FARM MANAGEMENT AND DEVELOPMENT

Thesis for the Degree of B. S.

R. F. O'Brien

1936

Farm management

Farm management

Farm Management and Development

A Thesis Submitted to

The Faculty of

MICHIGAN STATE COLLEGE

of

AGRICULTURE AND APPLIED SCIENCE

By

R.F.O'Brien

Candidate for the Degree of

Bachelor of Science

June 1936

BOOK I

BOOK II

Farm Management

INTRODUCTION

Changing economic conditions make it necessary to study the organization of the farm business to determine whether adjustments may be made which will improve the farmer's net income. Price changes in goods and services purchased by farmers have been more than offset by price changes in farm products. Certain fixed charges, such as indebtedness and interest, change very slowly. Adjustments in farm plans are necessary because of these inequalities.

The purpose of this treatise is to show the possibility of enhanced profits through the proper planning of the management of the farm. To illustrate this a farm in southwestern Michigan, with which the author is familiar, has been selected as an example and from which general conclusions can be drawn. On this farm an attempt will be made to show what should be handled on the farm and how much, and the reasons for each decision.

Chapter I

FACTORS AFFECTING FARM ORGANIZATION

Three general factors affect the organization and the selection of what may be best produced. These factors are: (1) Natural factors; soil, topography, plant and animal disease and pests. These determine what can be efficiently produced on a given farm. (2) Economic factors; the relation between cost of production and the selling price which determines the advisability of producing any given item over a period of years. (3) The ability, experience, resources, likes and dislikes of the farmer himself and his family.

The topography of the farm considered is of a morainic nature. The hills were piled high by the glaciers that passed through this region. Between the hills are many low, fertile lands that have a very good natural drainage. However, this natural drainage of the lowlands is not sufficient and tile drainage is necessary to the development of the land to its greatest advantage. The receding of the glaciers left few stones and the farm is exceptionally free from stone. The soil on the hills is largely of clay loam, although there is occasionally a gravel loam. The hills are very productive. The lowlands are of a silt loam and are very highly productive and are capable of growing high priced crops. Corn has been grown on the lowlands in the past and

the returns have been very high.

The hills have been fairly alkaline and required but little application of lime. The lowlands, although not excessively acid, required considerably more lime before being capable of producing good stands for alfalfa.

The climate of this area is very well suited to the growing of corn, small grains, and alfalfa hay. The typical annual precipitation is about thirty-four inches and the growing season between frost-free dates is about one-hundred sixty days.

Insects and diseases increase the risk of growing certain crops. Notably among these are the corn borer,which has already caused considerable reduction in corn yields, and grasshoppers which caused considerable damage in the summer of 1934, and exceptionally dry summer preceded by a very dry summer. Cinch bugs also cause considerable damage.

Chicago's nearness afforded this farm a very good market and advantage was taken of the fact. Milk was sold from the farm to a central organization which retailed the milk. The price paid to the owners of the farm was therefore higher than the average received elsewhere. Eggs, fruit, vegetables and poultry enjoyed a very good market.

Prices received by the owners and other farms in this district were slightly higher for meat, grains and the like than were received elsewhere because of

the following advantages: (1) Low transportation costs, and (2) because this area with its large nearby cities tends to be a deficit area for most agricultural commodities.

Nearness to market was an advantage especially important for such highly perishable commodities as milk and fresh vegetables and for such heavy, bulky commodities as potatoes. ~~The distance to~~ Chicago, to Gary and other large centers ~~was~~ within easy trucking distance. Also because of their nearness to large markets they were able to sell much of their produce at retail prices to people in surrounding cities and villages who drove out to the farm to get the products.

Chapter II

ORGANIZATION

The farm being considered in this treatise was located in Berrien County, Michigan, and was owned by two brothers. The two men are quite young and have both married recently. There are two homesteads on the farm and each of the homesteads is occupied by one of the brothers and his wife, but the farm is handled as one unit. The acreage is approximately two-hundred forty acres. An exception to this was made for the chickens, fruit and vegetables. Each household handled them from their homestead.

A farm of less than one-hundred sixty acres is usually handled intensively and a farm of larger acreage is usually farmed extensively. As this farm was of about two-hundred forty acres as stated before, this land was farmed quite extensively. There were some intensive features about the farm, however, as could be expected as two families farmed the land and also because of the high value of the land which was well adapted to intensive farming.

Approximately fifty acres was devoted to corn, which was cultivated by both tractor and horses. The corn was cultivated over a long period of time. The last cultivation took place when the corn was over four feet high and was, of course, done with horses

working singly. The seed corn was fed largely to hogs and the stalks were shredded and fed to the cattle. Because of the additional feed value to be found in silage this farm could use to great advantage a silo at each establishment if it were considered desirable to maintain herds separately. Or if the herd wassto be kept at one place only, which would probably be the most advisable as the farm houses were only about eighty rods apart and were connected by a very good road and as this would cut the overhead considerabley, two silos could be erected at one of the barns. The natural location of the barn on the north side of the road would be the logical location of these silos.

Nine acres of soy beans were produced on this farm for two reasons. The first and most important was for the income receivable from the sale of the seed. As the yield was quite high the production of soy beans was very profitable. The second reason was as a supplement to corn as a feed to livestock. It was considered second in value to corn as a feed. The amount grown was too small to be considered as insurance against the failure of the corn crop.

Twelve acres of potatoes furnish a highly profitable cash crop. With the use of fairly large

fields and with the judicial use of tractor power coupled with the use of horses the owners were able to produce this crop at a lower unit cost than the average farmer. Their nearness to the high markets enabled them to market them at prices that were distinctly higher than the average through Michigan. Another factor that helped produce income was the use of their own truck to haul their potatoes to market. As on this large farm their small truck (one ton) was used for many other purposes, the amount of fixed expense that had to be charged against the potatoes was very small and their use of their own truck saved the profit on the equipment that would have had to been paid to a trucker.

Of small grains approximately seventy acres were grown, of which thirty-five were in wheat, twenty acres in barley, fifteen acres in oats, and four were in speltz. As wheat, in this section, is the most highly profitable of the small grains the largest share of the small grain was in that crop and also because it was used as a cover crop for alfalfa. Barley, oats and speltz provided insurance against the failure of the wheat crop and also spread the work of preparing the soil and the harvesting out through the year thus permitting a more even distribution of labor and therefore lowering costs of production. Barley

and speltz were used, largely, in the feeding of hogs and the oats were used for horse feed. Speltz was not regarded with high favor and does not seem to be considered with much favor in Michigan. None of the last three named were considered as cash crops and were grown to be fed.

Nearly forty acres was in alfalfa and seventeen additional acres had been seeded to alfalfa. The owners had discovered as other Michigan farmers are that land in alfalfa could be made to produce greater revenue in this crop than it would if devoted to small grains and were, therefore, changing over to alfalfa as quickly as they could without disrupting their present organization.

The alfalfa was cut three times a year if not used at all for hay and twice a year if used for pasture during the hot summer months. As there was considerable land that was used solely for pasture the alfalfa was not used for pasture to any great extent except during the hottest part of the summer when the pasture grass was not well suited to the feed of dairy cattle.

Besides being used as a hay crop and as temporary pasture for cows a six acre field was used as pasture for hogs. Temporary fencing was used so that part of the field was pastured at one time and then the fence was shifted so that another section of the field was

being pastured. The hogs, with very little other feed, made very satisfactory gains and were produced at low cost.

Fifty-five acres was in woods and permanent pasture of which twenty-two acres was woods and thirty-three acres was open pasture. All of this land was in quite low, undrained districts. Twenty acres of this could be drained and made highly productive and this should be done very soon. The other twelve acres could be drained and made productive, but the cost would be quite high and the benefit would not be as great. In view of present conditions it would probably be advisable to defer the development of this latter acreage until a later date. The cost of clearing the woods is so high as to render the development of the land so occupied into farm land entirely inadvisable.

Slightly over an acre was used as a garden. This does not include an acreage of potatoes nor of orchard but does include berry bushes and vineyards. This amount of land was more than sufficient to supply the needs of the family and the surplus was sold to a very good market. A large part of the surplus was sold to customers who came to the farm and there were therefore no costs incident to the marketing of the goods thus sold.

The buildings were distributed over about four acres, but most of this was devoted to orchard which also produced a high income for the amount of labor necessary to production. The livestock was divided into the following classes: dairy cattle, beef cattle, hogs and chickens.

A herd of about fifteen cows were kept and were handled by the two men and were kept at the barn on the north. Running water was piped to the barn and to the milkhouse. As the farm was located along a power line electricity was available and was used quite extensively. This made the labor necessary to the handling of a dairy herd much lower than would otherwise have been the case. The special equipment that may be charged directly to the dairy business is the milking machine, the piping for water and the milkhouse. Also most of the cost of the electric lights should be charged to the dairy business.

The milk was sold to a concern that sold the milk at retail in Chicago. This concern sent tank trucks through this district to collect the raw milk. A Chicago commission inspected the dairies in the district and their approval was necessary to the selling of the milk for the purpose stated. As this farm satisfied the necessary requirements the price received was appreciably above average.

To make efficient use of pasturage and the large amount of feed available about forty head of beef cattle were kept on the farm. These cattle were sustained by pasture and the cutover hay fields and grain fields during the grazing season and fed in the barn on the south side of the road during the colder part of the year. This herd was composed of steers from the dairy herd. The steers from the dairy herd were of course not as desirable stock as would beef have been, but something has to be done with steers from a dairy herd and this seems to be the best method of handling the problem.

About thirty hogs were also kept on the northern farm where there was a very good hoghouse. These hogs were pastured on alfalfa in a field directly behind the building and were also fed in this building. In the past there were several times as many hogs and they were used to hog down corn and were also fed skim milk. Changing conditions necessitated lowering the amount of hogs. The corn-hog method was depleting the soil; the growing herd needed the corn fodder; and the high price obtainable for whole milk as compared with cream made it advisable to sell whole milk and discontinue skimming it. Therefore the number of hogs was reduced and although it will probably be advisable to keep some hogs, probably only one brood sow will be kept and the total number will not exceed fifteen after this year.

Besides the livestock mentioned before a large number of chickens were kept on hand. The nearness of the market is again an important factor. Three-hundred hens were kept at each farmhouse and the eggs were sold to Chicago and nearby towns and to small resorts in the summer. Caponizing was practised and a large number of capons were sold during the summer to the nearby small resorts.

The equipment on this farm was intelligently selected and although not large, was entirely sufficient and very efficient. Most farms are stocked with a great deal of inefficient machinery that duplicates itself many times. Among the more important features were a three-plow convertible tractor that could be used for culitvation and belt work, a hay loader and a small shredder that could be handled by a crew of three men. In addition a small grinding mill for the grinding of small grains should be noted as the grinding of small grains adds appreciably to their feed value. This last modern machine was powered by belt from the tractors.

The labor consisted largely of the two men and their wives. The wives took care of the chickens, the small gardens and the housework. Themen took care of the field work and the other livestock. In addition to the above labor a part time hired man

was employed during the summer. He was usually a boy from one of the neighboring farms. Additional help was hired as needed for such operations as threshing, digging potatoes and harvesting corn. All other operations required not more than the one extra helper.

The financial returns of this farm were quite high because of the high prices received for goods sold and because except for the land, which was valued between one-hundred and fifty dollars to two-hundred dollars per acre, the investment was not very high. The labor costs were low.

The diversity of products having high grade markets made the weathering of adverse economic conditions easier than might have been the case had the farm been highly specialized.

Chapter III

SELECTION OF KINDS OF CROPS

Before considering the desirable crop planning for the future it would be well worthwhile to note the past history of the farm. When the farm was first cleared the hills were cleared first and were planted to corn and a corn-hog program was followed as is practised in the corn-belt region. This was highly profitable for many years, but finally had to be abandoned because erosion was beginning to tear the top soil from the hills and gullies were becoming quite large. The owner then turned to draining the lowlands and tiling them. These lands were planted to corn and produced even more profitable returns than did the high lands at the earliest date. Modern methods of milk transportation coupled with a declining hog market made a change to dairy desirable in the conversion of the corn crop. The high overhead in building and labor for dairy as compared with hog raising together with the facts that a long depression had begun and the father had died and the ownership had passed to his two sons (the present owners) made it desirable to extend the change over a large number of years.

While the lowlands were being converted into farm land the problem of what to do with the eroded high lands had to be solved. As a dairy was contem-

plated alfalfa seemed the logical solution. This, of course, took some time to effect. An acreage varying from twenty to forty acres was seeded each year for about five years and now most of the hills are in alfalfa or are seeded to alfalfa. Each of the fields now in alfalfa will probably be in alfalfa for about four years and will then each be broken up and be in small garden crops for about three years when they will again be seeded to alfalfa. The growing of alfalfa has very well coped with the problem of erosion and has checked it completely.

Small grain crops that have been grown on land that had previously been in alfalfa show very high returns as compared with those following corn and the results are considered to justify the program for this reason only as well as for the erosion checking ability of the alfalfa.

This program will maintain the fertility of the highlands over a long period of years. The lowlands have been in production for a period of a bout ten years and as the crops are fed on the farm and are largely returned to the fields in the form of manure, the productivity should continue at a very high level.

The selection of crops to be grown on any given farm depends largely upon certain limiting factors such as climate, soils, topography, nearness to market, the type of livestock and the size of the farm.

Farms with heavy fertile soils provide the best opportunity for the production of such crops as alfalfa, sugar beets, corn, wheat and barley. The nearness to market favors such crops as potatoes and early truck crops. The soils on this farm should be considered quite heavy, but are light enough to produce potatoes and truck crops and because of the high fertility of the lowlands will produce high yields of these crops. The absence of a nearby sugar factory precludes the growing of sugar beets.

Dairy farmers obtain the greatest advantage by producing largely those crops that are most needed as dairy feed, namely: alfalfa, silage, corn and barley. Beef and hog feeders obtain the greatest returns from the carbohydrate fattening feeds such as corn and barley.

The values per acre of some crops are considerably higher than others, depending upon their yields and prices. Alfalfa, because of its high prices and high yields, is the most profitable of the hay crops. The high values of eash crops during the past ten years indicate the desirability of including some such crops in the rotation in order to increase income.

Since most of the farm crops are fed to livestock, it is desirable to grow those crops which will produce the greatest amount and highest quality of feed. Alfalfa and soy beans' hay produce the greatest

amount of feed per acre and at the same time have the highest protein content of all the common feed crops. Corn produces the most pounds of digestible nutrients of any of the grains, but it has a somewhat lower protein value. No allowance is usually made for the feed value of roughage, because it is frequently not utilized. Corn stalks and oats straw have greater feeding value than wheat and barley straw.

A good combination of crops should fulfill these conditions: provide high net returns from crop production, maintain or improve crop fertility, diversify income and reduction risk, provide for good distribution of labor and power, facilitate control of weeds, diseases and pests.

The rotation should provide a high value of crop production as a whole combined with the lowest possible expenditure.

The most important method of building up soil fertility is through the use of green manure and barnyard manure. As the lowlands are very high in fertility and as they have not been in production very long they can be highly cropped for quite a number of years before the fertility will be appreciably lower. The keeping of the highlands in alfalfa for a large part of the rotation and the use of the barnyard manure on this farm should keep the fertility of the hills at a high value.

Since this farm is a livestock farm and as it is primarily a dairy farm, it is important that the crops be so selected as to produce the greater part of the necessary feed. The inclusion of one or more cash crops is desirable to increase and diversify the farm income.

An ideal crop rotation would provide for a good distribution and use of labor and power throughout the year that would fit in well with the labor requirements of the livestock. Under such conditions the least amount of extra labor would have to be hired and the least amount of extra reserve power would be needed. The most common rush seasons for the usual farm crops are when corn cultivation and hay harvest conflict; in sowing grains during a late or wet spring; during threshing and the second cutting of alfalfa; and when silo filling conflicts with wheat sowing.

The last-named possible conflict does not apply to this farm at present because of the absence of any silos. Should silos be built and used the conflict would not be of great importance because the acreage of wheat is small and therefore the time and labor necessary is not great.

In regards to special crops this farm has selected two field crops in addition to garden crops. These two crops are potatoes and soy beans, of which potatoes was considered the most important. About twelve acres a

year were planted to potatoes with the use of a potato planter. This required but the use of two men and a team and the planter and a little time. For the harvest a potato digger was used to lift the potatoes out of the ground and clear away the tops. Considerable labor is required to pick up the potatoes and sack them and this is supplied by hiring the necessary additional labor.

The acreage of soy beans is about nine acres and this crop is grown largely for seed and commands a good price and the yield is also high.

Special crops have an advantage in that the grower can enter a market or leave it easier than he can with other crops. This advantage is a precarious one and those who have studied farm management advise against trying to do so over a short period of time as the crop may reach its peak before the farmer can enter it and be at its bottom before he gets out. Special crops should be planned with an outlook of several years for the greatest annual returns.

A large amount of the lowlands of this farm are suited to the growing of truck gardening but as this requires a very large amount of labor and a very high overhead it is not considered advisable for this farm to go into truck gardening very heavily. The risk would be too great for the amount of capital that is possessed by the owners.

Chapter IV
LIVESTOCK

The livestock organization on this farm is built around dairying as the principal enterprise with other kinds of livestock added to utilize more completely the available labor and feed, and to diversify the sources of income.

The nature of the market also affected the choice of the kinds of livestock to be kept. As discussed earlier, this farm had a particularly advantageous market for whole milk.

The amount of livestock kept on this farm was influenced by the kind of markets and kinds and amounts of buildings, labor and feed available. Very little concentrates were bought and ordinarily no purchases were made of grain as the farm produced the necessary grain. Good livestock, carefully fed, normally returns more than the market value of feed, but the advisability of purchasing large amounts of additional feed depends largely upon price conditions, whether the feed may be purchased reasonably and the livestock marketed to advantage. Under normal conditions one of the best means of adjusting the farm set-up from year to year is in the amounts and kinds of livestock kept.

The number of cows kept on this farm was about twenty. The size and condition of the buildings do not allow, at present, a much larger herd. The farm program as planned is to have a much larger dairy herd. The buildings must

be improved before this is possible. Some buildings and rearranging is planned to effect this change.

The amount of labor available also affects the amount of livestock which could most economically be kept. Two-man farms usually have ten to twenty cows. The use of milking machines allows a larger herd to be handled.

On well-organized farms the various kinds of livestock supplement one another while on poorly organized farms one kind of livestock tends to conflict and compete with another for available feed, labor and equipment.

Beef feeding is commonly combined with hog feeding because of the ability of the hogs to clean up after the feeder cattle and put on gains with less feed than where hogs are fed alone.

On this farm dairying was combined with hogs, poultry and beef cattle. The hogs and poultry did not conflict with the dairy for feed although they did conflict for the farmer's time. The beef cattle conflicted for feed but the available feed was greater than could be handled by the dairy and could be utilized best by dairy. Furthermore, the beef cattle conflicted but little in the time required for dairy except in the winter when there was a great deal of time available for both herds. This combination, therefore, tended to spread labor evenly throughout the year.

On this farm the dairy cows were registered Holstein stock because of the realization that such stock produces high milk producers. The dairy sales were high and this was due to two factors, namely: to high milk production per cow and to a high selling price of milk.

Because the cows were of registered Holstein stock, the bull was also. The heifer calves were kept in the herd. The other calves were sold on a special market for breeding purposes when possible as they commanded a high price. When this was not possible they were castrated and placed in the beef herd.

The beef herd was composed of both beef type cattle and the steers from the dairy herd. They were kept to best utilize the pastures and woods and to dispose of the feed not required by the dairy herd. The size of this herd was about twenty to twenty five head.

While in the dairy herd it was advisable to have purebred stock because of the high productivity and because of their high selling price. This was not true of the beef herd. Here good stock was desired but purebred was not, even for those that were of beef stock, as they were bought and raised. Purebred in the beef stock usually pays only when i t is possible to sell young stock for breeding purposes. Because of the high price of purebred stock if raising only for beef purposes, good stock though it may be, a mixed strain will usually pay highest for the amount invested.

Chapter V

LABOR, POWER AND EQUIPMENT

During the winter months two or three men can handle the work on this farm. Probably most of the time the two owners can handle the work. Most of the rest of the year the three men will handle the work. There are often times, however, during the year when additional labor will be required. This will be true during the harvesting of some of the crops. This variation in labor demand seems to be inavoidable.

The three-plow convertible tractor and the four horses on this farm furnish enough power to do the work efficiently. The small number of horses leaves more food for cows and the use of a large powerful tractor leaves more time for chore work during the rush season.

The equipment on this farm was not extensive, but was well-chosen. Special equipment was used for the harvesting of corn, potatoes and alfalfa in order to reduce the costs of labor. The equipment was very successful in so doing.

---- BOOK II ----

Chapter VI

DEVELOPMENT

Although systems of open ditches supplemented by small field ditches constructed by individual farm owners have enabled thousands of square miles of land to be farmed which were formerly worthless, the maximum productivity of the soil cannot be secured without under drainage. This fact must be recognized when the benefits to be derived from drainage are estimated; and the cost of under drainage must be added to that of open ditches to obtain the total expenditure necessary to bring the land to the point where the maximum benefits are possible.

The primary purpose of drainage is to carry off the water in the soil which is injurious to plant growth. This is accomplished by laying tile drains at such depths and intervals as to prevent the water table from rising within a certain distance of the surface. The determination of the proper depth and spacing of the tile drains is the most important and the most difficult problem met with in the design of tile-drainage systems.

Bacteria cannot carry on their activities in a saturated soil, since the water excludes the air; and soils which are water-logged will not produce the ordin-

ary crops. The results of drainage are: (1) the removal of gravitational water; (2) an increase in the amount of available capillary water; (3) an increase in the volume of soil from which plants can extract their food; (4) an increase in the temperature of the soil and (5) the aeration of the soil.

It should be clearly understood that drainage simply removes the free water in the soil. That is, the water in excess of the maximum capillary capacity. It cannot remove the capillary water and there is no danger of draining a soil too dry by placing the drains too close together. The depth of the tile, however, determines the height of the water table and the amount of water that can be held by capillarity.

For each soil there is a depth of water table which is best for plant life in tha t soil, and it is the engineer's task to determine that depth as nearly as he can by a study of the soil structure, by tests and by drawing on his own experience and that of others.

The removal of gravitaional water by drainage increases the amount of available capillary moisturein the soil instead of decreasing it. When the water table is within a foot of the surface, the roots of the plant will be confined to the top foot of soil and the amount of available water will be the capillary water held in the top foot of soil. When the water table is four feet below the surface, the capillary water in the four feet

of soil is available for the use of the plants; and while the amount os such water per foot may be less, the total amount of capillary water in the four feet is much greater than that in the top foot in the former case. Thus it is that drainage increases the amount of useful soil water.

The roots of plants will not penetrate into a permanently saturated soil stratum because of the absence of air. Plants must have air to live on, and if deprived of air for a period of twenty-four to forty-eight hours, they will die. Drainage, by lowering the plane of saturation, increases the volume of soil from which plants can obtain food. Not only is the food increased, due to the higher temperature of the soil and to the larger supply of air, but the rate at which the food is liberated is increased.

The more or less saturated condition of the soil in wet areas is due to the fact that the surface soil is underlaid with a stratum of soil so impervious that water can pass through it very slowly, if at all, with the result that the plane of saturation is always very close to the surface. Tile under drains in, or above, this impervious stratum provide artificial channels which collect gravitational water and carry it away. The water enters the drain through the open joints at the ends of the tile.

As the level of the ground water is lowered its surface does not remain horizontal, but becomes undulating, with the depressions over the drains and the summits between them. The surface of the ground water becomes more and more undulating until all the gravitational water in the soil above the drain has been removed. This position is shown by curve 4 in the accompanying Figure I. (See next page.)

From this stage the ground water slope becomes flatter and flatter until the pressure tending to cause flow is just balanced by the resistance and a stage of equilibrium is reached as shown by curve 6. The curvature of the ground water surface depends upon the character of the soil; the coarser the soil, the flatter the curve.

Before a tile drain system came to be intelligently designed, the area must be mapped, surveyed and gone over. Since under drainage generally follows surface drainage, the maps made for the design of the open ditch can be used. This map should show all possible outlets, all property lines, the area of the watershed to be drained by the system , even though part of the area is beyond the limits of the proposed system, and the slopes of the surface by contour lines with a vertical interval of one foot. The completeness of the survey and map will depend somewhat upon the size of the area

and the expense which is justified for preliminary investigation.

There are many typical arrangements of tile that have been found by experience to be satisfactory. Where only small areas required drainage or more or less isolated swamp or depressions which receive the natural drainage higher lands adjoining, the natural system is used. In this case, the main drain follows the largest natural depression from the outlet to the upper end of the area, and smaller drains branch off the main and tap the isolated areas. This is the system that will be used in the area that is under consideration for drainage on this farm.

The area to be drained is a twenty acre field in the southwest corner of the farm. This land is quite flat, very fertile and comparatively free from brush or other obstacles to its clearance and use as farm land. In its present condition it is worth about twenty dollars an acre; clear, it should be worth about one-hundred and fifty dollars an acre. The total cost of improvement will be very low as compared with the value returned.

As a topographical map of the entire farm has been made this is used as in the design of the ditch. A twelve inch tile is now used to carry the water from lands above this field. Much of the farm now is tile drained very satisfactorily and the experience gained

from it will be used to determine the depth and spacing of the laterals.

A depth of three and one-half feet has been found satisfactory as has also a spacing of one-hundred feet for the laterals.

A map of the farm by the Bureau of Agricultural Engineering, United States Department of Agriculture, accompanies this thesis as does also a map of the field and the proposed drainage by the author.