (Scott 1970: 98).

After about 1900, as ordinary farmers became better educated, they refused to attend Institutes where, according to an extension historian, "the speakers in reality knew little more than the members of the audience." Instead, farmers wanted to hear from specialists – college-trained staff "whose knowledge of a subject was far more thorough than that of even the most outstanding farmer." In the beginning, O. C. Gregg's practical approach had been important in getting the ear of the farmer, "but it became apparent that scientifically trained men and women" were needed for this type of adult education (McNelly 1960: 16). For that reason, Minnesota presenters after 1907 were usually university and experiment station staff.

Around 1890 the Minnesota Farmers' Institutes began holding special meetings devoted to the production of a single crop or type of livestock such as growing spring wheat, sheep-raising, sugar beets, or dairying. An annual State Fair Institute was established about the same time (Scott 1970: 109).

Between 1888 and 1925 the Minnesota Farmers' Institutes published thick, heavily illustrated *Annuals* containing articles by presenters, experiment station staff, and University faculty (Scott 1970: 97). The *Annuals* were free and supported by advertising. By 1910 distribution of the *Minnesota Farmers' Institutes Annual* reached 50,000 copies a year. Among the contents were numerous articles on the design and construction of farm buildings with titles such as "Model Chicken House" (1891), "A Cement Stave Silo" (1911), and "A Sheep Barn" (1914). The advertisements in the *Annuals,* many of them illustrated, were also a useful reference for farmers (McNelly 1960: 24; Scott 1970: 97; Abraham 1986: 39).

In 1909, the Minnesota Farmers' Institutes were placed within the newly-formed Division of Agricultural Extension (i.e., Minnesota Extension Service) of the University of Minnesota (McNelly 1960: 27). By 1914, when the federal and state governments began a cooperative extension service, the Farmers' Institutes had started to become obsolete. Critics complained that the Institutes used experts who were unfamiliar with the region, and the information they provided was often too general to be useful or was based on personal experience rather than scientific inquiry. Even lectures by trained experts couldn't provide the kind of specific guidance more and more farmers wanted.

The last Minnesota Farmers' Institutes were held in 1925. By then Minnesota had a network of professional extension agents who worked directly with farmers in each county. Scott explains, "Essentially, institutes were a transitional stage in the evolution of a teaching method for the countryside. By suggesting better methods of farming, they opened the eyes of many farmers to the opportunities that science offered" (Scott 1970: 137).

The Farmers' Institutes had been very successful. In 1913 a USDA survey found that about half of farmers in the Upper Midwest had attended Farmers' Institutes, and of those, about half had put into practice something they had learned there (Smith and Atwood 1913: 17-18). The Institutes "had driven a wedge into the wall of suspicion and distrust that had characterized rural attitudes toward science," writes Scott (Scott 1970: 102). They had "aroused interest in scientific agriculture, . . . suggested to farmers that agriculture colleges had something to offer, . . . and showed that farmers with no more than common-school educations" were receptive to learning about innovations and techniques that could lead to better farming (Scott 1970: 106-107).

MINNESOTA EXTENSION SERVICE (AND COOPERATIVE EXTENSION SERVICE)

Historian Roy V. Scott writes that, before the advent of agricultural extension,

> . . . agricultural leaders labored energetically if largely in vain to induce the rural population to improve its farming methods. . . . Agricultural societies, fairs, farm papers, land-grant colleges, and experiment stations appeared, but none met adequately the needs of agriculture. Essentially, such individuals and agencies were unable to reach and influence in an effective way the great body of ordinary farmers. To do so was the great task of agricultural extension (Scott 1970: 3-4).

According to Scott, the concept of agricultural extension is as old as the American republic: "Both Washington and Jefferson envisioned the establishment of some arrangement by which farmers might come into direct contact with men who could give them the instruction they needed" (Scott 1970: 34). The legislation creating the United States Department of Agriculture in 1862 gave the agency the duty "to diffuse among the people . . . useful information on subjects connected with agriculture" (Scott 1970: 35-36). The Morrill Land Grant College Act of 1862 suggested an extension role for the land-grant agricultural colleges, and the University of Minnesota College of Agriculture first began offering outreach programs for farmers in 1882. However, by the early 1900s, it was clear in Minnesota, as elsewhere, that these early activities were not enough. In 1908, the Association of Agricultural Colleges and Experiment Stations, which played a major role in establishing the Cooperative Extension Service, declared:

> The present scope of dissemination work among farmers is entirely inadequate. There are tens of thousands of farmers who do not take agricultural papers; probably not one farmer in 25 ever attends a farmers' institute; there is a comparatively small amount of . . . study of agricultural literature among farmers. . . . As a plain matter of fact, we are not today, either directly or indirectly, reaching the great masses of the tillers of the soil (quoted in Scott 1970: 167).

In 1909 the Minnesota Legislature passed the Minnesota Agricultural Extension Act which enabled the Minnesota Extension Service, to be operated by the University of Minnesota. This extension organization was reinforced and expanded five years later when Congress passed the Smith-Lever Act of 1914 which established the federal-state Cooperative Extension Service, a collaboration between the USDA and the land-grant colleges nationwide.

The University of Minnesota's extension program operated for about five years – 1909-1914 – before the federal government joined the effort with the Smith-Lever Act. The University's first Extension director was A. D. Wilson, a University of Minnesota graduate who had succeeded O. C. Gregg as superintendent of the Minnesota Farmers' Institutes in 1907. During those first five years Wilson appointed specialists in farm crops, livestock, poultry, horticulture, home economics, and club work to travel around the state offering field demonstrations and lectures. The work of these traveling teachers was supplemented by educational bulletins distributed free to anyone who wanted them (Gray 1951: 119; McNelly 1960: 22-23, 28).

The first county extension agents in Minnesota – in other words, Extension staff who actually lived and worked in rural counties – were hired in 1912. By this time, many in agriculture and government had become convinced that, in the words of Scott, "the man in the field offered the best hope for effectively instructing farmers" (Scott 1970: 261). Business leaders, too, were pushing the agricultural colleges to move beyond traveling lectures and "name agents who would go to private farms and in various ways aid farmers with their specific problems" (Scott 1970: 186, 200, 261, 304). In fact, it was a group of businessmen, the West Central Development Association, that launched the county extension agent movement in Minnesota (with encouragement from the West Central School of Agriculture and Experiment Station). The group raised money to hire agents in Traverse, Stevens, Grant, Pope, and Otter Tail counties. The first to be placed was Frank Marshall, county extension agent who was stationed in Traverse County in the fall of 1912.

In 1913, the state legislature set aside money to extend the county extension agent program to 25 counties. The University's Extension office assumed overall direction of the work (Scott 1970: 278).

The program was greatly strengthened in 1914 with the passage of Smith-Lever and the establishment of the federal-state Cooperative Extension Service. The Service was financed by a combination of federal, state, and local funds. In Minnesota, county extension agents were hired and paid jointly by the USDA, the University of Minnesota, and each county, which levied local property taxes to pay its share. The Smith-Lever Act of 1914 also allowed private businesses and farmers' organizations to contribute to extension.

In the beginning, not all Minnesota farmers welcomed the appearance of county extension agents in their communities, a situation that led the Extension Service to collaborate with county Farm Bureau groups to gain local support. In Minnesota, Farm Bureau associations in each county provided substantial funding for early extension work, and provided county-level program direction. In 1921, for example, Farm Bureaus covered 30 percent of county agent salaries and expenses in Minnesota (McNelly 1960: 175). In some cases, the county agent conducted business on Farm Bureau letterhead. The involvement of a private farm association in a public education program eventually caused considerable conflict including objections from farmers' organizations who opposed the Farm Bureau's sometimes conservative politics. A 1954 Minnesota law required the Farm Bureaus to withdraw from the public extension service (Goodhue County 1954; Cochrane 1993: 251).

In Minnesota, the early Extension program was also opposed by some because of Extension's ties to business (Scott 1970: 286). Grain buying companies, banks, land agents, and other agri-businesses enthusiastically supported Extension work, believing that their economic fortunes would also benefit from greater farm productivity. Some farmers were also mistrustful of college-educated county extension agents who tried to tell them how to run their farms. A Grant County farmer summed up the resentment farmers felt towards extension in a 1916 letter to the local paper: "One would think from the interest the land agents and businessmen take in the poor ignorant farmer that they (the farmers) should have guardians appointed over them" (quoted in McNelly 1960: 38-41).

After a shaky start, county extension work in Minnesota gained firm footing after 1917, when the United States entered World War I. The Emergency Food Production Act of 1917, aimed at boosting the food supply, increased federal funding for county extension work. By 1918, agents had been placed in every Minnesota county except Cook County and, writes Cochrane, "the county agent traveling about in his Model T Ford became the symbol of technological advance on American farms" (Cochrane 1993: 250).

In the mid- and late 1920s, as 1921's agricultural depression worsened, extension suffered new setbacks. Many Minnesota counties couldn't afford to pay their share of extension costs and 30 counties – more than one-third – were forced to drop their agents. "During these years the counties that had dropped county agent work made little progress in organization or technical development," one historian of the movement wrote. "This situation could be observed by driving through the counties. . . . There were fewer acres of alfalfa and fewer of the newer varieties of farm crops. The quality and condition of livestock was below average" (McNelly 1960: 87-88).

During the Depression of the 1930s the federal government provided new infusions of money for county agent work. The Extension Service also administered federal emergency aid programs for farmers. In the 1940s the Extension Service again worked to boost food production and organized many wartime aid projects. After World War II as farming technology advanced rapidly, the Extension Service hired many and varied specialists who carried specific technical information to farmers.

Gradually, the county extension agent became more of "a program chairman for his farmer clients," according to Cochrane, arranging meetings and conferences on different technical subjects, and bringing in experts to provide farmers with the latest technical information (Cochrane 1993: 251).

Scope of Work. Extension work was essentially teaching, and county extension agents were, in fact, off-campus members of the University of Minnesota faculty and staff. Minnesota extension agents also cooperated with other rural educational agencies. They participated in farmers' institutes and short courses, worked with boys' and girls' clubs, and encouraged the teaching of agriculture in public schools. They also collaborated with livestock and breed associations, crop improvement organizations, cooperative buying and marketing clubs, and farm management groups (Scott 1970: 284; Cochrane 1993: 251).

Extension agents offered farmers practical knowledge in every agricultural discipline. Early extension work in Minnesota emphasized crop diversification and livestock improvement. Early extension efforts also included soil testing, use of fertilizers, control of crop diseases, orchard management, drainage ditches, poultry culling, cow testing, rodent control, and stump blasting. In 1914 extension agents helped vaccinate more than 100,000 hogs against cholera. County agents also distributed to many Minnesota farmers the first alfalfa seed they had ever seen, thereby encouraging the growth of the forage crop strongly linked to crop rotation and the rise of Minnesota dairying. Extension agents also encouraged farmers to build silos to provide winter forage feed for dairy cows.

In the 1920s and 1930s, the scope of extension work widened with work in balanced livestock feeding, livestock parasite control, dairy herd improvements, artificial breeding, livestock housing, other farm buildings, labor-saving production methods, pasture improvements, and milk quality improvement. County agents were heavily involved in helping control contagious livestock diseases such as bovine tuberculosis and brucellosis. Extension agents administered federal emergency livestock feed loans and seed loans. Agents demonstrated the use of colony housing for chicks and piglets to improve sanitation and reduce disease. They also encouraged farmers to plant shelterbelts and woodlots, and offered instruction in farm woodlot management and wood products marketing (McNelly 1960; Pates 1999).

In the late 1930s and 1940s, the Extension Service added soil conservation, land use management, and tree planting programs. When infestations of corn borers and grasshoppers appeared in the state, agents organized emergency control measures and demonstrated new insecticides and field application equipment. They also worked with local and state officials on weed control.

After World War II, the Minnesota Extension Service conducted land use studies, encouraged counties to develop wildlife refuges, continued to teach farmers about soil conservation, and helped organize soil conservation districts. They encouraged pasture improvements, with Hay and Pasture Days events in 1947 drawing 35,000 farmers. As new fertilizers and weed control chemicals were developed, agents encouraged their use. When artificial insemination became affordable, extension agents also explained and demonstrated this new technology. As livestock herds grew, extension agents educated farmers about improved swine production methods including confinement housing, farrowing timing, and effective marketing (McNelly 1960: 134-161; Pates 1999).

In the 1940s and 1950s, extension educators also stressed better farm management including business accounting, farm credit study, and marketing. Farm management studies revealed wide variations in returns among farmers operating in the same community, and "furnished valuable ammunition to the county agents for their farm management teaching" (McNelly 1960: 37). The management studies led to the development of the Minnesota farm accounts book, a farm bookkeeping aid. Later, farm management associations were organized with several dozen farmers and an instructor, who was paid jointly by the Extension Service and farmers.

Extension work with women began during World War I with demonstrations on canning food, nutrition, and clothing construction. By 1917 Minnesota Extension had 12 home economists who, during the war, gave instruction to "rural women and girls in practical methods of increasing food production and eliminating waste and prompting conservation of foods" (McNelly 1960: 51). Between the 1920s and 1950s, many of the Extension Service's efforts for women occurred through homemakers' clubs, also called homemakers' demonstration groups, which kept farm women abreast of new developments in the rising field of home economics. Topics included clothing, sewing, and dressmaking; home furnishing, organization, and modernization; home management; nutrition and food selection; child care, child development, and family living; poultry management; and food production, preparation, and preservation. Annual county fairs were also a useful way for Extension home economist to reach rural women (Scott 1970: 284; Cochrane 1993: 251; McNelly 1960: 53, 89-90, 166-173; Pates 1999).

Farmhouse Improvement. Before the end of World War II, most Minnesota farmhouses still lacked modern conveniences like running water and indoor bathrooms. In 1946, as farm prosperity grew, Minnesota Extension began a major educational push for farm home improvements. The Extension Service worked in areas such as water, plumbing, and sewage disposal systems; central heating systems; electric lighting; new home construction; kitchen modernization and reorganization; and farmstead landscaping and home beautification (McNelly 1960: 162-164).

Assisting Farmers' Organizations. The Extension Service helped organize and worked with livestock and breed associations, crop improvement organizations, cooperative buying and marketing clubs, and other groups. The first Extension dairy specialists, for example, worked intensively with creamery boards, stressing the importance of improving butter quality and helping to organize cooperative dairy marketing associations.

Beginning around 1910 the Extension Service also educated farm boys and girls through what became the 4-H Club program. Eventually 4-H clubs expanded to the point that many counties employed a full-time 4-H club agent as part of the extension staff (Goodhue County 1954; McNelly 1960).

Demonstration and Test Plots. In the early years of Minnesota Extension, specialists worked with private farmers to demonstrate improvements that could serve as examples for other farmers in the area. Drainage systems were one example. Demonstration farms had also been used earlier by railroads and other private businesses to show farmers the results of scientific methods. However, demonstration farms suffered from "fatal weaknesses as a teaching device," according to Scott (Scott 1970: 185). Although farmers would visit a model farm to see what was being done, they invariably discounted the results, saying that the techniques used were impractical on their own farms (Scott 1970: 185, 258).

In Minnesota, Extension officials soon adopted different demonstration approaches. Field plots became an important teaching tool – one that the Great Northern Railway had used effectively in Minnesota in the early 1900s. Demonstration plots were small fields planted along busy roads throughout the county and identified with signs so passing farmers could see the results. The plots were used to demonstrate new crops and crop varieties; hybridization; weed spraying results; fertilization methods; drainage; and other new methods and technologies. Livestock demonstrations, such as swine and poultry sanitation and turkey confinement production, were similarly demonstrated (McNelly 1960: 84).

Publications. In 1909, the legislation enabling the Minnesota Extension Service mandated the publication and distribution of educational bulletins. The new Extension Service in 1910 began issuing free monthly bulletins under the title *Minnesota Farmers' Library*.

The first issue of the *Minnesota Farmers' Library* was devoted to farmers' clubs. Subsequent bulletins covered diverse agricultural topics. Farm structures were examined in articles such as "Two Types of Silos at Northwest Experiment Farm" (1913) and "Model Farm Houses" (1914).

Among the most influential articles in the *Farmers' Library* was T. L. Haecker's "Feeding the Dairy Herd" (1913), which became a classic that was revised and reprinted many times. The *Minnesota Farmers' Library* series included only 65 titles, dating mostly from the early 1910s, although several were revised and reissued as late as 1919 (Abraham 1986: 39). (Note: In this historic context study's bibliographic citations, articles from the *Minnesota Farmers' Library* are not identified as such but instead are listed under *Minnesota Agricultural Extension Service Bulletin*, which is the series that subsumed the *Farmers' Library* in 1915.)

A 1913 USDA study suggested that agricultural bulletins such as the *Minnesota Farmers' Library* were quite influential with farmers. In the Upper Midwest, about 40 percent of farmers received state bulletins, and more than 90 percent who received them actually read them. About half of farmers surveyed said they had put bulletin suggestions into practice on their own farms (Smith and Atwood 1913: 16).

The *Minnesota Agricultural Extension Service Bulletin*, published from 1915 to the present, descended from the *Minnesota Farmers' Institutes Annual* and the *Minnesota Farmers' Library.* Like its predecessors, the *Extension Service Bulletin* provided farmers with practical, easy-to-understand information, in contrast to the experiment station bulletins, whose articles were longer and more technical. Through the decades Minnesota Extension issued a voluminous stream of free bulletins, pamphlets, how-to guides, building plans, and other written materials, printing as many as 60,000 copies of the most popular titles (Abraham 1986: 53, 64-65).

In addition to distributing the publications originating in St. Paul, many extension agents published a county extension newsletter, which contained farm auction ads, informative columns, and local extension news. Agents also wrote original material for local weekly newspapers. In the mid-1920s they began doing frequent radio broadcasts.

BOYS' AND GIRLS' CLUBS AND 4-H CLUBS

Clubs for farm boys and girls were formed in the U.S. beginning about 1902. The clubs were a practical way to interest farm youngsters in agriculture and show them the value of improved farming methods and better homemaking. First separated by gender, the clubs were created spontaneously all over the Midwest, encouraged by Farmers' Institutes, high school and college officials, Farm Bureau chapters, other agricultural associations, and businesses. The land-grant colleges were enthusiastic supporters, too, "eager to adopt any technique that promised to take science into the countryside," according to Scott (Scott 1970: 125). He believes it would have been impossible to introduce cooperative extension programs for adult farmers if the boys' and girls' clubs had not paved the way (Scott 1970: 244). After about 1914, most clubs were operated through the Minnesota Extension Service.

In Minnesota, boys' and girls' clubs began in 1904 in Douglas, Olmsted, and McLeod counties. The success of such clubs stimulated widespread interest in educational programs for farm boys and girls throughout the Midwest (Scott 1970: 124-126; McNelly 1960: 49).

Boys' and girls' clubs were originally independent and diverse. By 1913, however, the 4-H symbol – a four-leaf clover representing head, hand, heart, and health – was being used to give clubs nationwide a single identity. The 1914 Smith-Lever Act provided federal funds to support farm youth clubs, and county extension agents began to assume responsibility for organizing and guiding them. Soon a national 4-H organization, supported by federal appropriations, was created.

The county extension agent typically spent about one-third of his time on 4-H work, including monthly meetings, 4-H tours, the county fair, and state and national fairs, camps, and shows (Scott 1970: 49-50; Plank 2002: 5; McNelly 1960: 167-169). In some counties a full-time 4-H coordinator was added to the extension service staff.

By the 1940s, 4-H was well-organized in Minnesota. Most counties had a dozen or more clubs, as well as a countywide 4-H federation. In 1951, there were nearly 2,000 4-H clubs in Minnesota, with 51,000 members and 6,000 adult leaders.

AGRICULTURAL COURSEWORK IN NON-UNIVERSITY HIGH SCHOOLS

The Minnesota Farmers' Alliance, the Grange, and other farmers' organizations lobbied strongly for agricultural and vocational training in public high schools, and agricultural experts supported such training as a good way to reach adult farmers through their children. Part of state government's response was the establishment of the University's five regional schools of agriculture, which were boarding high schools (see above).

Agricultural classes were also taught in regular public high schools beginning in the early 20th century. In 1909, for example, the Minnesota Legislature appropriated $25,000 for agricultural instruction in ten public high schools. The following session, the legislature funded courses at another 75 public schools. State funds were supplemented in 1917, when Congress passed the Smith-Hughes Act, providing federal funds for agricultural and home economics training at the high school level. By 1957, more than half of Minnesota high schools were offering agricultural education classes (McNelly 1960: 17).

In many Minnesota communities, agricultural instructors also played an extension role by visiting farmers to consult on problems, teaching evening classes for farmers, distributing building plans, and organizing boys' and girls' clubs.

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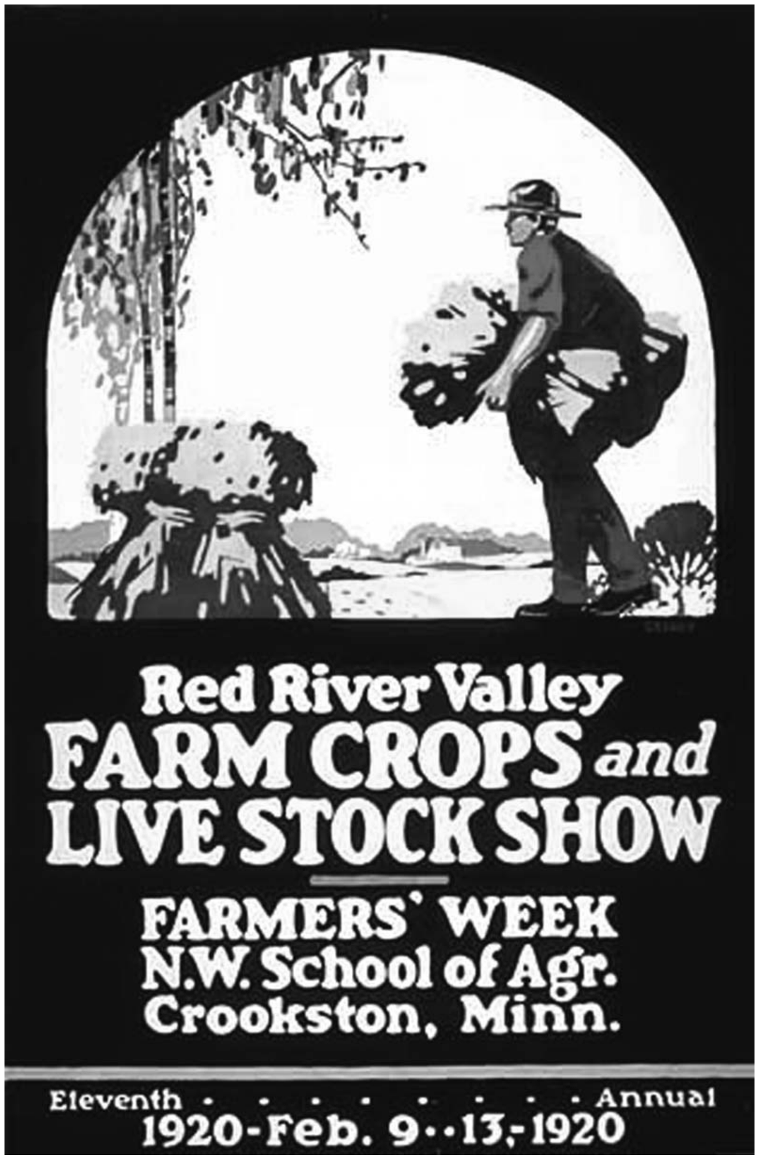
Dairy barn (1914), silo, and milk house at the West Central Experiment Station at Morris, which served 17 counties in western Minnesota. In an effort to get area farmers to diversify into dairying, Station staff distributed alfalfa seed and convinced farmers to build silos. One annual Visitors' Day in July of 1920 drew 8,000 to 9,000 people to the station to examine test plots and buildings, attend demonstrations, and socialize. Circa 1926. (West Central Minnesota Historical Research Center photo)



Crop and livestock shows, like county and state agricultural fairs, gave farmers a chance to learn about, and share their experiences with, new crop varieties, implements, livestock breeds, labor-saving devices, and farm building materials. Poster, 1920. (MHS photo)

FOCUS ON THE USDA AND THE MINNESOTA DEPARTMENT OF AGRICULTURE

Some Milestones of the USDA and the Minnesota Department of Agriculture

1849	–	Federal government began Census of Agriculture; taken every five years
1862	–	USDA established
1872	–	Minnesota Board of Health established in part to monitor milk quality
1885	–	Minnesota State Dairy Commission established; first dairy quality law
1889	–	USDA became a cabinet-level department
1899	–	City of St. Paul passed state's first city milk law
1903	–	Minnesota Livestock Sanitation Board established
1919	–	Minnesota Department of Agriculture (MDA) established in modern form
1924	–	U.S. Public Health Service developed a Standard Milk Ordinance as a model for states
1931	–	USDA created Bureau of Agricultural Engineering
1945	–	Minnesota Legislature created Grade A milk program
1949	–	MDA began regulating herbicide spraying

UNITED STATES DEPARTMENT OF AGRICULTURE

The United States Department of Agriculture (USDA) was established in 1862, the same year that the Homestead Act and the Morrill Land Grant College Act were passed. The new department's job was to provide American farmers – then more than half the population – with good information to grow their crops and livestock. The agency was given the duty "to diffuse among the people of the United States useful information on subjects connected with agriculture," according to historian Roy V. Scott (Scott 1970: 36). The agency's mission also included testing farm implements, introducing new plants and animals, and doing "chemical analyses" of soils, grains, fruits, plants, vegetables, and manure (Baker et al 1963: 11).

During its first three decades the USDA began conducting research, laying the groundwork for an even stronger research role in later years. The USDA also collected and published vast amounts of agricultural data and statistics and established an agricultural library.

Reflecting its growing importance, the USDA became a cabinet-level department in 1889. In 1897, James Wilson, a former professor of agriculture at Iowa State University, became head of the USDA. Wilson was a fervent believer in science-based agriculture. During his 16 years as Secretary of Agriculture, USDA's scientific activities were reorganized and expanded. The department conducted research in plant diseases and breeding, entomology, food safety, animal diseases, soil chemistry, drainage, irrigation, farm operations, forestry, and many other topics, playing a leading role in the professionalization of the new agricultural sciences such as agronomy and animal husbandry. Under Wilson, the USDA also began performing regulatory activities in areas such as animal and plant diseases and crop pests.

The USDA's main focus continued to be research and education until 1933. In field after field – agronomy, plant pathology and genetics, veterinary science, animal nutrition, soil science, agricultural engineering – the federal agency and the state agricultural colleges built a solid base of new knowledge. It was this knowledge that fueled agriculture's stunning technological advances after World War II. The USDA dominated agricultural research and experimentation for decades. But gradually, the state agricultural colleges and experiment stations strengthened. In the second half of the 20th century, these institutions became the pre-eminent agricultural research centers, doing both basic and applied scientific work. USDA scientists continued to complement the work of the state research institutions, but the federal agency lost its leading scientific role (Baker et al 1963: 11; Cochrane 1993: 96, 104-106, 201, 245-246).

Despite its diminished research role, the USDA remained a major player in educational outreach. Beginning in 1903 the USDA prepared bulletins, syllabi, and technical materials for use in Farmers' Institutes across the country. In 1914 the agency cooperated with agricultural colleges in establishing the Cooperative Extension Service.

The USDA also conducted animal, plant, and grain grading and inspections; regulated stockyards; offered disaster and drought assistance; established farm credit, Federal Land banks, and banks for cooperatives; created farm income stabilization programs; and studied farm risk management. The federal Bureau of Roads (now the Federal Highway Administration) was also within the USDA for many years. Other activities included food safety, labeling, and distribution; forest stewardship; natural resources conservation; marketing and export programs; nutrition and anti-hunger programs; and rural development, housing, water, and communications (Cochrane 1993: 140-143, 166, 246).

In the 1930s the USDA embarked on new activities to deal with the dire economic problems of farmers. Between 1929 and 1932, farm prices had fallen almost 50 percent. In 1933, under the Roosevelt administration, Congress passed the Agricultural Adjustment Act (AAA), which aimed to shore up farm incomes, stabilize crop prices, and control crop production. The AAA was the first of numerous federal farm support programs, many of which continue today. The USDA's mission widened to carry out the federal government's "widespread intervention into the operating economy on behalf of farmers," according to economist and historian Willard Cochrane (Cochrane 1993: 343). Running programs to address rural economic ills became one of the USDA's main tasks (Cochrane 1993: 120, 140-143, 166, 246, 343).

Public funding for agricultural research increased after World War II. In 1946 Congress passed the Research and Marketing Act of 1946 that broadened USDA's research to include the marketing, transportation, and distribution of farm products. The act also focused research on human nutrition and the food value of agricultural products. A USDA Marketing Research Report entitled *The Organization of Wholesale Fruit and Vegetable Markets in Minneapolis-St. Paul and Duluth-Superior* (Hanes 1964) is an example of such studies.

Information. The USDA's Census of Agriculture has been published every five years, since 1840. The USDA began publishing crop reports in 1863. The first reports helped farmers assess the value of their farm products at a time when commodity buyers had more current and detailed market information than farmers – a circumstance that often prevented farmers from getting a fair deal. Since 1905, USDA's Crop Reporting Board, now called the National Agricultural Statistics Service (NASS), has published weekly, monthly, and annual reports covering numerous aspects of agriculture. The USDA has published an annual *Yearbook of Agriculture* under that title since 1895.

Farm Buildings. The USDA's agricultural engineering research and activities included irrigation, drainage, soil conservation, and the design of farm structures and machinery. Responsibility for these functions moved frequently within the agency. From 1898 to 1931, several divisions within the USDA's Office of Experiment Stations had responsibility for rural engineering and drainage research. In 1931, a separate Bureau of Agricultural Engineering was established. It lasted until 1938 when it merged with the Bureau of Chemistry and Soils. Later, agricultural engineering and drainage research were assigned at various times to the Bureau of Chemistry and Engineering, the Soil Conservation Service, and the Bureau of Plant Industry.

One of the USDA's first drainage research projects was an investigation, begun in 1890, to determine proper locations for artesian wells on the Great Plains. Later, federal drainage investigations were conducted in the Red River Valley.

The Bureau of Agricultural Engineering published research on irrigation and drainage surveys, hydrology, and soil erosion, as well as river maps and profiles. Other Bureau publications included the history of tractors, farm operating efficiency studies, and rainfall and water flow records. Examples of USDA bulletins on farm structures include *Roadside Markets* (1932) and *Loose Housing for Dairy Cattle* (1953).

The USDA also supplied building plans to farmers, similar to those drawn and distributed by the agricultural colleges and experiment stations. In 1929 and 1930, the USDA carried out a study of the status of farm structures research in the U.S. Hired to lead the study and report its results was Henry Giese of the University of Iowa, one of the country's leading experts on farm building design (Giese 1932). In the 1930s USDA researchers cooperated with state agricultural engineers' offices and agricultural experiment stations to study farm operating efficiency. In 1932 the USDA helped found the Midwest Plan Service, a cooperative effort of public agencies to draw and distribute farm building plans in the Midwest.

In 1910 the USDA's Forest Service established the Forest Products Laboratory in Madison, WI, which became the nation's leading center for research on wood products. The Laboratory tested the application of new materials such as plywood for agricultural buildings. The 1939 USDA bulletin entitled *The Glued Laminated Wooden Arch* was based on research conducted in Madison.

County extension agents. See "Focus on University of Minnesota Programs" in a separate appendix.

MINNESOTA DEPARTMENT OF HEALTH AND MINNESOTA DEPARTMENT OF AGRICULTURE

The Minnesota Board of Health was created in 1872. Historian Philip D. Jordan has written, "almost from its beginning [the Board] took an active interest in safeguarding the public from diseased foods and unclean milk, butter, and cheese. It urged cleanliness, inspected dairy cattle and farms, stood behind local health officers, drew up model acts designed to prohibit [food] adulteration, and, after many years, finally succeeded in establishing a restaurant and food inspection program" (Jordan 1953: 149).

By the 1880s the state Board of Health was diagnosing diseases of animals and quarantining or destroying the animals, particularly when the diseases were also shared with humans. Of particular danger was bovine tuberculosis which could infect humans through milk, butter, and cheese, helping spread tuberculosis throughout the state. The state board also educated the state's frontier doctors and farmers about pasteurization, the process developed in 1864 of heating milk sufficiently to kill bacteria (including tuberculosis pathogens) but preserve the milk's quality. The Board's laboratory was located at the University of Minnesota. The board also worked for a safe meat supply by encouraging sanitary slaughterhouses and butcher shops and supporting municipal efforts in these areas (Jordan 1953: 69-71; 150-151).

The Board of Health had a Veterinary Department that was active by 1885 and based at the University's St. Paul campus. In 1897 the department succeeded in convincing the Minnesota Legislature to pass a law providing for the condemnation of cattle with tuberculosis. In 1903 the legislature created a State Livestock Sanitary Board with an increased mandate and funding. For decades the Board worked to control tuberculosis and other infectious diseases among animals (Jordan 1953: 83).

Dairy Regulation. A collection of state, municipal, and federal dairy laws and programs were developed beginning in the late 19th century to protect public health and insure the quality of dairy products. The state boards of health and agriculture, as well as city public health departments and federal agencies participated in the effort. Milk production and milk handling became the most regulated activity on Minnesota farms.

Dairy products in the 1870s and 1880s, in addition to sometimes being spoiled or carrying tuberculosis, were sometimes "stretched" with foreign substances before they reached the consumer. Milk, for example, could be diluted with water and chalk. To combat this problem, the Minnesota Legislature passed the first state dairy quality law in 1885. The law prohibited the adulteration of dairy products, prohibited the sale of oleomargarine (a provision to protect the dairy industry), and established a Minnesota State Dairy Commission to monitor the quality of dairy products.

The State Dairy Commission, which was the forerunner of the Minnesota Department of Agriculture (MDA), was given increased authority in 1889 to regulate the production, processing, inspection, and sale of dairy and all other food products. The Minnesota Department of Health and the State Dairy Commission enforced increasingly stringent dairy laws that affected the design and operation of dairy barns, milking barns, and milk houses on Minnesota farms. The State Board of Health visited 585 dairies in 1902 and found "only 7 could be classed as excellent; 164 were called good, 186 fair, and 229 unsatisfactory," according to Jordan (Jordan 1953: 83).

In 1899 the City of St. Paul passed a milk quality ordinance, apparently the first city ordinance of this type in the state (Jordan 1953: 161-163).

A statewide movement for cleaner, safer milk began in the mid-1910s and gathered strength through the 1920s, encouraged by the action of women's clubs throughout the state. In 1917, in an effort to increase milk pasteurization, the Minnesota Department of Health successfully urged the American Public Health Association to develop a program of pasteurization standards and the U.S. Public Health Service to create an advisory board on milk sanitation. The Minnesota Department of Health "is said to be the first in the United States to consider pasteurization a public health engineering program on a par with sewage control and [drinking] water pollution," writes Jordan (Jordan 1953: 165).

In 1917 Winona was probably the first city to require that all milk in the city meet state quality standards – primarily that the milk be from cows tested annually for tuberculosis – but also regulating the proper cooling of the fresh milk and conditions such as the location of on-farm privies near dairy barns. In 1919 the University of Minnesota offered a short course on the operation of milk pasteurization plants, "believed to be the first [course] of its kind in the nation" (Jordan 1953: 169). In 1922 Winona was one of the first cities to require that all milk be pasteurized.

In 1924 the U.S. Public Health Service published a "Proposed Standard Milk Ordinance" that helped guide many state and local laws. It is now in its 24th revision and still guides the dairy industry.

By 1925, 106 cities in Minnesota had ordinances controlling the quality of milk sold within their borders. Most forbade the sale of adulterated milk and raw milk with high bacteria counts, although few required pasteurization. Many milk suppliers, including those in Minneapolis, resisted pasteurization and tuberculosis testing. In 1930 about 18 percent of milk consumed in Minnesota was unpasteurized (Jordan 1953: 168-173).

In 1945 the Minnesota Legislature established the "Grade A" milk program, which set minimum bacterial counts for what was called Grade A milk, both pasteurized and raw. Grade A milk was sold for fresh consumption, while Grade B milk was sold to food processors. According to Jordan, the legislature also "made provision for the establishment of production standards," presumably allowing regulation of dairy farm conditions statewide. The control of pasteurization plants also moved from the State Board of Health to the Minnesota Department of Agriculture in 1945 (Jordan 1953: 174).

In 1945, 25 Minnesota cities required that all milk be pasteurized, 12 cities had ordinances that followed federal U.S. Public Health Service models, and 8 required that milk be rated. In that year there were 250 pasteurization plants in Minnesota. Beginning in 1949, state law required that all milk be pasteurized (Jordan 1953: 174; MDA ca. 2002).

Minnesota's dairy laws were revised and strengthened in the 1970s.

Other Department of Agriculture Activities. Major areas of MDA jurisdiction through 1963 are listed below. Those that predate 1919 were started by the State Dairy Commission, the predecessor of the Minnesota Department of Agriculture (MDA ca. 2002).

- weed control regulation (beginning 1885)
- grain inspection (beg. 1885)
- licensing and inspection of food processing and food-related facilities (beg. 1887, 1889, 1905, 1913)
- administering the Minnesota Pure Food Law (beg. 1906)
- regulation of food labeling and advertising (beg. 1907, 1915)
- regulation of cigarette sale and distribution (beg. 1914)
- sale, labeling, and inspection of agricultural seeds and seed potatoes (beg. 1927)
- regulating grades of produce; licensing wholesale food dealers (beg. 1931)
- regulation of herbicide spraying (beg. 1949)
- licensing of slaughter and packing plants (beg. 1955)
- licensing of all food handlers (beg. 1955)
- regulation of egg grading, candling, cleaning, handling, and sales (beg. 1957)
- responsibility for promoting and expanding markets for Minnesota farm products (beg. 1963)

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The USDA supplied building plans to farmers, similar to those drawn and distributed by the agricultural colleges and experiment stations. In 1932 the USDA was one of the agencies that helped found the Midwest Plan Service, a cooperative effort of land-grant colleges to draw and distribute farm building plans in the Midwest. (It is not known whether the builders of the barn pictured above were influenced by a source like the USDA.) Location known, circa 1910. (MHS photo by Harry Darius Ayer)

The Minnesota Department of Agriculture played a leading role in regulating the way milk was collected, handled, sold, and bottled. These laws influenced the design of dairy barns, milk houses, and milking barns. In 1945, the Department's certified Grade A milk program was established. As regulations increased, some farmers chose to retire or stop milking cows rather than modernize their dairy operations. Location unknown, 1923. (MHS photo by Henry A. Briol)

FOCUS ON FARMERS' ORGANIZATIONS

Some Milestones of Minnesota Farmers' Organizations

1850s	–	Minnesota's first agricultural societies organized
1854	–	Minnesota's first agricultural fair held
1854	–	Minnesota Territorial Agricultural Society established
1867	–	The Grange founded
1874	–	Minnesota State Poultry Association founded
1877	–	Minnesota Stock Breeders' Association established
1882	–	Minnesota Butter and Cheese Association formed
1891	–	Populist Party formed by the Farmers' Alliance
1900	–	Minnesota's first Farmers' Clubs organized
1913	–	Minnesota's first Farm Bureaus formed
1944	–	Democratic and Farmer-Labor parties merged

In a nationwide survey sponsored by *Farmer's Wife* magazine in 1921, farm women reported that a number of organizations were helpful to them. Among the most commonly mentioned were local farmers' clubs (also called community or township clubs). Also cited were cooperative shipping associations, cooperative creameries, a "potato exchange" [apparently a sharing of harvest labor], grain growers' associations, and the Grange. Survey respondents also mentioned study clubs, social clubs, boys' and girls' clubs, the local Farm Bureau, and church groups (Lundquist 1923: 17-18).

EARLY AGRICULTURAL SOCIETIES AND FAIRS

According to historian Merrill E. Jarchow, until about 1870 "the whole burden of agricultural experimentation, instruction, extension, and recreation fell upon agricultural societies whose work was carried on mainly through state and local fairs" (Earle D. Ross quoted in Jarchow 1949: 245). This pattern was repeated nationwide, where agricultural societies and agricultural fairs provided forums for innovators to discuss new ideas and improved farming methods, especially in the years before agricultural colleges, experiment stations, and extension services were founded. The design of farm buildings and structures was often on the agenda of these organizations.

Agricultural Societies. The first agricultural society in the U.S. was founded in Philadelphia in 1784, and the first in Minnesota was established in the 1850s. Early societies were made up mainly of wealthy gentleman landowners. They encouraged their members to experiment with new farming ideas, usually imported from Europe. Many groups sponsored exhibitions and field trials, published their transactions, and wrote articles for farm periodicals, thereby reaching beyond their members to a larger audience of farmers.

State societies and a national coalition (the United States Agricultural Society, formed in 1852) pressed for the establishment of federally-supported agricultural schools, colleges, model farms, and the U.S. Department of Agriculture (USDA), which was established in 1862. By the late 1860s, there were some 1,330 societies in the United States (McNelly 1960: 21-22; Scott 1970: 9-17; Cochrane 1993: 240).

In Minnesota, agricultural societies were first organized in the 1850s in populous counties such as Ramsey and Hennepin, soon followed by groups in Dodge, Dakota, Fillmore, Faribault, and McLeod counties. A statewide alliance, the Minnesota Territorial Agricultural Society (later the Minnesota State Agricultural Society) was formed in 1854. By 1874 the number of county societies had grown to 43. These organizations sponsored agricultural fairs and stimulated interest in improved farm machinery, better cropping methods, "the importation of blooded stock and the introduction of choice seeds, grains, and fruit trees," writes Jarchow (Jarchow 1949: 248).

Specialized Associations. As agricultural production increased nationwide, specialized societies appeared to promote the development and improvement of specific fields of agriculture. In Minnesota, many were organized in the late 1870s. Examples include the Minnesota State Poultry Association (est. 1874), Minnesota Stock Breeders' Association (est. 1877), Minnesota Dairymen's Association (est. 1878), Minnesota State Wool Growers' Association (est. 1879), Minnesota Butter and Cheese Association (est. 1882), Excelsior Fruit Growers Association (est. 1900), and the Twin City Milk Producers' Association (est. 1916). Some of these groups became involved in the dissemination of new designs and technologies for particular types of farm buildings.

Agricultural Fairs. Most county and state agricultural societies sponsored a fair where crops, vegetables and fruit, livestock, machinery, and household and domestic products were displayed and prizes awarded. In the mid- and late-1800s, before other agencies existed to instruct farmers, "fairs were the only means by which large numbers of ordinary farmers might be contacted directly," according to historian Roy V. Scott (Scott 1970: 16).

Fairs celebrated the harvest, and gave farmers a chance to learn about new crop varieties, implements, livestock breeds, labor-saving devices, and farm building materials. Until about 1870, they were primarily educational, consisting of stock and crop exhibits and informative talks, with amusements and entertainment being added in later years. Fairs provided a venue for the agricultural college and extension service to pass on scientific agricultural methods – including those related to farm building design and technology. Fairs also influenced farm building construction through commercial exhibitors who introduced farmers to innovations like cement staves, structural clay tiles, glue-laminated rafters, Quonset huts, prefabricated buildings, and glass-lined silos (Scott 1970: 17; Jarchow 1949: 245, 253-257).

Minnesota's first agricultural fair was organized in 1854 by the Hennepin County Agricultural Society. After several statewide fairs were held, in 1883 the state legislature provided an annual appropriation for the state fair, and in 1885 the fair moved to its current site. In addition to county and state fairs, there were livestock and crop shows including national and international agricultural expositions. Agriculture always figured prominently at "world's fairs" and similar events. The 1904 World's Fair in St. Louis, for example, had an entire working dairy farm within its 23-acre Palace of Agriculture.

OTHER FARMERS' ORGANIZATIONS

Farmers formed a variety of organizations to help affect governmental farm policy, improve market conditions, cooperatively work on projects, and provide community cohesion. Some groups overlapped with local cultural, ethnic, church, and social organizations. By way of example, some of the largest farmers' organizations are briefly described below.

The Grange. Perhaps the best-known populist farm group, the Patrons of Husbandry or "The Grange," was founded in 1867 by Minnesota farmer Oliver Hudson Kelley. After agricultural depression hit in 1873, Grange membership grew, with an estimated 1.5 million members and 21,000 local chapters by 1875. The group worked to enact state laws regulating railroads and eventually secured passage of the federal Interstate Commerce Act of 1887, which provided some railroad regulation and control of railroad freight rates. Local Granges also promoted agricultural fairs, and established marketing, processing, manufacturing, and purchasing cooperatives (most short-lived) to help farmers control costs and get better prices (Cochrane 1993: 95, 113, 308, 313; Danbom 1995: 154-156).

Scott writes that "the Grange made its greatest impact on the welfare of the farmer through its educational and social activities" (Scott 1970: 42). Attributing rural hardship and poverty to poorly-educated farmers, the organization advocated farmers' lending libraries, the study of agricultural journals, and educational lectures, often by agricultural college faculty. Common topics for Grange meetings in Minnesota included grain and livestock production, drainage, types of pumps and windmills, deep versus shallow plowing, plant diseases, and new machinery. The Grange lobbied for the establishment of the state School of Agriculture for high school students (which opened in 1888 with financial help from the Grange) and, in the early 20th century, for agricultural departments in regular public high schools. Grange membership declined in the 1880s, but the organization continued to be active in many areas. In fact, in the 1920s the largest farmers' organizations in the Midwest were the Grange, the Farmers' Union, and the Farm Bureau (Danbom 1995: 189; McNelly 1960: 17; Scott 1970: 46-47).

Farmers' Alliance. The Farmers' Alliance, another populist farm movement, arose in the 1870s and 1880s and claimed over a million members by 1890. In 1891 the Farmers' Alliance formed the Populist Party, called by historian David Danbom "the first and last major farmers' political party" (Danbom 1995: 160). Populists stood for a national currency, inflation to reduce debt, government ownership of railroads and telegraph lines, abolition of land monopolies, and other liberal reforms. In the 1892 presidential election, the Populist candidate won the popular vote in four states and the electoral votes of two others. Both the party and the Alliance declined after their next presidential candidate, William Jennings Bryan, was defeated in 1896.

Local alliance chapters across Minnesota met to discuss politics and economics, hear talks on better farming methods, and organize agricultural fairs. The Alliance encouraged reading circles, circulating libraries of farm publications, and early cooperatives. In Minnesota the Alliance spearheaded a move to make University of Minnesota agricultural education more responsive to farmers, which resulted in the creation of the St. Paul campus (also called University Farm) and the establishment of the Minnesota Farmers' Institutes programs. The Farmers' Union, see below, was a populist successor of the Alliance (Scott 1970: 39-41, 49-54, 82; Cochrane 1993: 95-96; Danbom 1995: 156-160).

Farmers' Union. The Farmers' Union (formally the Farmers' Educational and Cooperative Union) was organized nationally in 1902. David Danbom explains its origins and Populism's relationship to the theories of farmer efficiency that underpinned much of the institutional and informational infrastructure supporting Minnesota farmers:

> [The] demise of Populism [see Farmers' Alliance above] did not mark the end of politically active farm organizations, nor did it end the debate over the nature and source of farmers' problems. The heirs of the Grange and the Alliance movement and the Populists continued

> to believe that the source of the farmers' economic difficulties lay outside agriculture and that government action was required to rectify the situation. In the years after Populism's demise such organizations as the American Society of Equity and the Farmers' Union, founded in 1902 in Texas and strong thereafter in the Southwest and on the Plains, continued to keep the Populist faith. And conservatives continued to believe that the farmers were the authors of their own problems and that they could advance by becoming better businesspeople and more skilled producers" (Danbom 1995: 160).

The Farmers' Union formed cooperatives, lobbied for farm legislation, sponsored actions such as the withholding of produce from markets to get better prices, and encouraged agricultural education. It tended to have fewer ties with agri-business and be more inclusive and family-based than the Farm Bureau. Women were generally included within the central organization rather than in auxiliaries (Neth 1995: 140-142). By 1907 the National Farmers' Union had over one million members. By the 1920s the Farmers' Union was one of the Midwest's largest farmers' organizations (Danbom 1995: 189).

Historian Theodore Blegen explains part of the impact of the Farmers' Union in Minnesota:

> From the 1920s on, the Minnesota Farmers' Union appeared on the scene, first through locals, then through regional cooperatives. It entered into terminal and wholesale markets. The Union grew enormously and, for the Minnesota region, took form in the Farmers' Union Grain Terminal Association [GTA] and the Farmers' Union Central Exchange. The former has been described as' the nation's largest co-op marketing firm' and the latter as one of the country's 'leading farm supply wholesale co-ops'" (Blegen 1975: 399-400).

Farmers' Clubs. The farmers' club movement began around 1900 in Minnesota and nationwide. Participants in the Minnesota Farmers' Institutes often helped form these small township groups which served to disseminate information more frequently than was possible through Institutes, which took place only once or twice a year (Scott 1970). One of Minnesota's first local clubs was the Pioneer Farmers' Club, organized in 1903 by farm families near Northfield (McNelly 1960: 13-15, 21-22, 30, 58). When the newly-formed Minnesota Extension Service began to publish the widely-distributed *Minnesota Farmers' Library* in 1910, the first issue was devoted to farmers' clubs.

In addition to carrying on educational activities, many farmers' clubs in Minnesota made cooperative purchases of supplies such as calves, feed, twine, fence posts, building materials, and food staples that were ordered in carload lots and distributed from the train by the club secretary (McNelly 1960: 21). Some engaged in cooperative marketing (Scott 1970: 110).

In the 1910s and 1920s, the Minnesota Extension Service worked to strengthen the farmers' club movement, making speakers available and sending out literature to members. The first director of Minnesota Extension, A. D. Wilson, wrote in 1916, "We consider the farmers' clubs one of the strongest forces in the state agricultural development" (quoted in McNelly 1960: 25).

Farmers' clubs, which were often formed at the township level, were generally superseded by Farm Bureaus, which were organized at the county level.

Farm Bureaus. Farm Bureaus in Minnesota were first organized in 1913, three years after the country's first bureau was formed in New York in 1910. Farm Bureaus were county-level farmers' groups formed to support the work of county extension agents. In 1913, after county agents received an initial lukewarm reception in some Minnesota counties, the state extension office began requiring that farmers establish a formal association "as a guarantee that there was a sufficient number of farmers organized in the county to back up and support the work" of the local agents (McNelly 1960: 56). In 1923, the Minnesota Legislature officially made the county Farm Bureaus the cooperating agencies for local extension activities.

Minnesota's first county Farm Bureau was organized in Kandiyohi County in 1913, and by 1919 the state had 25 county bureaus with about 16,000 members. Both a statewide federation, the Minnesota Federation of Farm Bureaus, and a national association, the American Farm Bureau Federation, formed in 1919 (McNelly 1960: 28-29). According to historian Many Neth, members of Farm Bureaus were often an area's wealthier farmers, some of whom had ties to other agri-businesses. She indicates that Farm Bureaus were also "closely allied with the interests of agricultural institutions" and "less critical of corporate agricultural interests." Neth also writes that Farm Bureaus "fundamentally countered rural community-based institutions," including the township-based farmers' clubs, with a top-down county-wide organization that did not generally include women in major activities (but instead encouraged separate women's and children's groups) (Neth 1995:132-134).

Farm Bureaus helped fund county agents and organized both farmers and merchants and bankers in support of extension work. The Farm Bureau leadership in each county generally included representatives of livestock breeders, grain producers, horticulturists, and cooperatives, as well as the county school superintendent and a member of the county board of commissioners. Until 1954 the executive committee of the Farm Bureau in each Minnesota county set the yearly work program for the county extension agent. In turn, county agents helped recruit more Farm Bureau members and organized Farm Bureau activities (Goodhue County 1954). "Minnesota was one of three or four states in which the Extension Service was tied with a state Farm Bureau, carrying on political and commercial activities" according to one historian of Minnesota Extension (McNelly 1960: 59-60).

In addition to its lobbying and educational activities, the Minnesota Federation of Farm Bureaus organized the Farm Bureau Service Company, which offered members automobile insurance, feeds, seeds, fertilizers, weed sprays, and other farm supplies. This entity competed with other farm supply cooperatives, which became a source of ill will between the Farm Bureaus and members of other farm organizations. For example, there was often rancor at both local and state levels between the Farm Bureau and the more liberal Farmers' Union over politics and policy. Farm Bureaus gained considerable strength in the Midwest after World War II (McNelly 1960: 57, 58-59).

Women's Clubs. Agricultural societies tended to be comprised of male farmers, although some groups such as township clubs, the Grange, and the Farmers' Alliance included programming and activities for all family members. Beginning in the 1910s farm women's clubs were organized throughout the state, corresponding with a rise in women's organizations nationwide. While some women's farm clubs arose spontaneously, others were auxiliary to men's groups, associated with church or other cultural groups, organized by Farmers' Institutes participants, or organized by Minnesota Extension Service staff.

Some women's groups studied a range of agricultural and business subjects. They worked to improve working conditions and increase farm income, especially in areas where women had the most influence such as poultry management. Most women's clubs, however, focused on the domestic realm. For many clubs, included within this agenda was the study of farmhouse improvements including electrification, “modern” conveniences like indoor bathrooms, kitchen modernization, and redesign of the farmhouse service entrance (i.e, back door) area.

The Minnesota Extension Service, first organized in 1909, was a principal organizer of farm women’s groups in Minnesota. Many of the clubs were based on the concept of demonstration work in which members learned from direct observation and hands-on experience. By the 1920s, as many as two dozen homemakers’ groups were organized in each county. A few women, chosen as county leaders, attended Extension Service training. These women then taught the leaders of the homemakers’ groups, who, in turn, passed on what they had learned to the women of their group. This turned out to be a good way to transmit information to large numbers of women (McNelly 1960: 172).

Minnesota Extension also sponsored an annual summer retreat called Homemakers’ Week at the University’s residential agricultural high schools. At the West Central School of Agriculture in Morris, for example, Homemakers’ Week was held each year from 1934 through at least the 1960s. The multi-day session provided a welcome educational and social break from farm work. One woman reported that she especially looked forward to Homemakers’ Week at Morris because it was the only time all year when she got enough sleep and had a chance to relax (Scharf 2004).

While women’s organizations were successfully organized at local, state, and national levels, they were generally not as well-attended as men’s organizations, perhaps because women simply didn’t have the time (McNelly 1960: 25).

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Farmers' organizations, women's clubs, 4-H Clubs, and similar gatherings fulfilled important social, educational, and political functions. They were also an important means for the exchange of technical information among farmers. Location unknown, circa 1915. (MHS photo by Erick Elkjer)

A St. Louis County poultry house, circa 1930. (MHS photo)

ORIGINAL RESEARCH DESIGN FOR AN HISTORIC CONTEXT STUDY OF MINNESOTA FARMSTEADS

Prepared by Gemini Research February 2004

Agriculture has played a dominant role in the economic, political, and social life of Minnesota for more than 150 years and constitutes one of our most important land uses. When Minnesota became a state in 1858, about 0.6 percent of the state's land (or 345,000 acres) was under cultivation. By 1935 when agricultural development reached its high point, about 60 percent of Minnesota's land area, or more than 32 million acres, was used for farming. In that year there were 197,000 individual farms in Minnesota.

Today agriculture is still a formidable force although both the number of acres in use and the number of farms have dropped. In 2002 there were 79,000 working farms in the state, or about 40 percent of the number in 1935. In 2002 more than 28 million acres were being used for farming. This represents more than half of the state's total land area.

In rural Minnesota the evidence of agriculture is everywhere. It includes a gridwork of one-mile section roads that neatly divide the land, deciduous trees forming windbreaks and shelter belts, broad fields and pastures, and farmsteads themselves – iconic farmhouses and barns with clusters of outbuildings and structures whose function is not always readily apparent.

OBJECTIVE

The purpose of the historic context study of Minnesota farmsteads is to help the Minnesota Department of Transportation (Mn/DOT) and the State Historic Preservation Office (SHPO) understand the forces that have shaped Minnesota's farms, identify and interpret the cultural resources found on farms, and efficiently evaluate the eligibility of these resources for the National Register of Historic Places.

PREVIOUS RESEARCH

The development of agriculture in Minnesota in all of its economic, technological, and political complexity has been the subject of considerable research and writing, but there are relatively few sources that specifically focus on Minnesota's historic farm buildings and other cultural resources. Similarly, there have been many typological studies of farm structures in various parts of the U.S., but few focus specifically on Minnesota buildings.

Recent works that provide information on historic farm buildings in Minnesota include:

> Henning, B. J., D. R. Henning, et al. *Mn/DOT Farmstead Study: The Cutover Region of Northeast Minnesota*. Draft, 1999.
>
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PROJECT SCOPE AND LIMITS

Geographic Limits

The farmstead historic context study will include a study of, and provide recommendations for, properties located throughout the state.

Temporal Limits

The historic context study will likely use as a starting point the time when intensive Euro-American agriculture began. (This may be set at 1819, the year soldiers first arrived at Fort Snelling.) The year 1960 will likely serve as an ending date. This year was chosen rather arbitrarily but will allow the study to analyze resources built in the mid-1950s that will reach 50 years of age during the first few years that the completed historic context study is in use.

Limits in Method

The best method to understand Minnesota farmsteads and prepare explicit guidelines for their evaluation would probably be to combine contextual research with an extensive, statewide field survey. Due to time and budget constraints, the current project will not include a field survey except for limited fieldwork used to help Gemini Research understand property types and test assumptions. Because of this limitation, some of the conclusions reached by the project may be provisional and should be modified in the future to incorporate new information gleaned from surveys.

Limits in Types of Properties

Most farms in Minnesota were developed and operated by a small group of people – usually a single family – and the context study will therefore focus on this type of farm. The study will not present specific guidelines to evaluate other kinds of farms (e.g., communal farms, demonstration farms, or farms created to serve logging camps or state institutions), although much of the contextual information will be helpful when evaluating those farms as well.

How much the context study will focus on farmsteads, rather than farm acreage, is yet to be determined. It has been suggested, for example, that the study develop registration requirements for acreage that was historically adjacent to farmsteads that appear to be National Register-eligible, but not for other farm acreage. Making decisions and recommendations about the inventory and evaluation of farm acreage in collaboration with Mn/DOT and SHPO staff will be an important component of this study.

The study will focus on resources like farmhouses, barns, corncribs, windmills, windbreaks, drainage structures, etc., that are ordinarily located on farms. It will not include resources like cooperative grain elevators, creameries, grist mills, etc., that are associated with agriculture but not usually found on individual farms.

The initial part of Gemini Research's work will focus on standing structures. An historic archaeology component, primarily written by historic archaeologists under separate contract, will be drawn into the study during the second year and will be incorporated into the final products.

Limits in Research Scope

The topic of the history of Minnesota agriculture is daunting in its breadth. Research for the project will be limited to identifying and understanding the historical factors, events, and patterns that most directly affected the way that Minnesota farms physically developed and changed through time. Some of those factors are represented by the research questions that follow.

Research Questions: The Land

In the early- to mid-19th century, the land that comprises present-day Minnesota moved from indigenous use to Euro-American ownership, first in the public and then in the private domain. This massive transfer of land involved a series of policies (most governmental) that resulted in actions like treaties with tribal groups, land grants to railroad companies, and programs such as the Homestead Act of 1862. The transfer was facilitated by government agencies, railroad and logging companies, private colonization societies, land speculators, and others who helped recruit farmers to Minnesota. Research questions include: How did policies and programs that enabled Euro-Americans to establish farms in Minnesota shape the agricultural development of the land (e.g., the location, size, and type of farms)?

Geography helped determine which of Minnesota's 53 million acres were most suitable for farming, how difficult it would be for farmers to prepare the land, and which types of crops and livestock would succeed. Research questions include: How did the particular characteristics of the land (e.g., soil types, topography, average temperature, length of growing season) affect the size of farms, how farms were laid out, what they produced, and how successful they were?

Research Questions: Farmers

Most farmers came to Minnesota from the eastern U.S. and Europe. They had various ethnic and cultural backgrounds, and, it is assumed, varying levels of farming experience and capital. In Minnesota, many owned the land on which they farmed, but others were tenants or hired hands. The demographics of Minnesota farmers changed during the 20th century, with ethnic influences becoming attenuated, families becoming smaller, more children being formally educated, more young adults leaving the farm, and more farming couples depending on an off-farm job to succeed. Research questions include: What are the demographic characteristics of Minnesota's farmers and how did these change through time? In particular, in what ways did demographics influence the physical nature of farms?

Research Questions: Systems of Farming

Various systems of farming – for example, wheat farming, dairying, livestock raising, and truck farming – emerged in different parts of the state and at different times as a response to geography, market forces, technological changes, and other factors. Research questions include: What were the farming methods, land use patterns, kinds of crops and livestock, and types of structures associated with each major system of farming in Minnesota and how did they change through time?

Research Questions: Farm Characteristics

Most Minnesota farms are vernacular landscapes, as opposed to being landscapes designed by professional architects or engineers. Their arrangement of fields, roads, building placement, and landscape plantings usually emerged for functional reasons, and similar patterns of farm layout are common in much of the state. Farm buildings often have designs that reflect practical considerations like labor-saving operations and conservative use of building materials. It is assumed that ethnic and cultural traditions exerted less influence on farmstead and building design in Minnesota than did other factors like geography and market forces or pressures to increase productivity. It is also assumed that ethnic influences are more likely to appear in earlier structures. It is assumed that structures designed and built in later periods will show more influence from professionals like scientists, agricultural engineers, and equipment manufacturers. Research questions include: Who developed designs for Minnesota's farm structures? How did farmers decide what to build, and where did they obtain plans? How did the development of new building materials and systems, and the emergence of professional agricultural engineers influence the design of structures? Who actually built the structures? When and how were they modified? Are there characteristics of Minnesota farms or farmsteads that are unique or significant when compared to those found elsewhere in the region?

Research Questions: Tools of Production, Technology, and Science

The history of agriculture has involved a constant search for, and continual adoption of, labor-saving methods, new technologies, and other ways to improve efficiency and production. Agriculture has also been at the mercy of natural forces threatening the farmer with drought, flood, and crop and livestock diseases. In the late 19th and early 20th centuries, America's increasing demand for food, depleted soil fertility caused by wheat monocropping and other uninformed or outdated farming practices, and the potential of new industrial and technological advances combined to spur the development of scientific agriculture. A range of individuals and institutions including government officials, scientists, educators, bankers, and railroad officials worked to develop and publicize new methods and urged farmers to adopt them. Research questions include: What was the impact of scientific agriculture on the physical development of Minnesota farms? Where did farmers get technical information on topics such as farming methods, building types, and technological changes? How did specific changes in technology – including new machinery, improved seeds, livestock breeding, power generation, and better transportation – affect farming methods, farm planning, and the design of buildings and structures?

Research Questions: Transportation and Communication Networks

Minnesota's first Euro-American farmers settled near rivers including the Mississippi, Minnesota, St. Croix, Red, and their tributaries. Because good roads were scarce, the rivers were critical to obtaining supplies and equipment, and exporting produce to markets. Beginning in the late 1860s, railroads provided a more efficient transportation system and allowed the agricultural development of previously inaccessible areas of the state. After about 1910, automobiles, trucks, and a statewide road system changed the way farmers transported supplies and products, and the way farms were operated. Research questions include: How did changes in transportation affect farming and how are these changes reflected in the physical characteristics of farmsteads?

Before about 1915 and depending on their location, many pioneer farmers in Minnesota lived in relative isolation. Neighbors were few and far between and trips to town were difficult and infrequent. The building of good roads, the advent of Rural Free Delivery and parcel post, and later innovations like rural electrification, telephones, radio, and television put farm families increasingly in touch with the greater world. These changes reduced social isolation and made it easier for farmers to learn about and share new technologies, and to more closely follow market trends. Research questions include: How did changes in communication change farming and how is this reflected on Minnesota farmsteads?

Research Questions: Political and Economic Events

Political and economic events have had a large impact on the nature of farming in Minnesota. The financial collapse of the Northern Pacific railroad in 1873, for example, was one of the factors that led to the development of bonanza farms in the Red River Valley. The pace of farm mechanization increased dramatically in 1917 when a sizeable portion of the nation's farm labor force was sent overseas to fight in World War I. The shortage of capital during the Depression and the shortage of materials and labor during World War II all influenced when and how farm buildings were constructed, upgraded, or replaced. Research questions include: Which major events affected the development of farming in Minnesota and what was their effect? What have been the major cycles of economic "boom and bust," and how did they affect farming? How did government agencies respond to these large events and what was the effect on Minnesota farms?

METHODS

The study will be conducted by Gemini Research of Morris, Minnesota, with Susan Granger serving as principal investigator and Scott Kelly as investigator. John Lauber will serve as a project historian, and Virginia Martin, Kay Grossman, and others will serve as historians, researchers, writers, and editors.

Gemini will conduct limited field work to test theories developed during the course of its research and to help develop and refine registration requirements.

Research will be conducted in a variety of sources including maps, photographs, books, articles, dissertations, trade catalogs, plan books, unpublished manuscripts, cultural resource studies, and other materials in various repositories. Included will be these key sources:

Previous Studies

Gemini Research will begin by examining cultural resource farmstead studies prepared in Minnesota and other states. These materials are likely to include historic context studies, National Register bulletins, Multiple Property Documentation Forms, and rural historic district nominations. Perusing previous studies will help Gemini learn from other states' approaches and identify parameters, sources of information, and potential pitfalls. The SHPO's inventory and National Register files will also be consulted as needed.

Secondary Sources

Gemini will develop a broad understanding of the history of agriculture in Minnesota and the Midwest, and a focused understanding Minnesota farms, by consulting a wide range of secondary sources. Sources will include histories of agriculture, building typology studies, works on changes in farming technology, discussions of farm periodicals, works on physical and cultural geography, and histories of agencies like the USDA, agricultural experiment stations, and the agricultural extension service. Gemini Research will consult with experts in the field to increase its understanding of patterns and events.

Specialized Literature

In an effort to understand the evolution of farm structures likely to be found in Minnesota, Gemini will examine materials produced by and for agricultural engineers and materials geared toward, or likely read by, Minnesota farmers. These include farm periodicals, technical bulletins from the University of Minnesota and United States Department of Agriculture (USDA), and catalogs and plan books produced by farm equipment manufacturers and others. Gemini will review secondary sources and conduct limited oral interviews to help gauge the way these materials were actually used by Minnesota farmers.

EXPECTED PRODUCTS

The context study's final products, developed in cooperation with Mn/DOT and the SHPO, are intended to help Mn/DOT and the SHPO understand and evaluate Minnesota farmsteads. Final products will likely include the following:

- Historic context narratives that discuss major factors influencing Minnesota agriculture with an emphasis on forces that affected the physical development of farms. Maps, photos, tables, and timelines will help convey the information.
- Property type information that will characterize the physical components of Minnesota farms. This information will discuss various types of farming in various parts of the state during various periods of time.

- A set of registration requirements that will help efficiently evaluate the National Register eligibility of farmsteads in Minnesota. Aspects of integrity will be discussed and applicable National Register criteria and statewide historic contexts will be referenced.
- A survey and research checklist to help Mn/DOT and the SHPO (and their consultants, if applicable) gather the field and research information needed to understand and analyze farmsteads and evaluate them using the registration requirements.
- An annotated bibliography of the sources most useful to the development of the context study, and those that will be most useful for Mn/DOT and SHPO staff.
- A set of key source materials compiled for Mn/DOT and SHPO staff.
- Recommendations, if any, for further research, future survey work, and the organization of SHPO inventory data.

The format of the final products will be developed in cooperation with Mn/DOT and the SHPO. All final products will be available to the public at the Mn/DOT Cultural Resources Unit and at the State Historic Preservation Office, both in St. Paul.

PROJECT SCHEDULE

The project began in November of 2003. Initial drafts and outlines of key products will be submitted by June 30, 2004. Materials will be prepared for historic archaeologists by the fall of 2004. Second drafts of all components are due on March 1, 2005. Final versions of all materials will be submitted by June 1, 2005.

LeFebure Farm, Otsego Township, Wright County, circa 1973. (MHS photo)

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An implement or machine shed with sheet metal siding and roofing, and a sliding door. Location unknown, circa 1910. (MHS photo by Harry Darius Ayer)

Stearns County, 2004.