PLANNING FARM BUILDINGS

J. C. WOOLEY

THIRD EDITION

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McGRAW-HILL BOOK COMPANY, INC.
New York Toronto London
1953

PLANNING FARM BUILDINGS

Library of Congress Catalog Card Number: 53-7123

THE MAPLE PRESS COMPANY, YORK, PA.

McGraw-Hill Publications in Agricultural Engineering

QUINCY C. AYRES, *Consulting Editor*

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PREFACE

"Planning Farm Buildings" has been developed with the idea in mind that new conditions in the agricultural industry call for greater stress on functional design in planning farm structures. The evidence for this is seen in the widespread need for remodeling present-day buildings.

The purpose of housing farm enterprises is to make them more successful. This involves an understanding of (1) the correct environment for animals, fowl, or crops; (2) proper conditions for maintenance of high quality in products produced; (3) an arrangement for efficient operation; and (4) cost commensurate with income. Buildings, yards, gates, and equipment must furnish a place in which the operator can use his energy so efficiently that he can match his productive ability in the operations of field enterprises, maintain high quality in the things he produces, and still have energy and enthusiasm left for participation in the affairs of his community.

The operations involved in caring for an enterprise at the farmstead must be coordinated as they are in a field machine such as the combine. During the period previous to the development of the combine there was a machine for each of the processes of cutting, collecting, threshing, and separating. Now we have them coordinated in one machine which needs only to be guided and kept in adjustment.

For the operations of farm enterprises we have automatic equipment for pumping and distributing water, milking, feeding, lighting, refrigerating, drying, lifting, transporting, washing udders, cleaning gutters, and loading manure. Less spectacular but perhaps of greater importance are the advantages secured by arrangement of pens, lanes, and gates for the handling of animals, by use of remote control of gates and doors; by location of storage areas that allow the cow to come to the hay and silage; by placing stored bedding so that it is easily available at the point of need; and by establishing a pack in the building to preserve the value of the manure, to make its removal a machine instead of a hand operation, and to facilitate its use in a soil-building program. Another important contribution is secured by raising or lowering work to bring it into the area where it can be done with the least expenditure of energy. The extent to which any or all of these

improvements may be utilized in a plan depends upon the relationship between cost and the value of benefits derived.

As in the case of the combine, the parts and processes must be arranged and coordinated, designed functionally and then structurally to render the long-time service needed for success. In this case, however, the operator works inside the "machine," controlling the movement of animals, attaching and supervising equipment, and expediting the total operation.

"Planning Farm Buildings" is recommended for a two-hour lecture course in functional design or a three-hour course where laboratory work and field trips are included. This course furnishes training for prospective county agents, farm managers, and vocational teachers and serves as a basic course for those interested in the work in structural design.

The author is grateful for the help and encouragement given him by his coworkers in Agricultural Engineering at the University of Missouri. He is grateful also to Dr. Albert Dyer and Prof. J. E. Comfort of the Department of Animal Husbandry, to Prof. A. C. Ragsdale and his associates in Dairy Husbandry, to Prof. E. M. Funk of the Department of Poultry Husbandry, and to the men in the various industries related to buildings who gave many helpful suggestions.

J. C. Wooley

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CHAPTER 1

NEW FARMING PRACTICES AND EQUIPMENT AFFECTING BUILDINGS

1. Improved Use of Land. This improvement, important to the farmer, to every citizen, and to the person interested in farm buildings in particular, has been developed to its present state in a series of steps. The basic step was the application of "scientific water management" to sloping cultivated fields. This resulted in better use of water and the control of erosion, thus laying the foundation for the program of soil improvement to follow. In addition to the benefits mentioned, the water-management program retained the shape and size of fields suited to efficient use of modern machinery. Gullies and draws too deep or too wet to cross separate the farm into small fields, but when filled and terraced they become the most productive areas.

With the adoption of this program for rolling cultivated land, the risk of losing fertilizer or lime placed on the fields is reduced to a minimum. For a number of years farmers wasted considerable money in selecting the kind of fertilizer needed. They took the advice of a friend or neighbor and bought a certain kind of fertilizer because he had been successful with it on his farm. They often bought phosphate when they already had a fair supply in their soil but were badly in need of some other element. The scientific selection, or "prescription use," of fertilizer for each field, made possible through recent developments in soil-testing methods, eliminates this waste and accounts for much of the widespread and successful use of fertilizer in late years. The increase in fertility of the soil results in greater production and increases the livestock-carrying capacity of the farm.

2. Improved Crops and Animals. These improvements have contributed to the success of today's farm-management program. Hybrid corn, new varieties of small grain and grasses, and improvement in breeds of cattle, swine, sheep, and poultry have kept production up to the level where the farmer can operate at a profit. On many modern farms the water-, soil-, crop-, and livestock-management programs are being integrated into an over-all plan that improves the soil and at the same time provides a profit. Perhaps the most important con-

tribution comes from the fact that the program provides for continuous productivity, forming the basis for long-time planning.

3. Scientific Feeding. This program can be credited with more efficient use of feed and much of the increase in production from livestock enterprises in the last decade. As in the prescription use of fertilizers, it is recognized that production and growth of animals is limited to the level of the essential nutrient that is in short supply in the feed (Fig. 1-1). The practice of supplementing home-grown

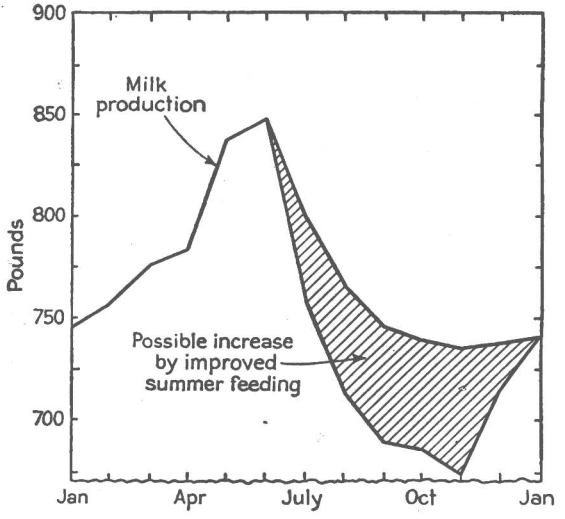

FIG. 1-1. Milk yield declines during the late summer, mostly as result of the high temperature but also in part because of the deterioration of the food supply, including the lignification of the herbage. (*U.S. Department of Agriculture.*)

feeds to make a balanced ration is almost universal on livestock farms today.

Recognition of the influence of the stage of maturity on the quality of grasses and forage crops has encouraged the development of the "all-year" pasture program to provide fresh growing crops throughout the season. This program generally utilizes a bluegrass pasture during its season of best production, followed by use of lespedeza, available when the wheat crop has been removed, the stubble and lespedeza furnishing pasture through the months when bluegrass is in the dormant stage. This is followed by pasturing fall wheat or barley fields until it is time to turn the animals into a winter pasture of mixed grasses which has had a full summer for growth. A period of

spring pasture on the wheat or barley fields gives the bluegrass a chance for a good growth before the animals are turned into it the following season.

This program offers possibilities of important savings in labor, although it will probably be necessary to provide for supplementary feeding of hay and possibly silage and concentrates for some enterprises. Hay sheds, sometimes portable, equipped with self-feeding mangers materially reduce the time required for this supplementary feeding. Some type of shed to furnish shelter from winter storms may be essential in the field devoted to winter pasture, and shade provided by buildings or trees will be necessary in the fields used for midsummer pasture.

If the dairy enterprise is selected for a large farm using the all-year pasture system, the farmstead may be located so that the cows can be brought to it for milking. If pastures are at a considerable distance however, it may be necessary to develop movable milking equipment to go to the fields. Such a plan is used in Holland. A truck is equipped with a milking machine and a refrigerated storage space for milk. The truck is driven to the pasture or to a yard or shed provided there, the stalls unfolded on each side of the truck, and cows milked in much the same manner as is now used in the regular milking barn.

This pasture system, no matter what enterprise is used, requires a distributed water supply for each field. Ponds with connected drinking places or shallow wells with pumps powered by windmills meet this requirement on many farms today.

4. Improved Machinery and Power. Modern equipment for field work has influenced the buildings needed on the farm. This development has been so rapid and so extensive as to almost revolutionize the management and procedures followed in farming. The history of the development shows the shift in the source of power from hand, to oxen, to horses, and now to the electric motor and the internal-combustion engine.

The actual effort exerted by the farmer has been decreased and his ability to produce has greatly increased. Table 1-1 gives figures secured from average cash grain farms in the corn belt (Ref. 4). In all items the striking difference in rate of improvement in field efficiency as compared to that at the farmstead is very evident. Field work was once the bottleneck on every farm. Mechanization has now shifted several peak labor loads to the farmstead. Considering all the work required by an enterprise, the percentage which is done at the

farmstead is given as follows: for milk and egg production, 80 per cent; for hogs, 40 per cent; for cattle and calves, 25 per cent; and for sheep and lambs, 20 per cent. The importance of this development to the planning of buildings and other farmstead equipment is evident. The farmer, by use of modern equipment, can do the field work formerly accomplished by himself and a hired man, but when it comes to the farmstead he can accomplish the extra tasks now left for him only by putting in extra hours of labor unless he can devise ways and means to increase his efficiency.

In a "balanced-farming" plan the farmer keeps a sufficient number of animals to utilize all the products of his fields, changing them into more valuable products to be sold in the market (Ref. 5). He has

TABLE 1-1. HOURS OF LABOR REQUIRED IN AGRICULTURE*
(Best practice)

Crop or livestock	1910–1914	1938–1942	1952†
Corn, per acre	19.5	10.3	8.6
Wheat, per acre	13.4	7.1	6.2
Oats, per acre	10.9	6.3	4.1
Mixed hay, per acre	11.0	8.0	7.9
Hogs, per 100 lb	3.7	3.3	3.0
Stock cattle, per head	25.0	25.0	25.0
Laying hens, per 100	160.0	160.0	160.0
Milk cows, per head	108.0	114.0	120.0

* L. M. Vaughn and L. S. Hardin, "Farm Work Simplification," John Wiley & Sons, Inc., New York.

† Unpublished data from Missouri Agricultural Experiment Station.

little difficulty in producing the crops but finds a real problem in caring for the larger animal enterprises needed to balance his business. The development of equipment for greater efficiency in handling and feeding livestock is a challenge to those interested in planning farm buildings.

The power and machinery used in field work has improved many products, created problems with others, and changed the form and method of handling of still others. Early harvesting of corn with a picker-sheller requires artificial drying at the crib in order to retain the high feeding value thus secured. Until suitable varieties of oats and barley are developed, combining these crops in many areas requires facilities for artificial drying. High-quality hay necessitates cutting at the proper stage of growth and drying by artificial means in many cases.

Field driers or equipment built into barns for the purpose must be provided. Field-cured hay harvested by baling or chopping requires less space but greater strength built into overhead storage structures, and placing it in storage necessitates the use of special forks or elevators. These elevators suited to handling grain, bales, or sacks have gone through the development stage and are now available in satisfactory form. Pneumatic elevators for cut hay, grain, and silage solve many problems of elevating and distributing materials to be stored. Ear-corn harvesters do the work quickly, but since filling is so rapid they create some problems in crib design. Where the farmstead is equipped with functional buildings requiring distributed storage, the portable type of elevator is an essential piece of equipment. Field harvesters for silage, with a pneumatic elevator at the silo, take much of the difficult work out of this process. Silo unloaders and now self-feeding silos are being tried in an effort to save time and labor in feeding. Mechanical self-feeders for poultry reduce the chore time for this enterprise. Self-feeders for hay have been used for yard and field feeding and are being used to a limited extent in barn feeding at present. Water-pumping and distribution systems, tractor manure loaders, gutter cleaners, milking machines, etc., add to the efficiency of chore work on many farms.

In all probability, however, some of the nonmechanical features of farmstead improvement will be fully as important as the more spectacular mechanical ones. These will be in the form of correct relationship of different parts of buildings, of gates, lanes, pens, etc., to facilitate the movement of animals, manure, feed, bedding, and the products being produced and permit it to be carried out with the least expenditure of time and energy. These improvements require a thorough knowledge of all the activities involved in the process of production and may require a period of trial and error together with much patience and work in their development.

5. Laws or Ordinances. Regulations made by those who buy and consume the products sold from the farm must be considered in planning farm buildings. If the farmer wishes to sell to advantage he must produce the quality demanded by the market. This is especially true in the dairy enterprise, but many poultrymen are finding that it pays to provide coolers and follow practices required for the production of quality eggs. Methods of producing hogs are not specified by the packers, but the kind and quality that bring the best prices are definitely known by producers. Satisfactory production of such hogs must follow an unwritten law on sanitation procedures that is almost

as definite as the ordinances governing the production of milk. If the hog producer desires quick, continuous, and profitable growth, he must follow these rules of sanitation. Production of baby beef cannot be carried on by methods that succeeded in the days when older animals were marketed. Corn and small grain to be used in manufacturing processes must be stored in a building away from livestock. The building must prevent deterioration in quality. These are all comparatively new regulations that influence the design of buildings for the farm.

6. Appreciation of Country Living. This appreciation is evident in most localities. The development of transportation facilities, the influence of travel, the relief from excessive physical labor, the improvement in the financial status of farmers, and the integrating effect of schools, churches, and clubs have contributed to this appreciation. The marked increase in suburban housing developments shows that city workers appreciate the advantages of living in the country. The problems incident to the modernizing of farm homes are much less difficult than in former times as a result of the general distribution of electricity and the availability of suitable equipment for heating, water pumping and distribution, and sewage disposal. The farmer has some advantage over the urban dweller in that he can use some of his field equipment in transportation of materials and in excavating for basements, foundations, and drains, and in some cases he may shift some farm labor to construction when regular work is not pressing.

In many cases the modern home is realized by remodeling and modernizing the present structure. The county agent can secure, or perhaps give from his own experience, valuable help on the possibilities of changing the existing home to meet modern needs. The suggestions will probably cover such things as repair and strengthening foundations, possible changes in interior arrangement of rooms, additions if needed, location of modern windows, pressure water systems with related improvements such as the bathroom, conveniently arranged and equipped kitchens, changes in architecture, and possibly landscaping and grading. When the family has decided on the improvements to be made they can plan for the particular things which they can do in making them. In many cases the farmer can install the drains needed, the septic tank, and the water pipes to the house, can repair foundations, and can remove unwanted porches, etc., making things ready for the carpenter. Wallboard covering for inside surfaces, finished with sand paint, facilitates the work of making