

LAND CLEARING PRACTICES IN MINNESOTA

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In an effort to gain knowledge of the standard practices in connection with various land clearing operations in northern Minnesota, a questionnaire was sent early in 1924, to approximately 100 farmers whose names had been obtained the previous year by representatives of the University land clearing department in connection with demonstrations and other land clearing activities in the state.

The questionnaire covered practically all phases of land clearing and was answered at least partially by nearly 50 per cent of the farmers whose names appear on the original mailing list. The data represent nearly 1000 acres in 8 representative counties of the cut-over district in Minnesota.¹ Table I shows the extent of the investigation.

TABLE I
EXTENT OF INVESTIGATION

Operation	No. farms reporting*	Total acreage involved	Average acreage per farmer reporting
Brushing	41	511.0	12.4
Stumping	35	546.0	15.6
Breaking	41	809.5	19.7
Stone removal	30

* These farms represent 8 typical counties in the cut-over district of Minnesota.

The farmers had not been asked to keep any cost records or other data. Very few knew anything about the questionnaire until they received it. Accordingly the data presented are estimates and in some cases perhaps not much more than guesses. In comparing the replies to many of the questions, however, the fact is brought out that on the whole they must be accurate, for they agree very closely in many respects. It is assumed therefore, that averages of the data presented with regard to the costs of various operations, are very nearly correct; and that the methods and practices advocated by the majority are probably as good and as economical as any others which might be used under similar conditions.

Brushing

The first step in land clearing, especially if clearing is delayed for a considerable time after logging, is brushing. As shown in Table I, 41 farmers reported their experiences in brushing. The report represents 511 acres, an average of 12.4 acres per farm.

In most cases a mixture of brush—poplar, hazel, and alder—predominated. Fifteen farms reported poplar, 10 reported hazel, and 5 reported alder.

As to the size of the brushing crew, three farms reported 3-man crews; eleven farms had 2-man crews; and on eight farms the crew consisted of one man.

¹ The counties with the number of replies from each are: Aitkin 2; Beltrami 15; Carlton 4; Itasca 9; Kanabec 4; Mille Lacs 2; Pine 1; St. Louis 5.

The tools used for cutting depended, of course, on the size of the brush. An ax was used by all, with the brush scythe next in popularity. The brush hook was used by three.

Twenty-three farms reported the number of man hours required to brush an acre. The maximum was 100 hours, the minimum 10 hours, and the average 32.4 hours. Seven farms reported 40 hours.

In answer to the question, "Can you prevent brush from sprouting by cutting it at a certain time of the year?" various answers were received. Of twenty-seven replying, thirteen answered "Yes," five answered "No," and the others qualified their negative reply. It seems questionable, therefore, whether there are advantages in cutting at a certain time in late summer.

On fifteen farms sheep were used to keep down the brush and sprouts, and in one case goats were used. Of the fifteen where sheep were used, nine reported good results; one, fair results, but that many animals were needed, and the others reported poor results. The general opinion seems to be that the sheep must be more or less "starved down" to the pasture to do any real good from the standpoint of brush removal.

On twenty-eight of the farms reporting, grass seed was sown between the stumps after the brush had been removed. This was usually a mixture of clover and timothy with the average rate of seeding 10 pounds per acre, the maximum rate being 15 pounds and the minimum 6 pounds. On nine farms the tramping of livestock was the only method used to get the seed in contact with the soil; on eleven farms some sort of drag or harrow was used, and in two cases this work was left to be done by rain. Four reported that the grass seed was sown on the ashes immediately following a fire.

The time spent in removing and piling windfalls varied considerably. The average time per acre on thirteen farms was 11.5 man hours and 13.2 horse hours, with a maximum of 38 man hours and 26 horse hours and a minimum of one man hour and two horse hours. On nine farms the crew for this work consisted of 2 men and one team, on two farms, of one man and a team, on one farm only one horse was used, and on another 3 men worked with one team.

Stump Removal

Stump removal is usually the most expensive step in land clearing. Under certain conditions, a considerable saving may be made by properly utilizing such natural agencies as time and decay. With white pine stumps and other species which decay very slowly, there is usually not much to be gained by delaying the stump removal operation, after the stump itself is dead.

A saving, however, is often made possible by the use of the most economical methods for a particular set of conditions and also by using that season which is best suited to a given operation. In this connection we would like to quote Chas. E. Hope, B. C. L. S., of Langley Fort, B.C., in bulletin 85: "I cannot too strongly emphasize the vital importance in land clearing of only doing just that kind of work which is most suitable for the particular time of the year; more time, money and labor have been wasted in clearing land from not carefully studying this question than from any other cause." To illustrate, Table III shows that blasting may be done at least one third cheaper when the soil is full of moisture than when it is dry. The ground is usually wet in the spring, but is seldom as wet at any other time during the open season. Therefore the annual stumping season is between the time the frost leaves the ground in the spring and harvest time.

TABLE II
INFORMATION ABOUT STUMPS
A

	Stumps per acre	Average diameter	Age of stumps	Size of tract
		Inches	Years	Acres
Maximum	500	48	45	100
Minimum	20	5	†	1
Average	101	16.2	14	15.6

† Green.

B

Kind of stumps	No. of farms reporting each kind	Per cent of farms on which kinds appear‡	Kind of stumps	No. of farms reporting each kind	Per cent of farms on which kinds appear‡
Pine	28	82.4	Maple	4	11.8
Birch	9	26.5	Oak	4	11.8
Poplar	8	23.5	Elm	4	11.8
Balsam	5	14.7	Basswood	2	5.9
Spruce	5	14.7	Cedar	2	5.9
Tamarack	4	11.8	Balm of Gilead	2	5.9

‡ Thirty-four reported the kinds of stumps.

Thirty-five farmers reported on stump removal, representing 546 acres, with an average acreage of 15.6 per farm. It will be noted from Table II that the average number of stumps per acre was 101; the average diameter was 16.2 inches, with a range of from 5 to 48 inches; and that the average age was 14 years with a maximum of 45 years. Pine² is by far the most prevalent species, being reported on 82.4 per cent of the farms; birch is next, on about 26 per cent of the farms.

² This includes White, Norway, and Jack pine.

TABLE III
 INFORMATION ABOUT BLASTING

	Man hours per acre	Cost of labor	Fuse used per acre	Cost	Caps used per acre	Cost	Explo- sives used per acre	Cost	Blast- ing cost per acre	Explosives saved by blasting when the ground is wet instead of dry
			Feet				Pounds			Per cent
Maximum	30	\$9.00	200	\$2.00	200	\$3.00	100	\$12.00	\$26.00	65
Minimum	4	1.20	33	0.33	16	0.24	20	2.40	4.17	20
Average	12.3	3.69	73.3	0.73	58.7	0.88	52.2	6.26	11.56	36

Note:—Labor is figured at 30 cents per hour; fuse at 1 cent per foot; caps at 1½ cents each; and explosives at 12 cents per pound.

The use of explosives is probably more universal than any other method of stump removal. This does not mean that explosives usually replace other methods, or that the use of explosives alone is more economical under most conditions. The use of explosives can be more readily adapted to varying conditions than most other methods, and lends itself very readily to a combination with other methods. For instance, the combined use of explosives and a stump-puller under many conditions is more economical than the use of either alone. With this combination, the stumps are ordinarily cracked with a small charge of explosives and the pieces are then removed with the stump-puller. The size of the stumps and the method of piling must also be considered. If the stumps are large or if they are to be piled by hand, it is likely that more explosives will be used in order to break them into smaller pieces. In short, a combination of methods is used mostly, and the particular method or combination of methods used depends on such factors as kind, size, and age of stumps; kind of soil; amount of moisture in the soil; method of piling or other means of disposal; size of tract to be cleared, and the means at the disposal of the farmer.

Of thirty-four farmers reporting on the kind of explosives used, three used 20 per cent dynamite; nine used 30 per cent; one used 60 per cent; and twenty-one used 40 per cent or its equivalent, in most cases the war-salvaged explosives pyrotol, sodatol, or picric acid. There was much favorable comment as to the results obtained from the use of these war-salvaged explosives.

In general, a slow-acting explosive is more desirable for stump blasting than a quick-acting one. Anything quicker than 40 per cent is seldom used, and the usual range is from 20 per cent to 40 per cent.

The soil auger and a bar were almost invariably used for making holes. These were usually 1½ inches in diameter. In four cases, however, a 2-inch soil auger was used.

In fourteen instances out of the thirty-five, some mechanical means of stump removal was used to supplement explosives. These consisted of block and tackle, tractor, and horse-power stump-pullers. In five cases tractors were used.

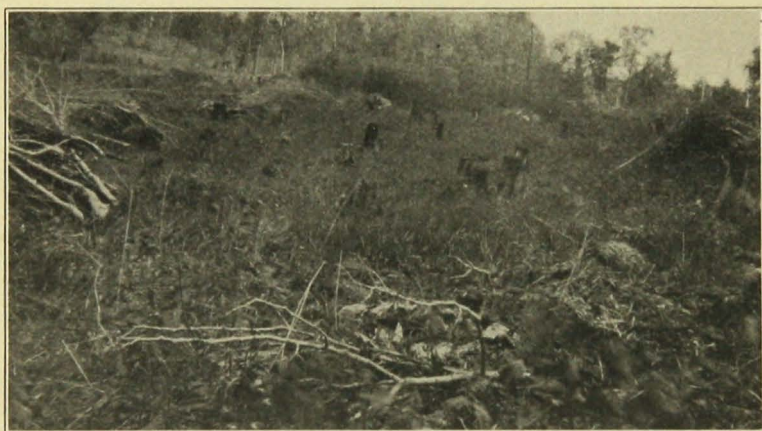


Fig. 1. Typical Example of the Clearing Problem in Northern Minnesota

Where horses were used all but one used a 2-horse team and almost always 2 men with each team. In two instances 3 men worked with one team and in two others 4 men worked with one team.

Various methods of skidding and piling were used depending on kind, size, and age of stumps, method of stump removal used, size of clearing, and means of the settler.

Twenty-seven farmers reported piling experiences. Of these, nineteen did all the piling by hand, seven used a wagon or stoneboat for hauling stumps to the pile, and one used a stump piler. While it is generally believed that a stump piler is necessary wherever mechanical means are used, 40 per cent of the farmers reporting on stump removal used mechanical supplements to explosives in stumping, and only 3.7 per cent of those reporting on piling used a mechanical piler.

The size of crew is practically the same as for pulling—2 men and one team in most cases.

Costs of Stump Removal

Table III shows that the total average blasting cost per acre was \$11.56, with a range of from \$26 to \$4.17. Blasting, however, constitutes only a part of the total cost of stump removal. There is usually a separate pulling cost, and the cost of skidding and piling is often equal to that of stump removal. This fact is commonly overlooked.

It was practically impossible to get even approximate estimates of the costs of these various items from our co-operators, but an estimate of the total cost per acre of clearing, not including breaking or brushing was obtained. The following question was asked, "What does it cost to stump and burn an acre ready for the plow?" Thirty-two farmers replied. All but three said less than \$50 per acre. The lowest estimate was \$10; the highest was \$65, and the average, \$31.53.

Burning Stumps

In answer to the question, "Can you pile stumps which have just been pulled or blasted into a pile large and compact enough without a piler or decking chain so that they will burn immediately?" Fourteen replied "Yes" and twelve replied "No," both without any qualifications. Two stated that this would be possible if the stumps have been blasted, and one replied that it could be done if there was no dirt sticking to the stumps.

The question was asked, "What does it cost to burn an acre of piled stumps?" The minimum cost was given as 50 cents; the maximum, \$5; and the average of twenty-two replies was \$1.91 per acre.

Breaking

Table IV gives a brief summary of the most outstanding features of the reports on breaking. Forty-one farmers answered this part of the questionnaire. The data represent 809.5 acres, an average of 19.7 acres per farm.

It is interesting to note that 39.4 per cent of the plows are 16-inch with the 14-inch size next in popularity. In general the 20-inch breaker and especially the 24-inch breaker require more power than is available on the farm of average size.

We see here a marked change, so far as the use of the tractor is concerned, from the stumping operation. In stump removal, tractors were used by 1.4 per cent; but in breaking, tractors were used by 42.4 per cent of the cases. This tends to confirm the general opinion that in its present stage of development the tractor can not be economically used for stump removal. Breaking, however, is very hard on horses and can be done more satisfactorily with a larger unit than with a small one.

When breaking new land, more or less leaf mold, undergrowth, and other rubbish must be turned under and covered. A wide furrow slice will do this more satisfactorily than a narrow one. A narrow furrow slice is likely to stand on edge and leave much of the rubbish uncovered. This is especially true where deep breaking is desired. For these reasons, then, a 16-inch or a 20-inch breaker would, under ordinary circumstances, be more desirable than a 12-inch or a 14-inch plow.

TABLE IV
BREAKING

Size of plow			Power			Breaking					First crops on new breaking			
No. of farms	Per cent		Unit	No. of farms	Per cent	Depth	No. of farms	Per cent	Best time of year	No. of farms	Per cent	Crop	No. of farms	Per cent
Inches						Inches								
24	6	15.8	Tractor	14	42.4	5	9	23.1	May or June	6	15.8	Potatoes or corn	14	37.8
20	6	15.8	4 horse teams	2	6.0	6	7	17.9	July or August	11	29.1	Small grain	19	51.4
16	15	39.4	3 horse teams	5	15.2	7	7	17.9	Fall	14	36.8	Grass	4	10.8
14	11	29.0	2 horse teams	12	36.4	8	9	23.1	Spring	5	13.2			
						9 or 10	7	17.9	Immaterial	2	5.2			

All of the 24-inch, the 20-inch, and two of the 16-inch breakers were drawn by tractors. The 4-horse teams and the 3-horse teams were used on five 16-inch breakers and two 14-inch breakers; and the twelve 2-horse teams were used on the remaining three 16-inch, and the nine 14-inch breakers. Wherever power is available a large breaker is used, and on a large proportion of the farms only 2-horse teams and comparatively small plows are used. On many farms only a few acres are broken each year. Quite obviously then, it would be necessary to have other work which could be done economically with a tractor to justify the use of one's own tractor for breaking purposes. On some farms, of course, these conditions exist, but on many they do not. A partial solution, at least, of this problem would be the use of a custom tractor breaking outfit in a community.

In all cases except five, the crew consisted of 2 men. With five outfits, one man alone did the breaking. In four cases of the five, 2-horse teams were used and in the fifth a 3-horse team was used. This leads to the general conclusion that 2 men are practically essential on a breaking outfit, whether it is a horse or tractor outfit. In very few instances does one man work alone and this is true only with the smallest horse-drawn units.

In answer to the question, "Have you tried burning the ground over before breaking and what is your idea of this practice?" thirty-two replied, five of whom had not tried it. Twelve stated that it was a good practice. Only two of the twelve made any further comments, these being that it saves valuable time when breaking, and that it gets the ground in good shape for seeding. Nine reported that they followed this practice but made no comments. Six objected to the practice on the following grounds: "Would not burn on heavy clay," "Not good for light soil," "Burns best soil," "Waste of good soil."

We may conclude from the data in Table IV, that 8 inches is the most popular depth and that most of the breaking is done during the late summer and early fall. The latter consideration will be influenced to a certain extent from year to year by the regular farm operations.

Stone Removal

While stone removal may be considered a distinct step in land clearing, it is usually considered along with "breaking" as the last or "clean-up" operation. In the present stage of the development of northern Minnesota cut-over lands, it does not occupy as prominent a position as do brushing, stumping, and breaking. Stone removal as a rule is quite expensive. Many of the best agricultural lands in the cut-over regions of Minnesota are quite stony, but there are still thousands of acres of good soil awaiting settlement on which stones are either absent entirely, or negligible. Naturally the latter are being

settled and cleared first, and as a result not much thought has been given to the art of stone removal on a large scale. As wild land becomes more scarce, however, more attention will have to be paid to this phase of land clearing.



Fig. 2. A Good Stump Land Pasture
Affords an income from the land during the process of clearing.

What is said here is not the result of an exhaustive study, but has to do chiefly with some of the major practices.

One of the questions asked the co-operators was, "Do you find it best to pick the smaller stones out of the field before breaking or to remove them after breaking?" Twenty-one answered that it was better to remove them before breaking. Many qualified their answers with remarks indicating that it was not always possible to get all the stones before breaking, but that it was good policy to make a thoro picking before. Three co-operators stated that they preferred to do their stone picking after breaking and three others stated that the best policy was to remove the stones parallel with the breaking job.

In answer to the question, "In handling stones that are small enough to be hauled on a stoneboat, do you consider this method cheaper and more satisfactory than breaking them up with a mud-cap and hauling them away on a wagon?" Twenty stated without any qualifications that the stoneboat method was best; three said that the stoneboat was best for a short haul; and two said that it would be cheaper to break them up so that they could be loaded on a wagon. One farmer said that he could save 50 per cent of the cost by hauling them during the winter.

Sixteen farmers answered the question, "How many wagon loads can two men and a team remove from the field in ten hours?" with a maximum of 20, a minimum of 6, and an average of 12.1 loads.

This of course will vary considerably with the distance of haul and size of load. However, the average given is probably close to what may be expected under average conditions.



Fig. 3. Land Clearing By-products

These often help to pay a considerable share of the cost of clearing.

In an effort to throw some light on the extent of the practice of burying stones rather than hauling them off, two questions were asked: (1) "Is it possible to bury large rocks cheaper than removing them when the soil is a heavy clay or otherwise hard to dig?" and (2) "When the soil is easily shoveled, do you find that the total cost of digging a stone down is less than the total cost of removing the stone by any other method?" In answer to the first question only one farmer said that he had tried it, but made no comments. A few of those who had not tried it, said that it would be cheaper to remove the stones. Seven farmers spoke favorably of the second situation. It was quite apparent from replies in general that burying the large rocks is practiced very little.

Summary

1. The average brushing crew consisted of two men. In many cases one man worked alone.
2. The ax was the most popular tool for cutting brush, with the brush scythe next in popularity.
3. The average number of man hours required to brush an acre was 32.4
4. It seems questionable whether the advantages of cutting brush in the late summer for the purpose of preventing "sprouting back" would justify this practice under ordinary farm conditions.

5. Sheep must be more or less "starved down" to the pasture to do any real good from the standpoint of brush removal.
6. Blasting may be done at least one-third cheaper when the soil is full of moisture than when it is dry. Forty per cent dynamite or its equivalent was used in 62 per cent of the cases.
7. The annual stumping season is between the time that the frost leaves the ground in the spring and harvest time.
8. In forty per cent of the cases some mechanical means of stump removal was used to supplement explosives. These consisted of block and tackle, tractor and horse-power stump-pullers. The tractor was used in 1.4 per cent of the cases.
9. In all cases except one, a 2-horse team was used for stump removal, and almost always two men with each team.
10. Out of twenty-seven farmers reporting their stump-piling experiences, nineteen did all of the piling by hand, and only one used a stump piler.
11. The total average blasting cost per acre was \$11.56, including both labor and materials.
12. The average estimated cost of stumping and burning an acre ready for the plow was \$31.53.
13. Of the breaking plows used, 39.4 per cent were 16-inch, with the 14-inch next in popularity.
14. In breaking, tractors were used in 42.4 per cent of the cases.
15. Wherever sufficient power is available a comparatively large breaking plow is used.
16. In most cases the breaking crew consisted of two men.
17. Eight inches was the most popular depth of breaking and most of the breaking was done during the late summer and early fall.
18. In the majority of cases where there were stones it was believed advisable to make a thoro picking before breaking.
19. Most farmers believed that it was cheaper to haul stones, which were too large to load on a wagon but which could be hauled on a stoneboat, than to break them with a mud-cap and haul the pieces on a wagon.
20. Under average conditions, two men and a team could remove 12.1 wagon loads of stone in ten hours.
21. The method of burying large rocks was practiced very little.