# MICHIGAN LAND TRUSTEES

TOWARD A

PERMACULTURE PLAN

FOR THE

LAND TRUST HOMESTEADING FARM

1984

Jonathan Towne

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# INTRODUCTION

The Michigan Land Trustees own a forty acre marginally productive farm. Half of the land needs artificial drainage, the other half could use irrigation and it all needs organic matter to make it productive. In the face of the current agriculture price-cost squeeze, it's no wonder we can't get a productive farm going. Agriculture should not be secondary to the homesteading school program.

Cultures live and die because of the health of their agriculture. Examples are the Greek, Roman, Mayan and the Middle East civilizations which have left us their parched landscapes as a legacy. The dust bowl period of the 1930's means more than just dirty clothes on the line for the folks in Washington DC. The rate of erosion, even on relatively flat land, is many times the 1½ tons that can be sustained per acre. Our dependence on fossil fuels, the instability of having only a small segment involved in food production, erosion and the general ecosystem disruptions from pesticides and runoff must be considered temporary subsidies. When fossil fuels, the soil, and the natural environment are used up, things will fall apart. And it is not nice to look at 100 acre fields laden with pesticides or dirty rivers anyway.

Permaculture fits the requirements of a worthy MLT project. The Friends of the Trees Society have a good definition of permaculture;

> Permaculture is the conscious design of agriculturally-productive ecosystems with the diversity, stability and resilience of natural ecosystems. It is harmonious integration of people into the landscape; done in such a way that the land grows in richness, productivity and aesthetic beauty. Permaculture is a design science which can be applied in any ecosystem.
>
> Permaculture puts great emphasis on trees, shrubs, and perennials which require relatively little maintenance. Very little tillage is needed and buildings all have multiple uses and supportive relationships are maximized.

To support and enhance the health of the people and community is what MLT is all about.

Permaculture is not new. Areas of Europe for centuries were based on systems of Oaks and Chestnuts on steep land with livestock grazing the understory. The nuts were used both for human and livestock consumption. It is an old idea but it is still in its infancy. If we were to devote an appropriate amount of attention towards developing varieties and permaculture techniques that we have toward techniques of traditional agriculture, we would revolutionize our society.

Because we are treading new ground, and the results are in the future, our first efforts may seem a little anticlimactic. Complex, stable and productive ecosystems don't happen overnight, especially with a, hopefully temporary, lack of suitable species and varieties. But like the newly planted apple orchard, some returns will come rather quickly and with the fertilizer of human guidance and care, the returns will never stop increasing.

# SURVEY: THE NATURAL ENVIRONMENT OF THE LAND TRUST HOMESTEADING FARM

To provide a background, and introduction, and useful data for formulation of a permaculture plan, we must consider the physical environment and its history.

## Climate.

The LTHF is situated in zone 5 which is characterized by an average minimum temperature of -10 to -20. However, Lake Michigan exerts a moderating effect which may push it into zone 6. Limited meaning should be put into this arbitrary system of classification. It is still a trial and error approach to grow some frost sensitive varieties. Our yearly rainfall averages about 36 inches with a drier season in the summer and a wetter season in the spring. The large snowfall is valuable for its insulating effects. The growing season varies between 140 and 160 days. Our relatively high humidity can cause problems with fungal diseases.

## Microclimates.

Microclimates occur because local topographic, vegetational or other factors influence aspects of climate in a specific area. An obvious case is the halting of air drainage at the west end of the farm-especially in field 1- because of woods. Being lower and having unobstructed drainage from higher areas, cold air can accumulate- effectively shortening the growing season and causing cool nights. The southern and western aspects of some areas will cause the soil to warm up faster in the spring having both desirable and undesirable effects. The shading of trees will have a cooling effect while raising the humidity.

## Physiographic Background.

The LTHF is situated on the Valparaiso morraine in the Black River drainage basin. The glacier receded from this point roughly 14,000 years ago following which lower areas of the farm were subject to deposition of glacialfluvial origin. The elevation is about 625 feet and the farm's gentle relief doesn't exceed a 6% slope. Much of the farm has a southern and western aspect.

## Edaphic Considerations (soils).

Five factors go into soil formation: climate, topography, parent material, native vegetation and time. Soils on this farm vary significantly because of two of these- topography and parent material. (See Soil Map)

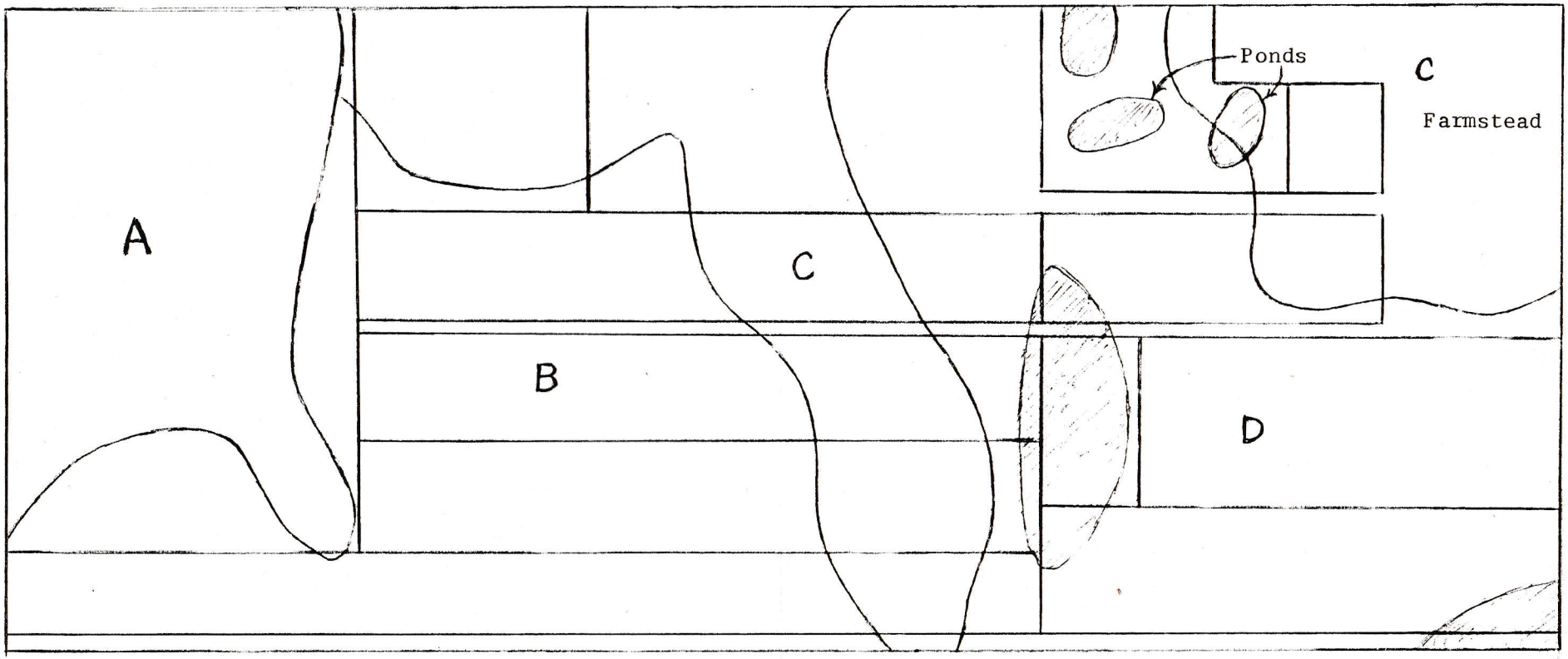
Higher areas at the east end of the farm were formed of parent material that is glacial drift, unmodified by glacial runoff (glacialfluvial action). This is the Capac loam series characterized by a fine texture and high water retention capacity. Its problems include excess water during wet periods especially between Nov. and May when the apparent water table is between 1 and 2 feet of the soil surface. Artificial drainage is indicated. Tilth is another problem needing timely tillage and high organic matter.

Comprising the Northeast corner and going across the middle of the farm is the Selfridge loamy sand series formed in glacialfluvium over heavier sediments on a till plain or lake plain. It is of medium productivity having a perched water table during the Nov. - May period. Aritificial drainage would be of benefit.

The Thetford loamy sand series makes up the lower flatter areas of the farm. It is also of glacialfluvial origin but doesn't have the fine textured subsoil. Consequently its apparent water table is within 1-2 ft. of the soil surface only between Feb. and May. Its productivity is hindered by its droughtiness and its high water table during very wet periods. Maintaining organic matter is important and artificial drainage may not be practical.

The Adrian much soil type makes up much of the 8 acre woodlot. It differs because of its location in a depression which causes the high water to

# Soil Map




(Shaded areas are very wet areas)

N

A. Adrian Muck (very wet)

B. Thetford Soil
(Loamy sand, 0 - 2% slope)

C. Selfridge Soil
(Loamy sand, 0 - 3% slope)

D. Capac Loam
( 1 - 5% slope)

hinder decomposition of organic matter. Consequently up to 3 feet of muck has accumulated in the last 14,000 years. The area is flooded much of the year and has little usefulness except as a wooded natural area.

Permaculture seeks to not only utilize the space above ground efficiently by 3 layers of vegetation, but also to use the entire soil profile to full advantage. This presents problems, since most species cannot tolerate waterlogged soils. This effectively decreases the depth of the working soil and makes the utilization of the profile by rootsystems less of a consideration in the choice of plants. However, the species which thrive in waterlogged soils should be used whenever possible.

## VEGETATION: PAST AND PRESENT

Ecosystems are subject to both internal and external forces. Inter and intra species competition and cooperation with changes in soil and microclimate tends to produce stable ecosystems always moving toward the climax with shade tolerant trees dominate. Insects, diseases, fire, wind throw, climate, fauna, soil conditions and of course people can modify or set this process back. These forces at work today are quite different from what they were. The actual percentage composition of species at the point when the forests were first infringed upon by white man may be of less importance than what the forest type was and the group of species that were likely to occur. It would, however, be interesting to check the data in the original land survey in the early 1800's to find what species were the witness trees in the immediate area.

Ecologist John T. Curtis' book: Vegetation of Wisconsin is the definitive source for categorizing communities. By reading the Soil Conservation's description of common trees for each soil type and direct observation of the species present, a definite set of conclusions may be reached as to forest type according to Curtis.

This area is influenced by Lake Michigan in that evaportranspiration is reduced because of increased humidity and a cooling effect during the growing season. As a result we have mesic conditions unless the soil is wet or very dry. Most of the soil conditions on the LTHF are on the moist side because of high water table during part of the year, consequently the tendency to move to climax mesic Beech--Maple forest is impeded so we have a diversity of other more moisture tolerant trees. Our proximity to the so-called tension zone causes us to also have some species typical of more northern forests.

Areas of the Adrian soil series have a water table commonly above the soil surface. The forest type is southern wet forest with wet--mesic forest at higher points. The dominant tree is the Silver maple with Black willow and Cottonwood is very wet places and American elm and White ash in dryer areas. Even here the tendency is to move toward mesic conditions as sediments and organic matter build up the soil surface in the long run.

The Capac, Selfridge, and Thetford soil series seem to be on the continuum of southern wet--mesic to mesic forest types. It is difficult to assign values to each series because of the different nature of their excess soil water conditions. The Thetford soil type, with a high water table from Feb. to May is not beset with excess soil moisture to a great extent at drier times of the year because of a lack of clay pan. In fact, it is very prone to drought. This probably limits the number of species that thrive on it. Some species like drier conditions, such as sassafras and aspens, and compete well here even though it seems to be, in general, a wetter forest type owing to the periodic high water table. The other two soil types have fine textured top soil and seem to favour a more wet mesic forest type.

# SPECIES LIST

These species are present or may have been present on the Land Trust Homesteading Farm.

## CANOPY LAYER

| Mesic Forest Trees | Wet Mesic | Wet Forest |
|---|---|---|
| American beech (1) | Sycamore | Silver maple (2) |
| Sugar Maple (1) | American elm (2) | Black willow |
| Hemlock (1) | Rock elm (2) | Cottonwood |
| Yellow birch (1) | Red maple (2) | Box elder |
| other | Blackgum | Swamp White oak |
| Red Oak (2,3) | Pin oak | Tamarack |
| Black cherry (3) | Black ash | |
| White ash (2,3) | | |
| Basswood (2,3) | | |
| Tulip tree | | |
| Sassafrass (3) | | |
| Bitternut hickory (2) | | |
| Shagbark " (2,3) | | |
| Black walnut (3) | | |
| Butternut | | |
| Slippery elm (2) | | |
| Kentucky Coffee tree | | |
| Large toothed aspen (3) | | |
| Trembling aspen (3) | | |

(1) Good shade tolerance.

(2) Medium shade tolerance.

(3) Not optimal forest type but have strong presence

## UNDERSTORY LAYER
(incomplete)

| | |
|---|---|
| Eastern Hophornbeam | Hawthorns |
| American Hornbeam | Dogwoods |
| Witchhazel | Willows |
| Serviceberry | Alders |
| Paw Paw | Sumacs (includes poison ivy) |
| American Hazelnut | Virginia Creeper |
| Prunus sp. | Vitus Riparia (wild grape) |

etc.

## THE PERMACULTURE ECOSYSTEM

The climax beech-maple forest, while dominated by two important food trees, is of limited usefulness as a model of the permaculture ecosystem. While the flora may be diverse, the productivity of the understory and ground level is limited because of the low light levels. If we look at wildlife populations, we find a large number of species but small numbers of wildlife indicating stability but not productivity of the values we need.

The edge effect is the increased productivity that occurs where two communities interface. The diversity and density of species increase, making use of more ecological niches. Wildlife is abundant in these areas.

An interesting community that was prevalent in southwest Michigan is the savanna- specifically the oak opening. This is a fire maintained community where the forest cover was less than 50%- composed of fire resistant trees. Early explorers reported that they looked like orchards. The dominant tree was the Burr Oak. The understory and ground layer were species typical of mesic prairies and included the American Hazelnut, which thrived even directly under the oaks. Other trees included the Shagbark Hickory. On wetter sites the Swamp White oak replaced the closely related Burr Oak and had a wet-mesic prairies and oak forest and could be considered an edge effect.

By separating the crown of the overstory trees and developing the understory and ground layers, the edge effect can be used to advantage. Losses due to competition can be minimized and the synergistic efforts of cooperation can be maximized. If developed properly, such a system will efficiently use environmental inputs.

What kind of products will the permaculture system produce? Less tangible products include: Diverse, stable and substainable food producing ecosystems, a nice place to live and work, and a system that can be shown to the world. These products come with doing a good job in development. Tangible products include: Honey from bees which perform a pollination function, livestock products from the forage and nuts produced, nuts and fruit for human consumption. Ground up acorns, locust pods, black walnuts and hickories can serve as a concentrate for livestock. Black walnuts, English walnuts, chestnuts and hazelnuts all have developed markets. Brambles, ribes, strawberries, blueberries and tree fruits can be produced and sold. Many of these products will be grown on the same land.

Will it be economically viable? Faith in the inherent productivity of the permaculture system will suffice concerning this question. Only by creating and generating interest in permaculture will new varieties and techniques be developed to realize its potential.

### Available Species for Permaculture

CANOPY LAYER

| | |
|---|---|
| Gleditsia triacanthos | Honeylocust |
| Castanea mollissima | Chinese Chestnut |
| Juglans nigra | Black Walnut |
| J. regia | English Walnut |
| Acer saccharum | Sugar Maple |
| Castanea dentata | American Chestnut |
| Quercus alba | White Oak |
| Q. macrocarpa | Burr Oak |
| Q. bicolor | Swamp White Oak |
| Carya lacinosa | Shellbark Hickory |
| C. ovata | Shagbark Hickory |
| C. illinoesis | Pecan |
| C. (lacinosa X illinoesis) | Hican |
| C. (ovata X illinoesis) | Hican |
| Juglans cinera | Butternut |
| Fagus grandifolia | American Beech |

| | |
|---|---|
| Diospyros virginiana | American Persimmon |
| Pinus sp. | Korean Stone Pine<br>Swiss Stone Pine<br>Italian Stone Pine |

UNDERSTORY

| | |
|---|---|
| Morus rubra | Mulberry |
| M. alba | |
| Asinoma triloba | Paw Paw |
| Amerlanchier sp. | Serviceberries |
| Corylus americana | American Hazelnut |
| Prunus sp. | |

Description of Canopy Layer Species

Honeylocust. The potential for honeylocust as a protein and energy source for livestock outstrips that of the grains. The pods are also useful and nutritious for human use, but work needs to be done to improve its palatability (the ancestor of the garden pea probably didn't tast good either.). This native legume is very intolerant of shade and its leaves intercept very little sunlight. Problems with it include its thorns, that can puncture tractor tires. The thornless varieties have also been bred to be seedless in many cases. The palatability problem for livestock can be addressed, by grinding and mixing with other grains or nuts. By proper pruning, a valuable sawlog can be produced.

Chinese Chestnut. This species was introduced as a replacement for the American Chestnut that was all but wiped out by a blight. Its important role is seen to be temporary since the native species is a better timber tree in addition to tis virtues as a nut producer. Roughly the size and shape of an apple tree, this tree likes lighter, well drained soils on the acid side. Thetford loamy sand my be good chestnut soil, especially on higher points. The nuts demand a good price and are excellent livestock feed. Chestnuts bloom late and are not succeptible to spring frosts.

Black Walnut. This tree would grow well on the Selfridge and Capac soils. It is a valuable timber tree producing quantities of very good tasting nuts. It is another species with light foliage that lets alot of light through. There is a thriving market for its nuts and they can be ground up shell and all for high protein cattle feed. It can be trimmed to produce a nine foot saw log with out reducing yields. Walnuts need good soil for growth and may not be compatible with certain other plants because of a natural herbicide it secrets from its roots. Its yields may not be reliable for unimproved strains because of frost and its every other year bearing habit. Seedlings can be planted for grafting onto scions of improved cultivars.

English Walnut. The varieties we are interested in, is the Carpathian strain, noted for its hardiness and quality of nuts. This tree is known to be a high producer of marketable nuts. It is not as upright in habit as the black walnut. For hardiness and early bearing, scion wood of improved varieties should be grafted onto black walnut rootstock. The walnuts in general, are known for their lack of pests.

American Chestnut. We would be remiss not to include this tree that was once the dominant and central tree of the Appalachian region. Its range extends into Michigan and it is likely that its range was expanding when the imported chestnut blight all but exterminated this tree. Michigan is at the forefront of its possible resurgence since there are stands likely having at least an-partial immunity to this disease. Nuts are available for planting. Since it can take several years for the blight to affect the growing sapling, they should be planted in the hopes of finding a cure or that a resistant strain might popup.

Butternut. This is another native walnut with requirements similar to the black walnut. It is, however, a smaller and short lived tree. Its wood is valuable but hard to produce in quantities. It is hardier and produces a

distinctive and worth nut. The tree is worth growing and there are improved varieties that can be grafted onto Black walnut rootstock.

Oaks. The venerable oaks have the potential for being a major tree crop as they were in Europe. The acorns especially of the white oak group, can be abundant, of good size and of reasonable taste. There is a report of an oak tree in California that produces acorns that taste like cashews! One species is the burr-oak, a large tree, prefering intermediate soils, and a producer of large sweet acorns. A closely related tree, the Swamp white oak, prefers wet soils. Other oaks of importance are the white oak, chestnut oak, and the chinquapin oak that is known to be very prolific. All the large oaks produce valuable timber and firewood. The native red oak is very common in this area and should be encouraged since it is prolific, fast growing and a good lumber producer. Its nuts are of lesser value to us but are of definite value to wildlife.

Sugar Maple. There is some sugar maple present in the woodlot and its presence should be encouraged so that a sugar bush may eventually be established. Improved varieties exist which produce a higher quality sap.

American Beech. In addition to the chestnuts and the oaks, the beech is the third member of the beech family. In the wild it is not known to produce its nuts in great quantities or of good size, but there is an improved variety-Jenner. Its usefulness lies in its shade tolerance, so that it may be planted along a woods edge or in an established forest or tree farm.

Hickories. These slow growing relatives of the walnuts are another group of potential food trees. The worth of the Pecan is well known. There are northern varieties of the pecan which may be applicable here. Another tree with improved cultivars, is shellbark. This tree likes moist soils and may grow well here. Another native hickory is the shagbark which has also been improved. The hickories are more subject to insect problems than the walnuts.

Persimmons. The American Persimmon should be hardy here. This is an ebony whose wood is used for golf clubs. The fruit is excellent when ripe and is good livestock feed.

Mulberries. While limited in popularity as a human food, mulberries are valuable to poultry and swine. The native red mulberry is more shade tolerent than the common imported white mulberry.

Paw Paw. The paw paw can make a valuable contribution being very shade tolerant and having improved varieties for Michigan.

Hazelnuts. The American Hazelnut is hardier and more disease resistant than the European Filbert and is a potentially valuable understory tree.

Prunus sp. The stone fruits are fast growing short-lived trees or shrubs that may have a place when planted between newly planted slow growing canopy trees. Native species of plums and cherries, along with other plums, peaches and cherries can be profitably grown before the canopy trees mature.

Amelanchier Sp. The serviceberries definitely deserve more attention. This small tree or shrub produces fruit similar to the blueberrry.

Understory Species

Forage. Legumes and grasses can be grown for forage, but care should be taken to ensure compatibility with the overstory.

Brambles. Raspberries and blackberries thrive under lightly shaded conditions. Strawberries also can be grown.

Ribes sp. Currants and gooseberries are forest plants liking moist soil.

Row crops - When the trees are young, the land may be cropped between the trees until tney are shaded out.

## RELATIONSHIPS AND CONSIDERATIONS FOR SETTING UP THE SYSTEM

The following tables try to relate environmental preferences and utility to people with the different species so that an efficient permaculture system may be set up.

As mentioned earlier, we have a problem with frost pockets on the LTHF. A coniferous belt of trees in a suitable place would channel cold air elsewhere. Frost sensitive plants should not be place on south facing slopes where premature warming can cause frost damage. Microclimates should be considered.

Obviously, a stable system should not have runaway pest problems. This should be considered. Large areas with the same species would be inviting pest problems. Native species are more adapted to the pest of any area.

The system should be labor efficient. Self-harvesting by animals should be maximized. Areas could be grazed close in the fall to facilitate the nut harvest.

Other characteristics to be considered:

Shade tolerance.
Longevity.
Time to bearing.
Edibility of plant to livestock.
Associations in native ecosystems.
Pest resistance.
Wildlife benefit.
Growth habits.
Deciduous?

## DISTRIBUTION OF YIELD

| | |
|---|---|
| Honeylocust | Oct. - Nov. |
| Chestnuts | Oct. |
| Oaks | Oct. |
| Beech | Oct. |
| Maples | March |
| Walnuts | Oct. |
| Hickories | Oct. |
| Mulberries | July |
| Hazelnuts | Aug. - Sept. |
| Paw Paw | Oct. |
| Serviceberries | July |
| Stone Fruits | July - Sept. |
| Dwarf Chinquapin Oak | Oct. |
| Forage Perennial | April - Nov. |
| Strawberries | June |
| Raspberries | July - Sept. |
| Ribes | July |
| Blueberries | July - Aug. |
| Blackberries | Aug. |

## PREFERRED SOILS

| | | |
|---|---|---|
| Honeylocusts | (all) | Thetford series |
| Chestnuts | | |
| Oaks | (all) | |
| Beech | | Selfridge series |
| Maples | (all) | |
| Walnuts | | Capac series |
| Hickories | (all) | |

## PRODUCTS AND USES

| Tree/Shrub: | Human Products & Uses: | Animal Forage: |
|---|---|---|
| Honeylocust* | Timber | Ruminants |
| Chestnuts | Timber and nuts | Swine, poultry |
| Oaks* | Timber and nuts | " " |
| Beech* | Timber and nuts | " " |
| Maples | Timber, syrup, & sugar | |
| Walnuts* | Timber and nuts | Ruminants |
| Hickories* | Timber and nuts | |
| Mulberries | Fruit | Swine, poultry |
| Hazelnut | Nuts | " " |
| Paw Paw | Fruit | " " |
| Serviceberries | Fruit | |
| Stone fruits | Fruit | Swine, poultry |
| Dwarf Cinquapin Oak | Nuts | |
| Rosa species fruits | Fruit | |
| Blueberries | Fruit | |
| Ribes | Fruit | |
| Perrenials for forage | | Ruminants, swine, poultry |
| Perrenials for seed | Undeveloped | |

*Frost sensitive trees.

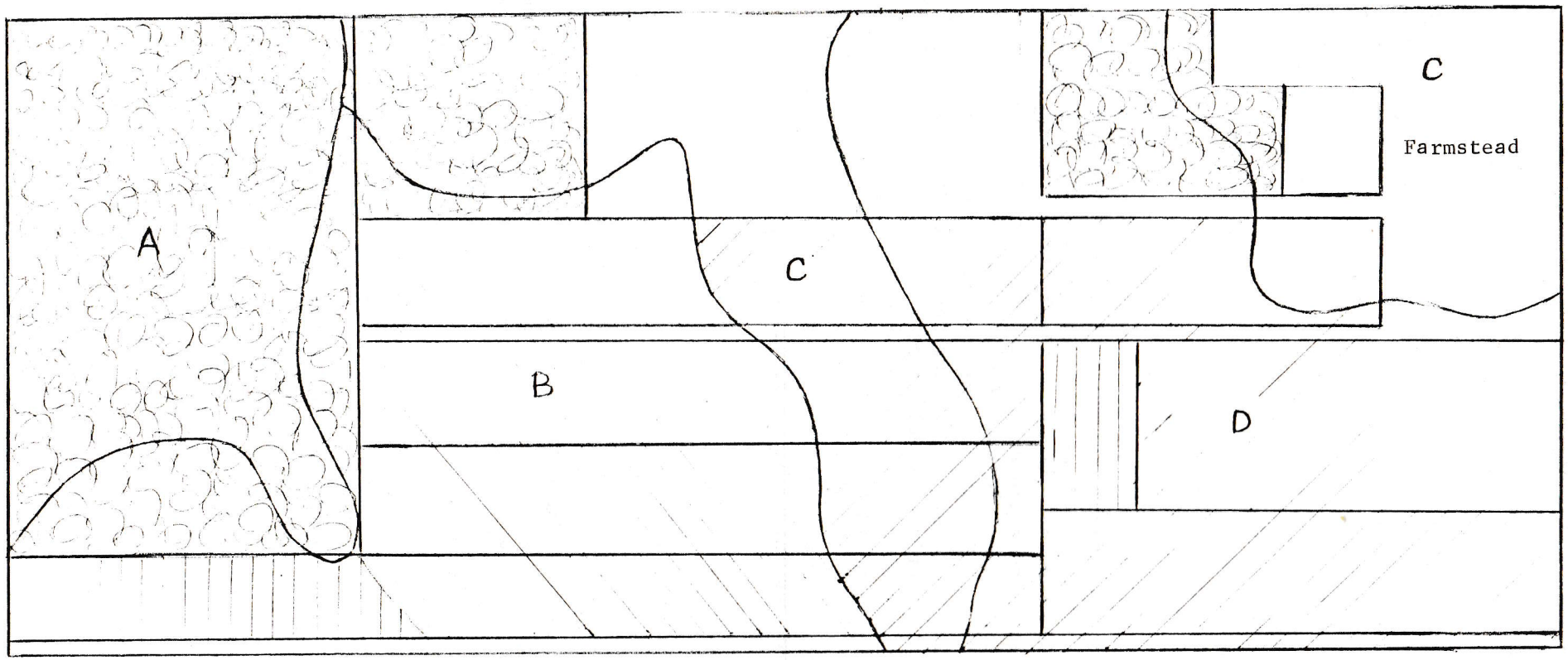
## SETTING UP THE PERMACULTURE SYSTEM

I have divided the farm into three regions to be approached consecutively. This is to accomodate the needs of the farm manager and to concentrate on areas with inadequate productivity first. The goal is to set up a three story cropping system of perennials, but in the interim, the regular annual crops will be grown to maintain the cash flow. Determination of the best ground layer composition and to a certain extent the understory, may be delayed for the time being. This stuff is not easy to figure out and the best system may take years to develop.

Another consideration is that cattle are presently being raised, presenting problems with protection of planted stock. This problem can be dealt with by either witholding the animals until the plants are big enough, or to put fencing around each tree and to not let the animals get hungry enough to eat the foilage. Some plants are more edible to cattle than others. In the long run it may be better to go with another animal such as sheep.

The map indicates these three regions and indicates the plantings to be done in the first region. The other two regions are meant to be considered superficially (this all is a rather superficial rendering of a very complex field.).

# Regions For Development




A. Adrian Muck

B. Thetford Soil

C. Selfridge Soil

D. Capac Loam

N

= Wooded areas

= Region 1

= Region 2

= Region 3

The first Region is made up of four separated problem areas that aren't being utilized very productively.

The first area is roughly one acre at the west end of field one. It is characterized by the Thetford soil type and has been in alfalfa. The alfalfa has done poorly due to low fertility and soil moisture. It was limed 5 years ago and may be quite acid now. It is not fenced and because of its remoteness, in order for livestock to utilize it, a lot of expense or inconvenience would have to be accomodated.

Thetford is probably the best soil type on the farm for chestnuts, although its temporary high water table may cause problems. As mentioned earlier, this area may be a frost pocket which lends support to the use of the hardy chestnut. About 30 trees may be needed. Seedlings can be acquired very reasonably. While unimproved chestnut seedlings can be good nut producers, the option is always there to graft on varieties a year or two down the road.

Hazelnuts would be a good understory. Another option, which is somewhat ideologically out of place, is to plant christmas trees as an understory. This is a good place for them. Brambles and strawberries would grow well here with added fertility. The farm managers can decide this.

The second area for consideration is also in field 1 and is of a different nature. It is the southern edge of the field that is heavily shaded by the neighboring woods. A shade tolerant tree is needed. The trees available that fit the bill are the beech and the sugar maple. I vote for the maple since it is likely to grow better here. Planting improved seedlings can be done cheaply. These trees which would be widely spaced to serve as a buffer between the woods and the field, would eventually be a sugar bush (Further on down the road of course). These improved trees can have twice the sugar in their sap.

The third area (still in the lst region) is field 9, a very wet depression that has been very unproductive. A savanna like system could be set up using swamp white oak and burr oaks as the dominant species. A couple of honeylocust would fit in also. With an appropriate understory such as mulberries and a grass legume ground cover, this area could produce pork. Planting stock could be obtained from native stands. There is Burr oak presently started in a nursery. About 12 trees would be needed.

The 4th area is field 5. This field of 2.5 acres has been fenced and pastured and has a mixed stand of sapling in it. This stand, consisting mostly of white ash, cherry, soft maple, and elm should probably be thinned and allowed to reach marketable size (save the one pin oak!). The rest would be planted to walnuts, hickories, and honeylocust. The honeylocusts would go in the wetter depressional areas. About 50 trees would be needed. Black and English walnuts, since they produce very marketable crops, should predominate. Depending on the needs of the managers, the surface layer may be pastured or cropped.

The second region could be considered next year or later. It is the 6 acres of Thetford soil type remaining as indicated on the map. Much more research and resources are needed to do it. The just planted row of chestnuts and walnuts will give us a better idea of how these trees are suited to these conditions. A coniferous windbreak needs to be planted across this region to protect the lower areas from surprise frosts and the higher areas from the wind.

The last region is up front in the moister soils. This 10 acres can be developed more intensively. Wet spots can be planted sooner. A row of lower growing butternuts, english walnuts, chestnuts, and/or other trees can be planted under the wire next to the road.

## ADDITIONAL AREAS OF FOCUS

Soil tests. All areas should be tested to determine Phosphorus, potassium, magnesium and lime requirements. While rock minerals and lime can be applied on the surface, they incorporate sooner if tilled in.

Nursery. Any permaculture system should be supported by a tree and variety propagation program. It is recommended that a good sized nursery be set up this spring. Considering the limited funds, this is an inexpensive but slower way to stock the farm with quality trees we need. A nursery is important also to ensure the propagation of rate species such as the American Chestnut and kentucky coffee tree. The nursery will provide for replacement and improvement in the established tree farm as our understanding continues to evolve.

Woodlots. These areas should be managed for wood products, Maple sugar, and ecological values. Scarce plants and animals should be preserved. Wood products include timber, poles and firewood. Some trees that there should be more of: Tulip tree, red oak, sugar maple, and beech.

Bees. 5-10 or so hives should be managed on the farm. They provide honey and pollination.

Research and Development. The available literature should be searched and awareness kept up to date on new varieties and research. Because the concept is new, many answers can be found through experimenting right on the farm. An example is: Will Burr oak graft onto swamp white oak rootstock? If information isn't available, the answer could be found by doing it. Being pioneers, our experiences should be made abailable to others by publication.

Plants That Should be Grown in the Nursery. (seed is available)
Walnuts for rootstocks and quality seedlings
Hickories
Honeylocust (thornless)
American Hazelnut
Serviceberries
Paw Paw
American Chestnuts
Tamarack
Bald Cypress
Northern White Cedar

Farmstead. Little has been said about designing household systems to be applied around the farmstead. Systems could be set up using chickens pastured on mulberries, siberian pea shrub and comfrey, for example. A coniferous windbreak definitely needs to be established north of the house. This area of needs has been separated for purposes of simplification and logic-possibly detrimentally- from the rest of the farm which is oriented towards producing for the market.

Aquaculture. There are pond sites that could be developed and incorporated into the permaculture system.

## APPENDIX I: SOME IMPROVED VARIETIES

| | |
|---|---|
| Chestnut (Chinese) | Ford Sweet |
| | Laperoka |
| Beech (American) | Jenner |
| Oak (Burr) | Ashworth |
| Walnut (Butternut) | Crack-easy |
| | Kenworthy |
| (Black) | Thomas |
| | Burns |
| (English) | Hansen |

| | | |
|---|---|---|
| Walnut | (English) cont. | Ashworth |
| | | Fately No. 5 |
| | | Broadview |
| Hickory | (Shellbark) | Burger |
| | | Fayette |
| | (Shagbark) | Mann |
| | | Nielson |
| | | Wilcox |
| | (Pecan) | Colby |
| | | "Missouri Hardy Seedling" (Stark Bros.) |
| | (Hican) | Burton |
| Persimmon | (American) | Etter |
| Mulberry | (probably albarubra hybrids) | Downing |
| | | Illinois |
| | | Wellington |
| Hazelnut | (American) | Winckler |
| | | Rush |
| | (European) | Barcelona |
| Paw Paw | | Davis |

## APPENDIX II: SAMPLING OF PRICES

| | |
|---|---|
| Stark Bros. Nursery 1984 | |
| Shellbark hickory (seed grown, selected 1-1 1/2') | $ 6.95 |
| Butternut (grafted, 2') | $13.95 |
| American Hazelnut | $ 6.95 |
| Black walnut Thomas (grafted) | $12.95 |
| Hybrid B. Walnut (grafted) | $13.95 |
| English Walnut Carpathian | $10 - $15 |
| Missouri Hardy Pecan (seedling 2 -3 ') | $ 7.95 |
| Musser Forest 1984 | |
| Chinese Chestnut (seedling 2 -3 ') | 25 for $25.00 |
| Miller Nursery 1983 | |
| Black Walnut (Thomas- grafted 2 - 3') | 10 for $70.00 |
| English Walnut (Metcalf seed strain) | 10 for $58.76 |
| Kelly Bros. 1983 | |
| Shellbark Hickory Improved seedling 2 - 3' | 2 for $9.45 |
| Black Walnut Improved seedling 3 - 4' | 2 for $8.95 |
| Hardy Pecan | |
| Purple Juneberry | |
| Dean Foster (Hartford) | |
| American Hazelnut | 25 for $124.00 |
| Carpathian walnut | " |
| Hardy Pecan | " |
| Hybrid Mulberry | 10 for $57.50 |

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(Classic discourse on the need for development of tree crops.)

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(Have soil maps, descriptions of soil types, native species of each soil type, and species suitable for planting in each soil type.)