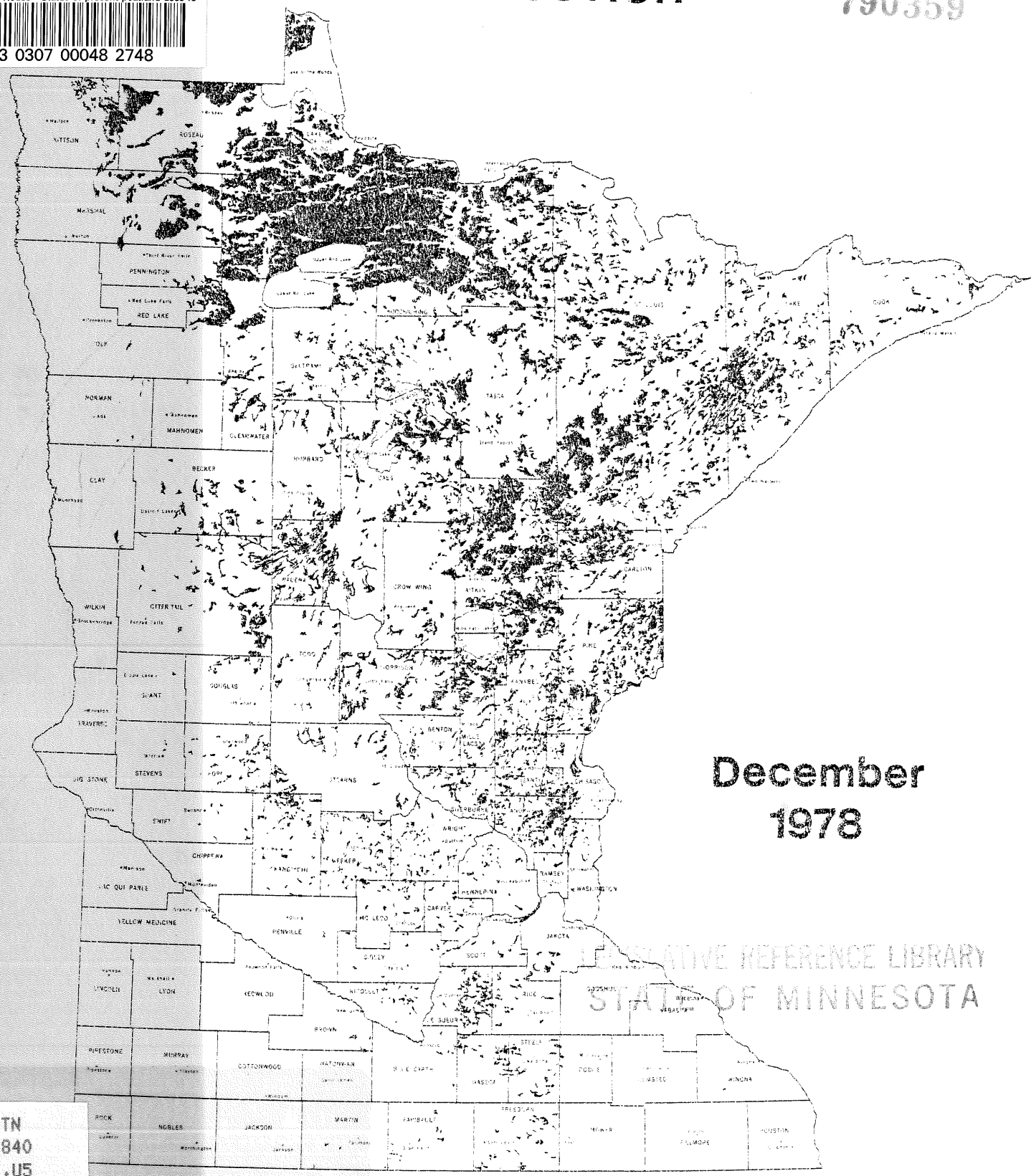
STATUS OF PRESENT PEATLAND USES FOR AGRICULTURAL AND HORTICULTURAL PEAT PRODUCTION



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MINNESOTA DEPARTMENT OF NATURAL RESOURCES

FINAL REPORT
PHASE II - PEAT PROGRAM

Status of Present Peatland Uses for Agricultural and Horticultural Peat Production

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For
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SUMMARY

The main emphasis of this study was to evaluate the present uses of peatlands in Minnesota for agricultural and horticultural purposes. In addition, during the course of this investigation an inventory of current peatland utilization was made including location and total extent of peat in state and national forests, in designated state and national wildlife refuges and management areas, recreation areas, natural areas containing peat, and undeveloped peatlands both public, private and Indian.

Information was obtained on the location and extent of the various crops grown on peatlands and data was gathered from farmers concerning major operational problems and current management practices.

Peatlands used for commercial horticultural peat production were located on county maps and acreage presently being harvested was determined.

A literature survey was made of current agricultural and horticultural uses of peatlands including types of crops, suitability of peatlands, properties of peat, management practices and problems associated with these developments.

Current information on commercial peat production in the U.S. was included and an evaluation was made of the potential of Minnesota horticultural peat production in the future. Also the reclamation potential for mined peatlands was determined.

INTRODUCTION and OBJECTIVES

The present utilization of Minnesota's peatlands was the first task undertaken in this study. The total extent of peatlands used in agriculture, commercial horticultural peat production, as wildlife and recreation acres (wilderness, parks, etc.), natural areas and those areas not developed were inventoried in detail. The work was accomplished by using published soil surveys, photo interpretation and actual field surveys.

The objectives of the study were as follows:

1. Inventory of present peatland utilization in Minnesota.
2. Study the various agricultural uses of peatlands and the major management problems including;

    a. vegetable crops
    b. forage crops (hay-pasture crops)
    c. special crops
    d. food crops
    e. fiber crops (commercial forests)
    f. management considerations for production
    g. environmental problems

3. Inventory and evaluate the use of peatlands for commercial horticultural peat production including:

    a. methods of harvesting
    b. management considerations
    c. environmental problems
    d. horticultural peat markets and values
    e. estimate of future potential for development

4. Complete a review of the current literature on use of peat for crop production, horticultural peat production and use.
5. Determine the reclamation potentials for mined peatlands especially for crop production.

INVENTORY OF PEATLAND UTILIZATION

The 1977 inventory of Minnesota peatland utilization included collection of data in all counties containing peat. These data included the location of and type of farming operations in the state as well as the location and type of commercial peat operations presently producing peat products. In addition to collecting these data other uses of peatlands were determined and located on county maps and the acreage of a particular use was calculated.

The data included peatlands occuring in state and national forests, wildlife areas, recreation areas, natural areas, and the amount of peatlands under Indian ownership. Undeveloped peatlands or those not in any designated use were also surveyed and the acreage measured.

Table 1 shows the acreage of peatlands in Minnesota by use.

Agricultural use of peatlands for all types of crops totals only 677,994 acres or 8.9% of the total peatland in the state.

Commercial peat operations total only 1,400 acres at present. This includes only those areas presently being used for harvesting operations and not leased or private lands for future expanded production.

The undeveloped peatlands constitute the largest acreage. These lands which are not presently utilized for any specific purpose total 4,377,102 acres or about 57.4% of the state's total peatlands. Of the undeveloped peatlands 3,852,853 acres were in public or private ownership - mostly public owned. In addition 524,249 acres of peatlands were located on Indian lands.

AGRICULTURAL UTILIZATION OF PEATLANDS IN MINNESOTA

The 1977 inventory included locating and compiling the acreage of the various types of crops grown on peatlands in Minnesota. Included in this data were the following types of farm operation on peatlands:

1. hay - pasture and miscellaneous forage crops

TABLE 1 MINNESOTA PEATLAND UTILIZATION - 1977 INVENTORY

Type of Use	Acreage of Peatlands	% of Total Peatlands
Agriculture	677,994	8.90
Commercial Horticulture Peat	1,400	0.02
State and National Forests	2,055,095	26.90
State - 1,578,586		
National - 476, 509		
Wildlife	276,771	3.60
National Wildlife Refuges and Management Areas 71,587		
State Game Refuge 41,489		
State Wildlife Mgt. Areas 163,695		
Recreation	79,526	1.00
BWCA 40,107		
Voyageurs Nat'l. Park 9,725		
State and County Parks 26,694		
Natural Areas	163,190	2.10
Lake Agassiz Peatland 22,528		
Red Lake, NATURAL National Landmark 137,920		
Cedar Creek Natural History area 2,742		
Undeveloped Peatlands	4,377,102	57.40
Public & Private 3,852,853		
Indian Peatlands 524,249		
STATE TOTALS	7,631,078	100.00%

2. row crops
3. wild rice
4. turf grass
5. grain crops
6. vegetable crops
7. grass seed crops

Table 2 shows the agricultural utilization by crops grown on peatlands in 1977.

The most extensive type of agricultural use for peatlands was for the production of hay and pasture crops. This type also included several types of miscellaneous forage crops as well. The total acreage used for these crops was 528,006 acres which constitutes 6.9% of the total peatlands.

The major hay and pasture crops grown on peatlands are timothy, gnome, grass, clovers, blue grass and several mixed hay crops. Pasture crops are usually bluegrass, orchard grass and several other minor crops.

Row crops were grown on over 90,000 acres of peatlands in 1977. The type of row crops grown on peatlands in Minnesota were chiefly corn and soybeans although sunflowers were grown in NW Minnesota to a small extent.

The data in table 2 shows that almost 90% of the peatlands in Minnesota developed for agriculture were used for hay, pasture and forage crops. Wild rice grown on peatlands, although a relatively new commercial crop in Minnesota, has increased dramatically in acreage in the past few years. There were 18,507 acres of wild rice grown in the state in 1977. Counties where commercial wild rice is grown on peat are mostly located in the northern and northwestern part of the state. Commercial wild rice paddie production has developed only recently as a result of research on non-shattering wild rice varieties, improved management practices and new

TABLE 2 AGRICULTURAL UTILIZATION OF PEAT SOILS IN MINNESOTA - 1977 INVENTORY.

TYPE OF AGRICULTURAL UTILIZATION	ACRES	% OF TOTAL PEATLANDS
HAY-PASTURE	528,006	6.92
ROW CROPS	90,534	1.20
WILD RICE	18,507	0.25
TURF GRASS	12,063	0.16
GRAIN CROPS	10,481	0.14
VEGETABLE CROPS	9,469	0.12
GRASS SEED	8,934	0.11
TOTAL FOR STATE	677,994	8.90

harvesting techniques.

Turf grass, particularly blue grass grown for commercial sod, is another specialized crop which has increased recently on peatland soils. A total of over 12,000 acres of turf grass were grown in the state in 1977 and the amount will probably increase in the future. Most of this turf grass is used for home and institutional landscaping. Also many football fields and athletic fields are sodded with peat-grown turf grass.

Grain crops grown on peat soils in the state total over 10,000 acres. The major grain crops grown include oats, barley and wheat.

The acreage of vegetable crops grown on peatlands is over 9,000 acres as shown in table 2. The principal vegetable crops are potatoes, carrots, radishes, onions, parsnips and cabbage. One area in southern Minnesota produces asparagus on peatland for canning purposes. The potential exists for greatly expanding vegetable production on peatlands as the peat soils are ideally suited for the growth of most cool-season vegetables. Yields are very high on these soils and the quality of vegetables produced is excellent.

Certified grass seed production on organic soils in the state totals 8,934 acres and is mostly located in only a few counties in NW Minnesota. The type of grass seed produced on peatlands includes Park variety of Kentucky bluegrass, Merion bluegrass, one of the elite varieties. Certified varieties of timothy and reed-canary grass are also grown for seed in the state.

Location and Distribution of Crops on Peatlands in Minnesota

The data in table 3 shows the location, distribution and extent of crops grown on peatlands in Minnesota for each county and region. The total acres of each crop grown on peat soils is shown in this table for each county as well as the percentage of total peat that was used for crop production in this 1977 inventory.

Table 3. Agricultural Utilization of Peatlands in Minnesota, by counties and regions.

Region	County	Total acres of peat	Hay-pasture	Row crops	Wild rice	Turf grass	Grain crops	Vege-tables	Grass seed	Total acres in Ag. production	% Peat utilized for Ag.
1.	Kittson	60,314	- -	- -	- -	- -	1,587	- -	- -	1,587	2.6
(NW)	Marshall	146,535	6,848	456	- -	- -	717	- -	- -	8,021	5.5
	Norman	3,770	218	- -	- -	- -	- -	- -	- -	218	5.8
	Pennington	37,803	5,649	- -	95	- -	888	- -	- -	6,632	17.5
	Polk	29,517	128	77	1,741	- -	435	128	250	2,759	9.0
	Red Lake	7,450	1,626	- -	- -	- -	435	- -	- -	2,061	27.7
	Roseau	255,436	937	- -	51	- -	1,552	- -	8,269	10,809	4.2
							- -				
2.	Beltrami	785,661	5,784	- -	2,263	- -	- -	- -	- -	8,047	1.0
(Headwaters)	Clearwater	108,109	10,397	- -	6,758	- -	282	85	415	17,937	17.0
	Hubbard	62,864	179	- -	- -	- -	- -	- -	- -	179	0.3
	Lake-of-the-woods	482,528	11,555	462	- -	- -	- -	- -	- -	12,017	2.5
	Mahnomen	26,432	9,175	1,092	- -	- -	- -	- -	- -	10,267	38.8
3.	Aitkin	575,936	5,485	- -	6,067	- -	2,534	240	- -	14,326	2.5
(Arrowhead)	Carlton	123,294	2,809	- -	- -	75	- -	45	- -	2929	2.5
	Cook	37,626	- -	- -	- -	- -	- -	- -	- -	---	0.0
	Itasca	336,558	1,718	- -	310	- -	- -	- -	- -	2,028	0.6
	Koochiching	1,154,899	- -	- -	154	- -	- -	- -	- -	154	<0.01
	Lake	165,171	- -	- -	- -	- -	- -	- -	- -	---	0.0
	St. Louis	929,827	4,736	- -	- -	140	- -	60	- -	4,936	0.5
4.	Becker	113,542	11,788	393	- -	- -	- -	- -	- -	12,181	10.7
(West)	Clay	3,336	918	- -	- -	- -	- -	- -	- -	918	27.5
	Douglas	16,505	8,816	- -	- -	- -	- -	- -	- -	8,816	53.4
	Grant	15,865	454	- -	- -	- -	- -	- -	- -	454	2.9
	Otter Tail	191,576	48,523	837	- -	- -	26	- -	- -	49,386	25.8
	Pope	33,585	4,725	- -	- -	- -	- -	- -	- -	4,725	14.1
	Stevens	1,534	647	- -	- -	- -	- -	- -	- -	647	42.2
	Traverse	3,880	- -	- -	- -	- -	- -	- -	- -	---	0.0
	Wilkin	- -	- -	- -	- -	- -	- -	- -	- -	---	---

Table 3. Agricultural Utilization of Peatlands in Minnesota, by counties and regions (continued).

Region	County	Total acres of peat	Hay pasture	Row crops	Wild rice	Turf grass	Grain crops	Vege-tables	Grass seed	Total Acres in Ag. production	% Peat Utilized for Ag.
5.	Cass	243,185	1,737	---	505	---	---	---	---	2,242	0.9
(NC)	Crow Wing	68,942	18,344	51	179	---	131	---	---	18,705	27.1
	Morrison	108,557	27,100	2,377	---	130	---	---	---	29,607	27.3
	Todd	72,875	17,018	436	---	---	---	---	---	17,454	24.0
	Wadena	79,019	9,448	439	26	---	---	---	---	9,913	12.5
6W.	Big Stone	12,033	---	---	---	---	---	---	---	---	0.0
(WC(W))	Chippewa	2,048	625	---	---	---	---	---	---	625	30.5
	Lac Qui Parle	6,348	---	---	---	---	---	---	---	---	0.0
	Swift	14,250	214	---	---	---	---	---	---	214	1.5
	Yellow Medicine	2,609	217	---	---	---	---	---	---	434	16.6
6E.	Kandiyohi	98,476	9,623	473	---	---	---	---	---	10,096	10.3
(WC(E))	McLeod	30,186	2,913	4,707	---	---	---	---	---	7,620	25.2
	Meeker	41,070	17,699	2,496	---	110	---	---	---	20,305	49.4
	Renville	16,191	1,850	2,775	---	---	---	---	---	4,625	28.6
7W.	Benton	23,032	9,277	---	---	---	---	---	---	9,277	40.3
(EC(W))	Sherburne	43,290	14,059	210	---	230	---	---	---	14,499	33.5
	Stearns	100,947	27,531	2,185	---	---	---	---	---	29,716	29.4
	Wright	37,616	8,151	2,203	---	---	---	---	---	10,354	27.5
7E.	Chisago	30,464	4,601	383	---	1,536	---	---	---	6,520	21.4
(EC(E))	Isanti	65,843	12,132	6,500	---	---	---	---	---	18,632	28.3
	Kanabec	41,912	18,962	241	---	---	---	---	---	19,203	45.8
	Mille Lacs	84,969	9,147	350	---	---	---	130	---	9,627	11.3
	Pine	231,737	19,030	---	358	1,165	461	120	---	21,134	9.2
8.	Cottonwood	886	---	---	---	---	---	---	---	---	0.0
(SW).	Jackson	7,430	3,635	1,161	---	---	---	---	---	4,796	64.5
	Lincoln	1,915	217	---	---	---	---	---	---	217	11.3
	Lyon	4,612	1,098	439	---	---	---	---	---	1,537	33.3
	Murray	4,826	1,755	---	---	---	---	---	---	1,755	36.4
	Nobles	2,393	1,087	---	---	---	---	---	---	1,087	45.4

Table 3, cont'd.

REGION	COUNTY	total acres of peat	hay-pasture	row crops	wild rice	turf grass	grain crops	vege-tables	grass seed	total acres in ag. production	% peat utilized for ag.
8.(cont.)	Pipestone	222	222	-	-	-	-	-	-	222	100.0
	Redwood	10,089	877	439	-	-	-	-	-	1,316	13.0
	Rock	-	-	-	-	-	-	-	-	-	0.0
9.(SC)	Blue Earth	17,305	7,904	4,273	-	-	-	-	-	12,177	70.4
	Brown	4,077	1,600	1,828	-	-	-	-	-	3,428	84.1
	Faribault	30,763	16,392	10,329	-	-	-	51	-	26,772	87.0
	Le Sueur	37,965	15,097	4,884	-	154	230	-	-	20,365	53.6
	Martin	1,660	150	-	-	-	-	-	-	150	9.0
	Nicollet	18,510	4,754	2,427	-	-	-	-	-	7,181	38.8
	Sibley	23,414	9 236	3,007	-	-	-	-	-	12,243	52.3
	Waseca	16,975	6,299	7,348	-	-	-	-	-	13,647	80.4
	Watonwan	905	-	-	-	-	-	-	-	-	0.0
10.(SE)	Dodge	2,221	500	340	-	-	-	-	-	-	0.0
	Fillmore	446	-	-	-	-	-	-	-	-	0.0
	Freeborn	48,423	23,167	11,688	-	-	1,203	3,482	-	39,540	81.7
	Goodhue	2,154	1,939	-	-	-	-	40	-	1,979	92.0
	Houston	666	-	-	-	-	-	-	-	-	0.0
	Mower	-	-	-	-	-	-	-	-	-	-
	Olmstead	2,880	800	-	-	-	-	-	-	800	27.8
	Rice	16,675	6,594	1,270	-	250	-	-	-	8,114	48.2
	Steele	18,346	11.052	4,267	-	-	-	1,032	-	16,351	89.1
	Wabasha	-	-	-	-	-	-	-	-	-	-
	Winona	-	-	-	-	-	-	-	-	-	-
11.(metro)	Anoka	41,770	8,192	-	-	7,000	-	3,472	-	18,664	44.7
	Carver	27,285	10,414	2,387	-	243	-	-	-	13,044	47.8
	Dakota	12,397	1,671	659	-	691	-	134		3,155	25.4
	Hennepin	39,334	4,060	2,648	-	-	-	260	-	6,968	17.8
	Ramsey	10,880	-	-	-	-	-	130	-	130	1.2
	Scott	22,444	12,401	1,220	-	339	-	-	-	13,960	62.2
	Washington	16,058	4,100	560	-	-	-	60	-	4,720	29.0
STATE TOTALS		7,631,078	528,006	90,534	18,507	12,063	10,481	9,469	8,934	677,994	8.9

The northern part of the state has the least agricultural development on peatlands although the most extensive peat areas occur there. The three N. Minnesota regions including region 1 (Northwest), region 2 (Headwaters) and region 3 (Arrowhead) generally have less than 20,000 acres of peatlands used for crops although many of these counties have a total of over 500,000 acres of peatlands. Counties which have the most peatlands such as Koochiching, St. Louis, Beltrami and Aitkin each have less than 6,000 acres of cropland on peat. On the other hand, regions such as west central and southwestern Minnesota where very little peat occurs use their peatlands more for agriculture. This is because these regions as well as southern regions are located in areas where agriculture is the principal enterprise and the climate is much more favorable for crops.

These three extreme northern regions of the state have not developed their peatlands for agriculture because of the shorter growing season and frequent low temperatures in the peat areas in summer. Such crops as corn and soybeans which do well in warmer regions are not well suited to these cool climates of N. Minnesota. Many hay and pasture crops grow very well in the northern part of the state but agriculture in general has not been particularly successful in these regions and there are fewer farmers to develop these peatlands. Future development of peatlands in this part of the state depends upon the demand for food, improvements in production technology, and development and introduction of suitable crop varieties especially adopted for this particular climate. High protein grass crops, seed crops, special vegetable crops and other crops especially adapted to the climate and soil conditions of these regions are possibilities for the future.

The location and extent of the several crops grown on peatlands in all the counties and regions are as follows:

Hay and Pasture Crops

These crops are grown in all regions of the state and even counties with very little peat have some lands where hay, pasture and forage crops are grown. The total extent of hay and pasture crops in peatlands in the state is over 500,000 acres.

Ottertail county in western Minnesota has over 48,000 acres of hay-pasture crops on peat soils. Other counties with considerable acreage include Morrison, Stearns, Freeborn, Pine and Crow Wing. The extreme northern regions of the state have the least acreage of peatlands being used for these crops.

Row Crops

Row crops such as corn and soybeans are the second most extensive crops grown on Minn. peatlands - a total of over 90,000 acres. These crops occur principally in the southcentral, southeast, east central, and west central regions of the state. Freeborn and Faribault counties in extreme southern Minn. along the Iowa border have the most corn and soybeans on peatlands. They each have over 10,000 acres of these crops growing on peat soils. Isanti, Blue Earth, McLeod, Waseca and LeSueur also have large acreages of these row crops on peatlands.

Wildrice

Wildrice, a relatively new commercial crop in the state, is presently grown on over 18,000 acres of peatlands. The data in Table 3 shows that clearwater and Aitkin counties have developed the most acres of wildrice on paddies constructed on shallow peatlands. The production of this crop will probably increase in the future if areas can be developed on peatlands

near a reliable source of water which is necessary in order to flood the rice paddies during the early growth stage.

Turf grass

Commercial turf grass or sod is another specialized agricultural crop particularly suitable for production on organic soils in Minnesota. The data in table 3 shows Anoka county in the metro region of Minn. leads all other counties in turf grass production on peat soils - 7,000 acres. The totals for the state are over 12,000 acres.The deeper peats are more suitable for this crop as a thin layer of peat is removed each time the grass is harvested. The acreage of cultured bluegrass sod has increased greatly in the past few years as improved management practices have been developed and the introduction of efficient mechanical harvesters that cut and stack the sod in the field.

Other counties in regions adjacent to the metro region (Minneapolis - St. Paul area) also have significant acres of turf grass production on peat lands. These include Dakota, Chisago, Pine, Rice, and Sherburne. It is expected that production of turf grass in peatlands will increase significantly in the state in the future as the demand for sod increases.

Grain Crops

Table 3 shows that grain crops grown on peatland occur mostly in the northwestern region of the state although Aitkin county has over 2,500 acres. A total of over 10,000 acres of grain crops are grown on peat soils in the state. The major types of grain crops on these soils are oats, barley, wheat and rye.

Vegetable Crops

The acreage of vegetable crops grown on peatlands in Minn. as shown in table 3 totals over 9,000 acres. Anoka county in the Metro region and

Freeborn Co. in SE Minn. each have over 3,000 acres of vegetables on peat soils. These are mainly grown for the fresh produce market.

Experimentally very good yields of certain cool-season vegetable crops such as lettuce, carrots, cauliflower, etc. have been grown on peatlands in N. Minnesota. Production of some of these vegetable crops on relatively extensive and uniform peat soils for frozen and canned vegetables is a good possibility for future agriculturel development. These extensive organic soils areas are well suited to large scale commercial vegetable production because they are uniform, have ample available water and are easily managed for high quality vegetable production.

Grass seed

Certified grass seed production on peatlands at present occurs only in three counties in NW Minnesota. These are Roseau, Polk and Clearwater counties where a total of 8,934 acres are grown. The types of grass grown for this certified seed include bluegrass, timothy and reed-canary. Bluegrass seed production is the dominant type.

Adjacent counties in NW Minnesota will probably begin to grow these seed crops in the future as most of the peatlands in this region are non-acid and partly decomposed types well suited to grow grass. Excellent yields are possible on peatlands that are properly fertilized and managed.

CROPS ON PEATLANDS IN MINNESOTA

Crops that are being raised and marketed in commercial quantities include carrots, cabbage, cauliflower, celery, potatoes, lettuce, wild rice, grass seed, cultured sod, radishes and onions. The best crops are the ones that have short growing seasons or can withstand light frosts which usually occur in the late summer and early fall.

Some average yields to be expected are: carrots - 10 tons per acre,

potatoes - 15 tons per acre, celery - up to 50 tons per acre, and cauliflower - 1,000 crates per acre.

The main commercial vegetable crop in Minnesota at the present time is carrots. These are quality carrots in size, appearance and taste. Advantages in raising carrots on organic soils are as follows: thinning is required, the length can be controlled somewhat by control of the water table and easier harvesting as the soil does not become as compacted as mineral soil and the carrots are removed much easier.

Cultured sod or turf grass was first raised in Anoka county Minnesota on peatlands and is still being raised and harvested on these lands. Advantages of raising sod on peat lands are the availability of sufficient moisture, a compact shallow root structure and the water-holding ability of the peat which allows the cutting of a thin layer of sod. These thin layers of sod are of excellent quality, are much easier to handle and allow larger quantities to be transported, thus resulting in a savings in transportation costs.

Celery is raised on a small scale by some farmers and was raised on a large scale by the Chun King Corporation in St. Louis county some 20 years ago. Celery grown on peat is of excellent quality as to size, color, texture and taste and quantities of up to 50 tons per acre can be produced. Some problems were encountered with frosts in the late spring and early fall or late summer. An irrigation and spray system was used by the Chun King Corporation in these critical periods.

The 1959 data on fertilizer experiments on celery by the University of Minnesota at Wilderness Valley Farms, St. Louis Co. showed high yields. Combinations of nitrogen, phosphorus and potassium fertilizers consistently produced yields averaging 40 to 50 tons (fresh weight) of celery per acre, The highest yield obtained was 56 tons using 80 lbs. of nitrogen, 160

lbs. of phosphate and 640 lbs. of potassium.

Potatoes have been raised successfully for many years on peat by various farmers in the state. Some exceptionally high yields have been recorded and also some very poor ones due to late spring and early fall frosts which have occurred and severely damaged or killed the vines. In some years very wet weather at harvesting time has hindered operations.

Cabbage and cauliflower do exceptionally well on peat as the low night temperatures in peatlands favor their growth and development. The quality of these crops grown on peat is equal or superior to any on the market. The cool nights in peat also contribute to the production of a good quality head lettuce.

Wild rice was tried experimentally years ago by the Chun King Corporation in St. Louis county. The availability of water, land and desire to enter new markets prompted this research. Various problems were encountered and some were overcome. Exceptionally high yields (1500 - 1800 lbs. per acre of green rice) were thought possible after some research. As in any crop, disease is always a problem and caused a complete loss one season. After four seasons of research the management decided to terminate the project. A summary of the Chun King work is included in the Minnesota Resources Commission Staff Report No. 14, "A study of Wild Rice in Minnesota", dated July 28, 1969.

Radishes and bunching onions do exceptionally well on peat soils. The texture of the soil allows them to push sideways very easily, thus eliminating the need for any thinning. Their quality is equal to any observed on the market.

Corn and soybeans are the major row crops grown on peatlands. These two crops are best produced in the southern part of the state. Grain crops are also well adapted to peat soils.

Christmas trees and ornamentals do well on properly-drained peat fields.

Nursery stock should be considered as a big advantage would be the availability of moisture on peat lands which would eliminate the irrigation systems needed on the sandy soils used in most areas.

PEATLAND FORESTRY

The utilization of peatlands for forest product production has been practiced in Europe for many years expecially in the Scandinavian countries. However, very little research has been done in the U.S. to evaluate the potential of peat soils under intensive management for the production of wood products.

Tree species in Minnesota that should be considered for commercial development on peatlands include black spruce which is mainly used for paper production, tamarack for pole timbers, northern white cedar for posts, and hybrid aspen for pulp.

In order to utilize peatlands for commercial forest production it is necessary to determine the suitability of various types of peatlands for forest improvement under specified management practices. Some of the management practices that should be considered include the possibility of drainage, proper fertilization and regeneration possibilities.

With the possibility of wood products being in short supply in the next 30 years, consideration of peatland forestry under intense management should be investigated. Minnesota's extensive peatlands may prove very suitable for future commercial forest developments.

MAJOR MANAGEMENT PROBLEMS FOR CROP PRODUCTION ON PEAT

The successful utilization of peatlands as organic soils for crop production depends upon a consideration of several important factors. The most important of these factors are as follows:

1. Possibilities of land acquisition.

   Peat lands in this area not considered commercial horticultural peat may either be purchased from counties, the State of Minnesota or possibly from private owners. Leasing arrangements are also possible for certain lands held by the county or state.

2. Suitability of land for clearing and development.

   Within large peatland areas there are many relatively treeless sites with only low shrubs, sedges, grasses and reeds. These sites would be very easy to clear and prepare for cropping. Other sites with a thick growth of tamarack, spruce or cedar are less desirable for development because of the high cost of clearing and stump and root removal.

3. Feasibility of drainage.

   For a successful crop production an adequate drainage system is a necessity. Areas to be developed should be suitable for constructing the necessary ditches, outlets and other structures to alleviate flooding as a management problem in crop production.

4. Suitability of crops.

   The choice of crops suited to the soils, climate, labor situation and the various economic considerations of the area must be carefully considered before any agricultural enterprise is proposed. Processing, transportation and marketing of a particular commodity must be carefully explored before deciding on the type of types of crops to be grown.

Farming organic soils is a highly specialized enterprise which requires different technology than regular farming on mineral soils.

5. Suitability of the soil.

   In choosing organic soils for crop production the developer should carefully evaluate the following properties:

   a. The pH of the surface soil.

   b. Depth of the soil.

   c. Volume weight of the soil.

   d. Decomposition of the surface soil.

   e. Character of the underlying mineral material if less than five feet thick.

The major management problems associated with crop production on organic soils include drainage, water-level control, prevention of shrinkage, frost control and fertility.

DRAINAGE SYSTEM

The type ot drainage system best suited to the conditions in most peatlands is a combination ditch system. The system should be designed to accomodate runoff from the surrounding large watershed and also to alleviate flooding in the cropped area. Such a system would consist of relatively wide and deep ditches (approximately 8 feet in depth and 10 feet in width) around the perimeter of the cultivated area in order to isolate this area from the adjacent undrained bog. Smaller lateral ditches spaced no more than 200 feet apart and approximately two feet in width and six feet in depth are recommended for cropland areas.

WATER-LEVEL CONTROL

For some shallow-rooted vegetable crops, sod crops and others, it is desirable to mainatin the water table level to within 18 inches of the surface. This can be done by properly spaced water-level control structures

along the lateral ditches. These structures help prevent drying out of the soil within the rooting zone of shallow-rooted plants during periods of excessively dry weather. They also reduce soil losses due to shrinkage and to excessive microbal decomposition.

SHRINKAGE OF SOIL

Shrinkage or subsidence of organic soils occurs when these soils dry excessively. Wind erosion, oxidation and compaction by farm implements may also lead to loss of soil or to lowering of the surface elevation. This problem may be prevented or at least minimized by a good water level control system.

FROST CONTROL

Summer frosts occur more frequently on organic soils than on adjacent higher-lying mineral soils. The reasons for this are due to cold air settling in the lower-lying peat areas and to poor heat conduction by organic soils.

In N. Minnesota peatlands frost may occur any month during the summer although the average frost-free season is long enough for most cool-season crops. To reduce the possibilities of frost damage to crops the following practices are helpful:

a. Keep soil moist by maintaining high water levels.

b. Proper fertilization to harden plants.

c. Selection of frost-hardy crops.

d. Cultural practices such as culti-packing, minimum tillage, etc.

SOIL AMENDMENTS AND PLANT NUTRIENTS

Organic soils when used for crop production generally need lime application in places where the pH of the surface soil is below 5.0. The purpose of lime is to provide calcium and to increase nutrient availability to crop plants.

With some forage crops an initial corrective lime application is necessary before seeding. Other crops are limed as needed.

Addition amendments needed on these soils may include sulphur, copper and others for particular crops.

The major plant nutrients needed on these organic soils include nitrogen, phosphorus and potassium.

NITROGEN

Nitrogen is ususlly adequate on organic soils but it may not be readily available to the plants if the soils have low temperature during early summer or if the peat is relatively raw. For crop plants with a high nitrogen requirement such as sod crops, onions and potatoes, it is good practice to apply some nitrogen to those crops annually.

PHOSPHORUS

Phosphorus exists in an organic form in peat soils and it must be mineralized by microbial decomposition before it is available to crop plants. Organic soils in their natural state before cropping are generally deficient in phosphorus. After a few years of fertilizer application, however, the levels of phosphorus increase appreciably in the surface soil due to fixation by organic matter of applied mineral forms.

POTASSIUM

Potassium is the plant nutrient which is most deficient in organic soils. Unlike phosphorus, potassium is readily leached and must be added in the form of fertilizer in large quantities. As a general rule it is advisable to apply fertilizer containing both phosphorus and potassium in a one to three ratio. As an example, a fertilizer grade of 0:10:30 is commonly needed on organic soils.

Soil test analyses are recommended to determine the nutrient needs of crop plants grown on organic soils. Fertilizer rates and grades for the particular crops are generally made by the county agricultural agent. Soil tests are made by the Soil Test Laboratories, University of Minnesota, St. Paul, Minnesota.

OTHER MANAGEMENT PROBLEMS

Other management problems to be considered are disease and insect problems and prevention of fires.

Diseases and insects can be kept under control if the proper spray schedules are followed for the particular crop and certain cultural practices are followed to minimize disease and insect carry over.

Fires can usually be prevented by taking precautionary measures. If a fire does get out of hand, it can be extinguished on peat lands by ditching around the burn or using water that contains a wetting agent to spray on the burn. A wetting agent, such as a common detergent, reduces the surface tension of water allowing it to penetrate the dry peat and quelch the burning organic matter.

Burning of peatlands is a common practice in N.W. Minnesota and farmers gave the following reasons for using fire as a management tool:

1. Useful in clearing land of trees and brush.
2. Can remove undersirable surface peat types.
3. To dispose of excess straw and plant debris.
4. To clear roadsides and ditch banks.
5. To burn weeds and tall grasses.
6. To dispose of wastes.
7. To suppress undesirable species.
8. To expose underlying soils more productive of plant growth.
9. To release fertilizer elements (plant nutrients).

The practice of burning is one formerly used in Europe but is no longer recommended there because of the many disadvantages. Some of the disadvantages of using burning of shallow peat are as follows:

1. Burning may reduce drainability of lands.
2. May expose poor soils, toxic elements, boulders, or high lime substrate
3. May destroy forests if not controlled.
4. May destroy property which would result in a law suit.
5. Benefits from added fertilizers after burning may not outweigh the disadvantages.
6. Nitrogen in peat is lost when peat is burned.
7. May cause accidents because of smoke.

The Manitoba Government in 1977 established a commission to study the effects of farmers burning peat and they recommended that the practice be prohibited except in exceptional cases where burning could be controlled as an acceptable agricultural practice.

Commercial Horticultural Peat Production in Minnesota

In Minnesota, approximately 1400 acres of peatland in the north-central and northeastern regions are presently mined to produce commercial peat products. These peat products include sphagnum moss peat, reed-sedge peat, potting soil, growing mixes and bulk peat for nurseries and landscapes. They are also sold in bags and bales and by the cubic yard in the Minneapolis-St. Paul area but most of the peat is shipped to the midwest and southern states.

The largest commercial peat project is located in Carlton county. This development is owned by Michigan Peat Company and utilizes 840 acres, or 0.68%, of Carlton county's 123,294 acres of peatland. Other commercial peat operations are located in Aitkin, Itasca, and St. Louis counties (see Table 4).

Table 4 Commercial Peat Operations in Minnesota

County	Total Acres of Peat	Acres Used for Commercial Production	Name of Company
Carlton	123,294	840	Michigan Peat
St. Louis	929,827	360	Power'O'Peat
Itasca	356,558	120	Colby Peat
Aitkin	576,936	80	Northern Peat

Commercial peat operations in Minnesota occupy less than 0.02% of the state's peatlands.

U.S. PEAT PRODUCTION AND USE

In 1976, production of peat in the U.S. reached an all-time high of 969 thousand short tons. This was a substantial increase, 26%, above production in 1975.

Table 5 gives the production figures by states, the number of active operations and the value of the peat sold in 1976. Total production of over 900 thousand tons was produced at 102 operations in 21 states. The leading producing states in order of output were Michigan, Indiana, Pennsylvania, Illinois and Florida. Michigan had the highest production (31% of total in U.S.) and Minnesota ranked seventh with only 26,429 tons. The total value of peat sold in 1976 was over $17,000,000.

Table 5. Peat Production in the USA in 1976, by state.*

State	Production (short tons)	Number of Operations	Percent of Total Production	Value (Thousands)
Michigan	300,103	16	31.0	$3,714
Indiana	145,661	14	15.0	1,716
Illinois	84,662	4	8.7	763
Florida	82,652	7	8.5	1,287
New York	34,075	5	3.5	684
Colorado	33,201	9	3.4	238
Minnesota	26,429	4	2.7	1,504

Table 5 (cont'd.)

State	Production (short tons)	Number of Operations	Percent of Total Production	Value (Thousands)
New Jersey	26,298	4	2.7	568
South Carolina	15,015	1	1.5	W
Washington	14,060	5	1.5	103
Wisconsin	9,742	4	1.0	W
Maine	4,781	4	0.5	173
Ohio	3,195	6	0.3	121
Maryland	2,891	1	0.3	W
Other States**	186,694	18	19.3	6,226
Total	969,459	102	100.0	$17,096

* U.S. Department of the Interior, Bureau of Mines Mineral Industry Surveys - 1977.

** includes California, Georgia, Iowa, Massachusetts, Montana, North Dakota, Pennsylvania, and states where individual companies withheld data. (W).

Table 6. Horticultural Peat Production in the USA*

	1972	1973	1974	1975	1976
Production	576,712	634,503	731,004	771,716	969,459
Percent change per year		+9.1%	+13.2%	+5.2%	+20.3%
Number of operations	103	98	102	109	102

*U.S. Department of the Interior, Bureau of Mines, mineral Industry Surveys. 1977.

Table 6 shows the production figures for peat during the period 1972 to 1976 in the U.S. These data show a steady increase in peat production during these five years and the total increase rose approximately 60%. The number of operations producing horticultural peat remained at about 100 plants.

Table 7 shows the types of peat harvested in the U.S. in 1976. The reed-sedge type was dominant and its production was about double that for the sphagnum moss type.

Table 7. Types of peat harvested in the USA in 1976.*

Type of Peat	Total Harvested (in short tons)	Percent of Total
reed-sedge peat	444,730	45.9
humus peat	309,388	31.9
moss peat	215,341	22.2
Total	969,459	

*U.S. Department of the Interior, Bureau of Mines

Although there are a great variety of peats, those harvested for horticultural use have been divided into three general categories by the U.S. Bureau of Mines for inventory purposes. These three types of peats are moss peat, reed-sedge peat, and peat humus.

The classification "moss peat" includes peats primarily composed of poorly or moderately decomposed leaves and stems of several types of moss. The moss peat is light in weight, porous, and may be fibrous (but free from woody materials.) Sphagnum-moss peat will have a strongly acid reaction and is generally found in cool, humid regions of the world. A hypnum-moss peat will have a more neutral reaction.

"Reed-sedge peat" includes peats containing the poorly-decomposed remains of reeds, sedges and reed-like grasses (this includes the cattails and rushes commonly associated with marshy areas.) Peats of this type are coarse, fibrous, and may contain the remains of woody plants. Many of these soils are formed on the borders of lakes, ponds, swanps, and marshes. The reed-sedge peats may range from slightly alkaline to slightly acid in reaction.

"Peat humus" is the category which includes the highly decomposed peats. The source of the plant materials which make up the peat can no longer be determined by observation. Such organic soils are often the

result of cultivation or prolonged periods of dryness, which hastens the decomposition of the organic matter. The peat humus will be dark brown or black in color, fine-grained, and slightly acid to neutral in reaction.

There are several organic soils which do not fit into these categories including sedimentary peats and mucks. Sedimentary peats are fine-textured peats formed by the sedimentation of aquatic plants on the floor of a water body or water-tilled depression.

Table 8. U.S. Imports of Peat Moss, by Country*

Country	1975 Quantity (in short tons)	1976 Quantity (in short tons)
Canada	283,190	329,346
Chile	-------	94
China, People's Republic of	-------	17
Denmark	7	--------
Finland	-------	35
Guatemala	1	--------
Ireland	10	22
Mexico	18	--------
Netherlands	10	3
Norway	-------	13
Sweden	-------	76
Switzerland	-------	1
USSR	-------	23
United Kingdom	218	23
West Germany	6,904	8,398
Total	290,358	338,051

*U.S. Department of the Interior, Bureau of Mines, 1977.

Table 8 lists the quantity of imported peat for 1975 and 1976 and the calculated value of the peat from the various countries. Estimated imports of peat were 338,051 short tons in 1976 with a value of over 29 million dollars. Canada led all other countries in imported peat in both 1975 and 1976. In 1976 Canadian imports to the U.S. totalled 329.346 tons valued at almost 29 million dollars. Practically all peat imported from Canada

as well as West Germany was the peat moss type (sphagnum moss peat). These imported moss peats are used principally by large florists and greenhouse growers for soil mixes, soil improvement and as packing material for flowers and shrubs. The major use for all the peats sold in the U.S. is for improving lawn and garden soils. The bulk of it is sold in packaged form (bales or bags) in garden supply stores although some domestic peat is sold in bulk for landscaping purposes and golf courses.

PEAT PRODUCTION METHODS

There are three methods currently used for the harvest of peat for horticultural purposes---the milled peat method, the hydro-peat process, and machine-cut method.

The term "milled peat" describes peat materials in a crumb or powder form. The particle size of the milled peat will range from a fine dust to approximately ¼" in dimater. The loose bulk density of milled peat is between 9 to 25 pounds per cubic foot, when dried to a moisture content of 55% by weight.

Milled peat is produced by harvesting a bog to a depth of approximately ½" at a time (assuming 80% moisture content by weight.) In an average season in Ireland, 12 crops can be harvested per year representing an annual yield of 73 tons per acre at a 40-50% moisture content. When peat is to be harvested by the milled peat method, the peat bog is laid out in a series of 50'-wide drying fields and the surface of each field is cut into small particles by a milling machine. To accelerate drying, the layer of milled peat is then harrowed. The peat can then be harvested by mechanical or pheumatic harvesters.

If the mechanical method is to be used, the peat must be scraped mechanically into ridges along the center of the field when the moisture content has reached approximately 55%. The dried peat is then placed in

ridges along the edges of the field and lifted by a spiral pick-up unit on one side of the tractor. Finally the milled peat is transported to the main stockpile via a wide belt.

Pneumatic harvesting utilizes large vacuum harvesters which pick up a very thin layer of milled peat particles from the harrowed field. The pheumatic harvester reduces the harvest cycle to one day, because only the smaller and drier particles are picked up by the vacuum. This makes the harvest operation less dependent on the weather conditions. However, harvesting using a pheumatic harvester may produce great amounts of dust which could affect nearby settlements.

There are several factors which must be taken into consideration when determining whether or not a given bog area is suitable for milled peat harvesting. The most important consideration is that of total workable area. Because of the size of the machinery involved, large, level bog areas are necessary. In Ireland, the smallest bogs harvested using the milled peat process have a net working area of 2100 acres. An average peat depth of 6.5-10' with reasonably level bottom contours is also needed. Other factors that must be taken into consideration are the amount and location of large trees, which must be removed if this method is to be used; water bodies; the type of peat (the higher the fiber content of the peat, the higher the power consumption by the milling machines); and the moisture content of the peat.

Peat harvested via the hydro-peat process is excavated through the use of high-pressure water jets. The peat is disintegrated at the excavation site and the liquid pulp, consisting of 95% water and 5% solids is removed from the bog by suction pumps and moved through pipelines to a drying area which is usually a sandy soil or a mechanical device. Under favorable conditions, the dried slurry can be molded into blocks within a few hours.

The hydro-peat process is especially useful in harvesting peat bogs that have large quantities of woody material or very high water tables. Simpler equipment can be used in this operation, but an ample water supply and level, sandy soils for drying areas are necessary.

The machine-cut method of harvesting was developed in Germany after World War II. It consists of a cutter mounted on a small tractor which cuts blocks of peat approximately 16x5x5" in size.

This method is commonly used in West Germany, Ireland, Finland, and Poland. It has an advantage in that harvesting can be done during periods of wet weather. Also, after shredding the air-dried blocks the quality of the horticultural peat is excellent.

DEVELOPMENT OF HORTICULTURAL PEAT

At the present time Minnesota is using only about 1400 acres of peatland for harvesting operations for the production of horticultural peat. Despite the fact that the use of horticultural peat in the U.S. for soil conditioning, growing mixes etc. has increased from 900,000 short tons in 1972 to 1.3 million tons in 1977 production in Minnesota has remained about the same.

Recent estimates show that Minnesota has about 20,000 acres (8,000 ha) of high quality Sphagnum moss peat ranging in thickness from 2 to 4 m. (6 to 12 feet). In addition there is probably over 200,000 ha (500,000 acres) of good quality moderately decomposed reed-sedge peat suitable for production of horticultural peat.

Factors to be considered in selecting a peat area for commercial horticultural peat production are as follows:

1. Quality of peat, root content and decomposition.
2. Extent of reserves.
3. Location and accessibility.

4. Feasibility of drainage.
5. Local climatic conditions.
6. Technology of harvesting and drying.
7. Availability of lands - public or private.

There are good prospects that the horticultural peat industry in the U.S. will continue to expand as the demand for these products continually increases. Minnesota with its large peat reserves including the only large Sphagnum moss peat deposits in the U.S. should increase its production of horticultural peat substantially in the near future. It is ironic that Minnesota presently imports more peat from Canada than it produces locally despite the abundance of high quality reserves in the state. Predictions by the U.S. Bureau of Mines is that the U.S. peat industry is expected to be one of continued growth. Consumption of peat in the U.S. by the year 2000 is forecast to range from 1.6 to 2.4 million tons annually. The estimated potential development in Minnesota by the year 2000 is for a production area of about 10,000 to 20,000 acres capable of producing up to 1 M tons per year. This is equivalent to 20 million 100 lb. vapor bales.

PEAT DEVELOPMENT FOR AGRICULTURE AND FORESTRY

In addition to the development of peat for energy and horticultural products as an extractive industry peatlands are suitable for growing a wide variety of crops and trees.

In selecting areas for crop production and peatland forestry the following criteria are suggested:

1. Type of peat soil
    a) acidity of peat
    b) stage of decomposition
    c) thickness

2. Drainage feasibility
3. Geographic location in respect to markets
4. Suitability for a particular crop
5. Climate of local area
6. Geology - hydrology of area
7. Accessibility

At the present time there are a variety of crop plants suitable for growth on peatlands in Minnesota. In addition to the traditional vegetable crops, grain, and forage crops promising new crop species include wild rice and high-protein grasses. Also turf-grass for lawns is an important new crop grown on peat.

Forestry on peat at present in Minnesota includes only black spruce for pulp and tamarack and white cedar for posts and poles. Very little management for the production of these species is practical at present in the state although in the future intensive management for forest product production on peatlands is a possibility. There are sufficient reserves of peatlands suitable for all types of commercial forest enterprises and this development should be encouraged.

Table 9 shows the present peatland use in Minnesota and estimates its future potential for multiple use of these resources.

Table 9. Minnesota Peatland Utilization--Present and Potential*

Type of Use	Present (1977) (Acres)	Future/Potential Uses (Acres) Minimum	Maximum
Agriculture (Crop Production)	677,994	1,000,000	2,000,000
Forestry (Commercial)	1,000,000(est.)	1,000,000	2,000,000
Horticultural Peat Production	1,400	10,000	20,000
Natural areas, wildlife, recreation	519,487	800,000	1,000,000

Table 9, cont'd.

Undeveloped Peatlands**		5,432,197	3,821,000	611,000
	TOTALS	7,631,000	7,631,000	7,631,000

*Department of Natural Resources, 1977 Inventory
**Includes non-commercial forests

Whether or not the above potential uses for peatlands will eventually be realized and, if so, when, is not now known. Such development will depend upon the desires of local and state people, legislative actions, future needs for food, fiber and energy, incentives conducive to development, environmental constraints and others. The peat resources, however, are extensive enough that competing uses for them should not greatly restrict or limit development for any one purpose.

B. RECLAMATION POTENTIALS FOR MINNESOTA PEATLANDS

The northern Minnesota peatlands have great potential for production of forage crops, high-protein grasses, vegetables, seed crops, commercial forests and wild rice to name a few. Recent experiments on peatlands in Polk and Roseau counties, Minnesota, used for production of forage grasses showed that under proper fertilizer practices yields of 3 to 6 tons (dry matter) were possible. Many of these grasses contained up to 25 to 28% protein and total protein yield per acre was over 2000 pounds in some instances.

Should the state develop some of these peatlands as an energy source their reclamation and use for such crop production after removing some of the surface peat should be considered. The technology for crop production on peatlands has been well researched and is available in technical bulletins.

Things to consider in evaluating a peatland site for agricultural or other type developments are as follows:

1. For grassland farming it is suggested that about 12 to 18 inches of peat should be left after mining so that the organic matter can be mixed with the underlying mineral soil. A grass cover crop is suggested for a period of time which gives good structure to the soil, prevents wind erosion and keeps down weeds, and requires only minimal amounts of commercial fertilizer.
2. For vegetable crops leave about 3 to 5 feet of peat at the bottom so that water levels can be better controlled and the roots are growing in peat.
3. If all the peat is removed the area can be developed into ponds and lakes for water fowl and recreation uses.
4. Type of mineral substrate should be known prior to development. Substrates may be marl, lake muds, stony, sticky clay, or poor quality sand. These conditions are poorly suited for crop production and should be avoided.
5. All of the peat deposits in Minnesota, due to the abundance of lime in the underlying substrate, become less acid with depth. The pH of many N. Minnesota peats normally are in the 3.5 to 4.5 range (very acid) in the surface but increase to 5.0 to 7.0 at the bottom near the mineral contact. This means the lower layers of peat deposits are more suitable for cropping (require no lime additions) especially for the lime-loving forage grasses that are well-suited to peatlands.

It is recommended that detailed inventories of peatland areas to be mined for either fuel or horticultural peat be made well in advance of development in order to evaluate and plan for the type of reclamation suited to a particular deposit. If the area is to be used for crop production it is necessary to know the thickness of the peat, the kind of

mineral substrate, the potential for drainage and the chemical and physical properties of the peat which affect crop plants.

RECLAMATION OF MINED PEAT LANDS

A. Agriculture

1. Vegetable crops
2. Sod "
3. Grass seed "
4. Grain "
5. Wild rice

B. Forestry

1. Spruce
2. Tamarack
3. Hybrid Aspen
4. Hybrid Birch
5. Energy crops - Alder, Willow, etc.

C. Recreation

1. Wildlife Habitats
2. Ponds for Waterfowl and Fish
3. Natural Areas - Unique areas

D. Waste Treatment

1. Sludge Composting
2. Waste Water

SUMMARY AND CONCLUSIONS

This investigation has shown that agricultural and horticultural peat development in Minnesota occupies less than 10% of the total peatlands. Except for hay and pasture crops very few other suitable peatland crops are grown to any extent. Despite this the development potential for crop plants on peatlands should be promising as there are thousands of acres of high quality peatlands in the state suitable for agricultural development.

The inventory has shown that peatlands have multiple uses - forestry, agriculture, wildlife management, natural areas and recreation. The highest percentage of peatlands in the state are presently undeveloped.

The potential for expanding commercial horticultural peat operations in the state for production of high-quality sphagnum moss peat and reed-sedge types is excellent. The state should encourage the development of this horticultural peat industry as the demand for these peat products surely will increase and Minnesota could easily become one of the leading states in the nation for peat production.

Development of peatlands for both agriculture and forestry in the state will require careful selection of suitable peatlands, a study of the local hydrologic conditions, the climatic conditions, the markets for the crops and application of the best management techniques for maximal production of high quality food and fiber.

APPENDIX

I. Book Reviews

Peat in Horticulture edited by D.W. Robinson and J.G.D. Lamb

Published for the Horticultural Education Association by Academic Press, London, 1975.

The physical and chemical properties of peat make it a very suitable medium for sustaining plants, be it in sites or as a processed, commercial product. Practical aspects of peat such as uniformity, sterility potential, lightness (low density) and cleanliness lend itself to modern applications enhancing our living and working environments. Also due to these properties are the special problems of low mechanical stability, nutritional complexities, chemical intricacies, and rapid weed establishment, requiring a skillful level of expertise to fully exploit peat's potentials.

Sixteen authors from England, Scotland, Ireland, Finland and the USA pooled such expertise following the September 1972 Horticultural Education Association Conference in Dublin, to contribute to this book. The necessary background of the beginning chapters deals with origin, formation and location of peat and its properties, chemical, physical and microbial. The following chapters present the requirements, practices and methods, products and cropping procedures. Established uses and recently developed techniques are fully covered. Concepts and information expressed by these authorities are important in guiding present applications of crop nutrition and herbicide treatments, and the promising future of peat in horticulture.

Peat and It's Use in Horticulture by Viljo Puustjarvi

Turveteollisuusliitto ry. Publication 3

Helsinki - Liikekirjapaino Oy, 1977.

The author, Dr. Viljo Puustjarvi, is the Director of the Peat Research Institute, a Council member of the International Peat Society, and the chairman of the Working Group for Classification and Standardization of Peat Products. His intensive research at the University of Helsinki has brought him international recognition and greatly aided the agriculture and export commerce of Finland.

The characteristics due to peats composition are first covered; presenting important constituents, sources, bog types, peat forming plants and all aspects of decomposition. In this section a complete presentation of Finnish peat classification can be found, and the remainder deals with products and methods of production, structure and commercial considerations. The second section of chapters covers water economies of plants and substrates, and watering procedures. Section three presents the fertilization aspects of peat including nutrients (major and trace), nutrient storage, plant relations, liming and fertilizer application methods. The fourth section deals with basin peat culture, in greenhouses including their management. The final section considers factors affecting productivity.

This book is a thorough account of Finnish peatland research, of achievements and applications beneficial to science and commerce. In addition, the information presented in this book is a valuable guide to general horticulture presented in a concise manner.

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