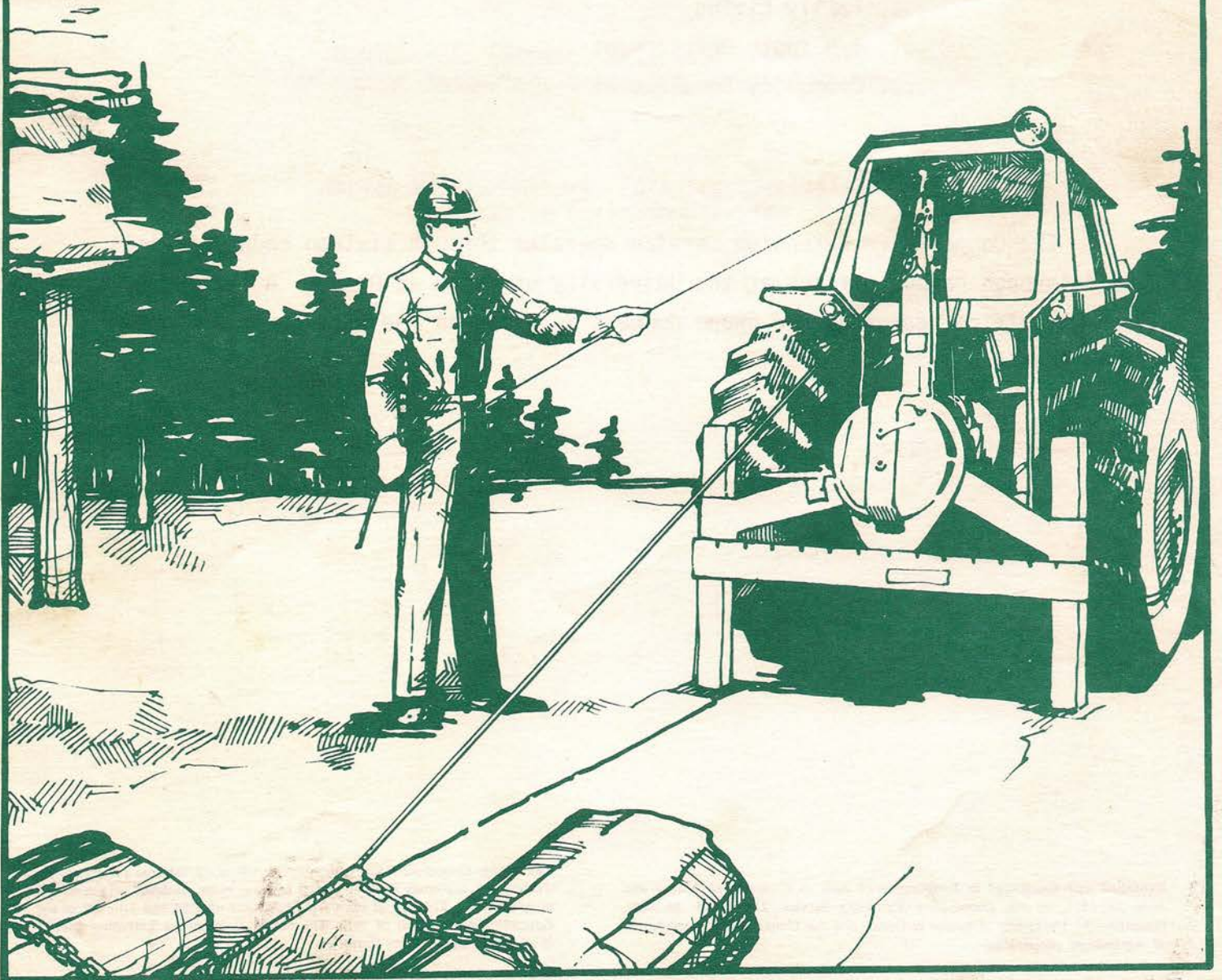




Cooperative Extension Service
University of Maine at Orono

Forestry Notes

Woodlot Harvesting with Small Tractors



University of Maine at Orono

Cooperative Extension Service

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Woodlot Harvesting with Small Tractors

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Woodlot Harvesting with Small Tractors

INTRODUCTION

Small four-wheel drive tractors that are modified for use in the forest offer some real benefits to woodlot owners. These machines are smaller in physical size and cost less than conventional logging machinery and thereby offer a reasonable alternative to woodlot owners who carry out their own timber harvesting and other forest activities. Some application and testing of this type machinery is also being carried by forest industry and logging contractors engaged in commercial timber harvesting.

As most of these four-wheel drive tractors were designed for use in farm, orchard and other agricultural operations, several modifications should be made to ready them for woods operations. Recommended additions to a small tractor include a canopy or rollbar, radiator protection, additional weight to counter heavy loads and a belly pan to guard undercarriage and lower engine parts. Additional equipment and modifications would include a spark arrester for the muffler, which is mandatory in many states, a fire extinguisher, tire chains and protector for the valve stem of tires. Branches and logging slash can damage the valve stem, causing flat tires, but a short section of large-diameter pipe welded to the wheel can solve this problem. A tractor so equipped and ready for woods work is shown in Figure 1.

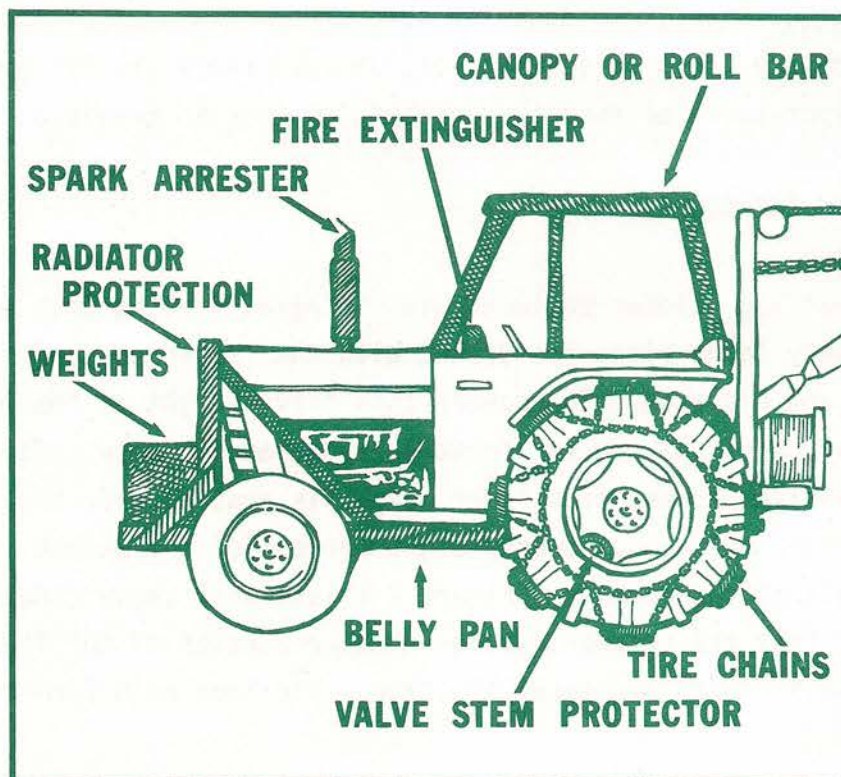


Figure 1. Farm tractor modified for logging.

There are some other items that can be added for either safety reasons or operating convenience. A guard for the muffler should be considered if it appears vulnerable. If there are steps and/or foot plates, they should be of skid-resistant material. In some cases, the operator will want to add heavy wire mesh screening around the cab for added protection. Extra weight for the front tires will also provide additional traction. For personal protection, the operator should have a safety helmet, heavy (safety) work gloves, steel-toed work boots and a first-aid kit.

There are several advantages to these small tractors - maneuverability is excellent; they are easily moved from place to place in a pickup or on a trailer; four-wheel drive gives added traction; diesel power, when so equipped, provides an economic and safe energy source. The combinations of this small size, relatively light weight and good maneuverability can produce less damage to the forest when used wisely.

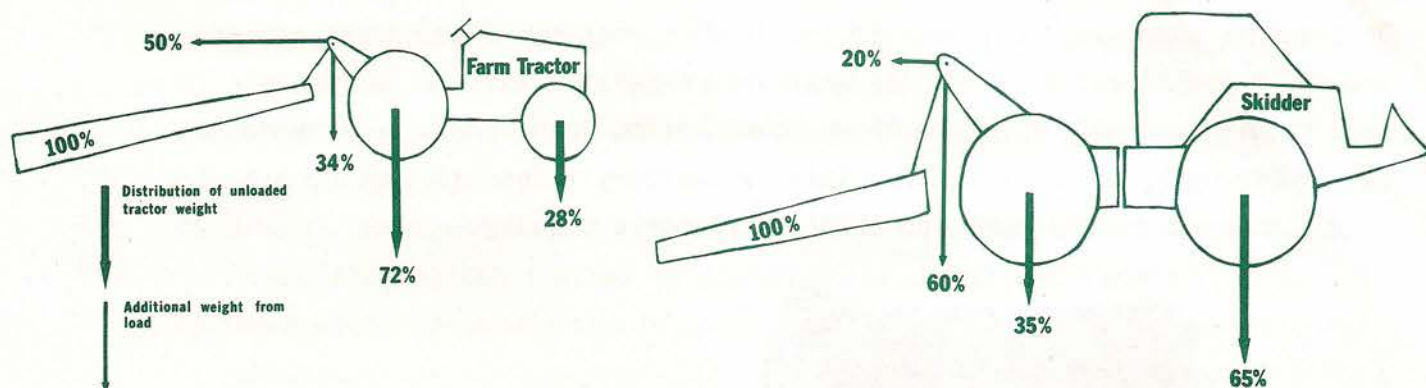
These tractors are also adaptable to uses other than timber harvesting. Most can be fitted with a variety of attachments that are useful in the woodlot but which also extend their utility to other jobs. They can be fitted with front-end loaders for moving dirt, snow, or gravel and with front or rear-mounted blades for road and trail work. They may also be equipped with trailers, powered or not, to increase hauling capacity. Winches may also be added to significantly improve timber harvesting and skidding capabilities for woodlot owners. The purpose of this discussion is to describe some of the features of four-wheel drive tractors and the accessories that will improve their utility by timber harvesters. A description of operating techniques is also provided.

SMALL TRACTORS AND ACCESSORIES

Weight Distribution

A conventional log skidder equipped with integral logging arch was designed to drag (skid) heavy loads along the ground with the larger ends of the logs carried foremost and elevated. To counter this heavy weight at the rear of the machine, engine weight is placed far forward for balance. In a typical application, about sixty-five percent of skidder weight is applied over the front axle. For the farm tractor, only about twenty-eight percent of the weight is directed over the front axle of the machine. Figure 2 illustrates these conditions. Note particularly that the skidder carries a major portion of the load weight OVER the rear wheels, which increases traction. The load on a farm tractor is

Figure 2. Distribution of tractor weights and load weights on a farm tractor with top end foremost and a wheeled skidder with butt end foremost. (Arveson, 1970)



carried BEHIND the rear wheels. This condition accounts for the light weight transmitted to the front end and results in reduced traction and steering. Any surge in skidding resistance can increase this force behind the rear wheels, lifting the front end of a tractor, causing it to tip over backwards. Operators should understand this design problem and take steps to counter it. Adding weights to the front end is an obvious solution. The operator should also understand that uphill skidding and turning will magnify this problem. Additional counter-weighting will be necessary for these conditions. THESE SMALL MACHINES ARE EASILY TIPPED OVER. WORK CAUTIOUSLY AND SAFELY.

An Accessory Winch

An accessory logging winch designed to attach to the three-point hitch on most farm tractors can materially improve the utility and efficiency of your woodlot logging operation. Again, some understanding of design of this machine part is necessary to provide for safe and feasible use.

Three-point hitches are designed for use in farm operations where implements are pulled behind the tractor. When logs are pulled behind the three-point hitch, a compression load (squeeze) is exerted on the bottom arms of the hitch and a tension load (stretch) is put on the top link. These forces run counter to the designed load. Modifications, such as strengthening the lower arms and securing the top link with a lock nut, to prevent it from vibrating it apart, are suggested. With these modifications, a logging winch suited for farm tractors can be added.

The winch power is supplied by a connection with the power takeoff shaft. When this is done, a power shaft safety cover should be added.

Skidding with such a winch requires additional care in hooking the load. With most tractor winches, log chokers are hooked in a notched beam (Figure 3). On tractors with small rear wheels the leading ends may drag on the ground, gouging the soil and as a result, skidding resistance will be increased. To reduce gouging and weight on the three-point hitch, logs should be skidded top first when using a farm tractor. This is contrary to normal logging practice with a conventional skidder and arch or tractor and sulky,

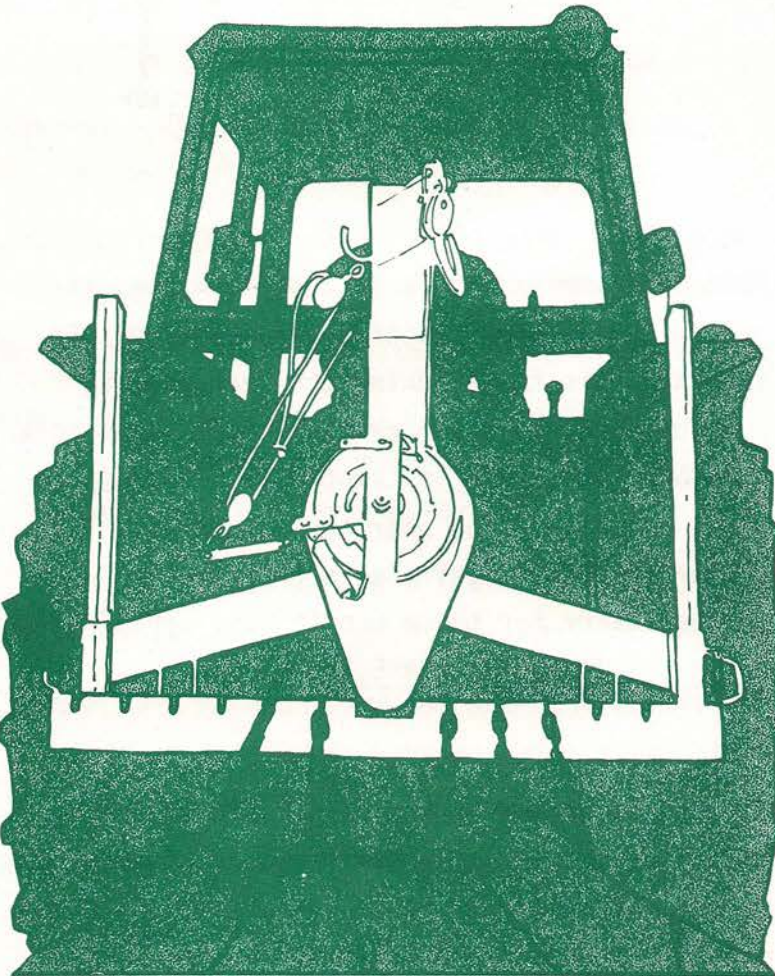


Figure 3. A Farmi winch mounted on the rear of a small tractor. For skidding, log chokers are secured in the notches of the notched cross beam.

Because of their size and weight, small tractors can be easily tipped over when winching. Even a light load, if caught on a root, can tip a small tractor. For this reason, it is imperative that WHEN WINCHING, THE LOAD MUST BE ALIGNED WITH THE CENTER OF THE TRACTOR. Since the operator is not normally aboard a small tractor when winching, there is little chance for personal injury, but tractor damage may be severe. The picture on the cover of this publication

illustrates the typical operator position when winching. If the tractor is tipped over, the engine must be stopped quickly to prevent damage. Stopping a diesel motor requires that the fuel or air supply be shut off. On some models, the fuel can be shut off when the tractor is overturned, but at the same time air cleaner lube oil will run into the engine, causing it to run at top speed. This is called "lube oil runaway". Learn how to shut off both air and fuel to your engine.

Blocks

The block is an accessory that can materially improve logging operation. By definition, a block is a pulley used with wire rope to change direction of motion or to increase pulling power. One modification of the conventional block is called a snatchblock. A snatchblock is a block with an open or removable side. Using a snatchblock on the winch line that comes from your tractor allows the operator to winch loads from the forest without the need for repositioning the tractor. Once the tractor and the block are aligned, loads can be winched to the block through a wide angle without moving the tractor.

SELF-RELEASING SNATCHBLOCK

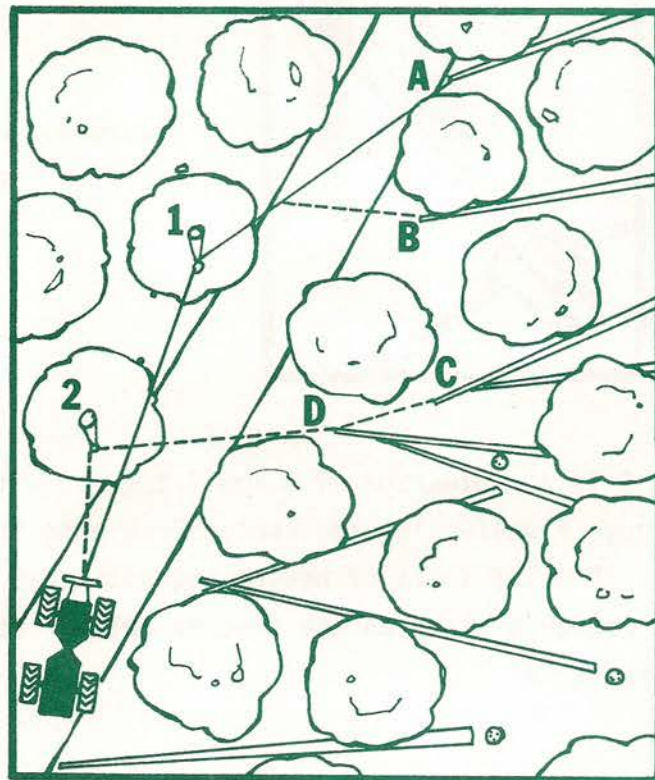
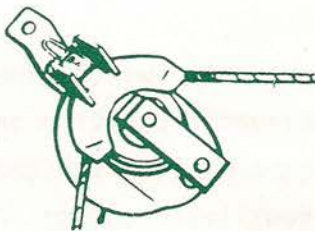


Figure 4. Snatchblock in tree 1 is used to bunch A and B and tree 2 to bunch C and D. Self-release feature results in all stems positioned for skidding.

Another hybrid of the traditional block is called a self-releasing snatch-block. This specially-designed block is available for use with small winches. When a self-releasing block is employed, the block will release the winch line when the load reaches the block and hits the release. This allows the load to be then winched directly to the tractor. Figure 4 illustrates the use of the snatchblock and shows a closeup drawing of the self-releasing snatchblock.

Another modification of the basic block structure has resulted in a helpful device called a portable block. A portable block is used for minor changes in direction such as maneuvering around obstacles in the woods. It can be quickly installed and has a large hook on the end, similar to a shepherds crook, which can be placed around a nearby tree. This provides for a change in direction that will allow the load to slide past an obstacle rather than be hung up by it. The portable block, illustrated in Figure 5, is not commercially available but can be inexpensively made by a welding shop.

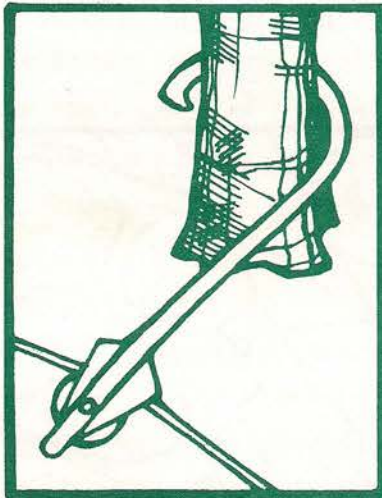


Figure 5. Using a home-made portable block to change the skidding direction to avoid obstacles.

Figure 6 is a photograph of a small tractor with the tractor winch line running through a self-releasing snatchblock hung in an elevated position on a nearby tree. A helpful bit of advice suggests that the control line for the winch should run through a block on the tractor rollbar to prevent its becoming fouled with the winch line.

Other Tools

There are some other tools that have also proven useful when skidding logs. Any device which reduces resistance between the load and the ground improves productivity and provides for safer operation. For several small- to medium-size



Figure 6. View of skidding winch in use showing snatch-block (upper right), winch line (upper line), and control line (left center). Note the control line runs through a block on the tractor rollbar structure to prevent its becoming fouled with the winch line.

pieces, the skidding sled, shown in Figure 7, an old auto hood or similar device will reduce the skidding resistance. For logs of larger diameter, the skidding grapple, which is shown in Figure 8, improves operation. One operator in Maine reported an increase in production of 20-30 percent in larger timber when using the grapple, as compared to traditional chokers.



Figure 7. The skidding sled reduces skidding resistance. It is pictured here in use with the portable block to align the load toward the desired direction at the end of the log pile.

Remote Control

Another option available to operators of the small tractors with winches provides for remote control. A remote control device that has been imported from Scandinavia and tested at the University of Maine School of Forest Resources has the jaw-jarring name of "Skogskompis" (Figure 9). This device consists of a retractable 90-foot control line in a housing that can be carried on the back of the winch operator. The operator can walk to the load, choke it, and use the

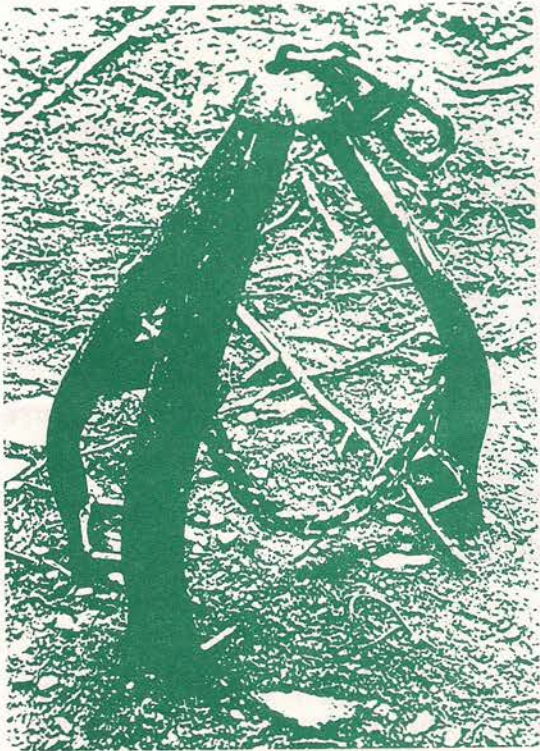
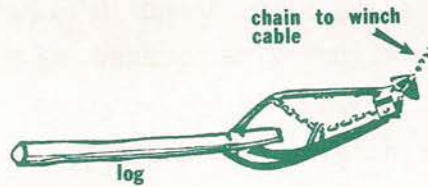


Figure 8. Skidding grapple. The grapple will grip automatically when the forward motion has begun. The 3-pronged design reduces risk of getting hooked behind stumps and roots as the cone-shape steers the logs around obstacles. The grapple also reduces the tendency of the log to dig in the ground when pulled up hill. The grapple has 6 points which ensure a secure grip and are also designed to release the log effortlessly at the end of the pull. The grapple works best with logs at 10-20 inches in diameter.



Not drawn to scale

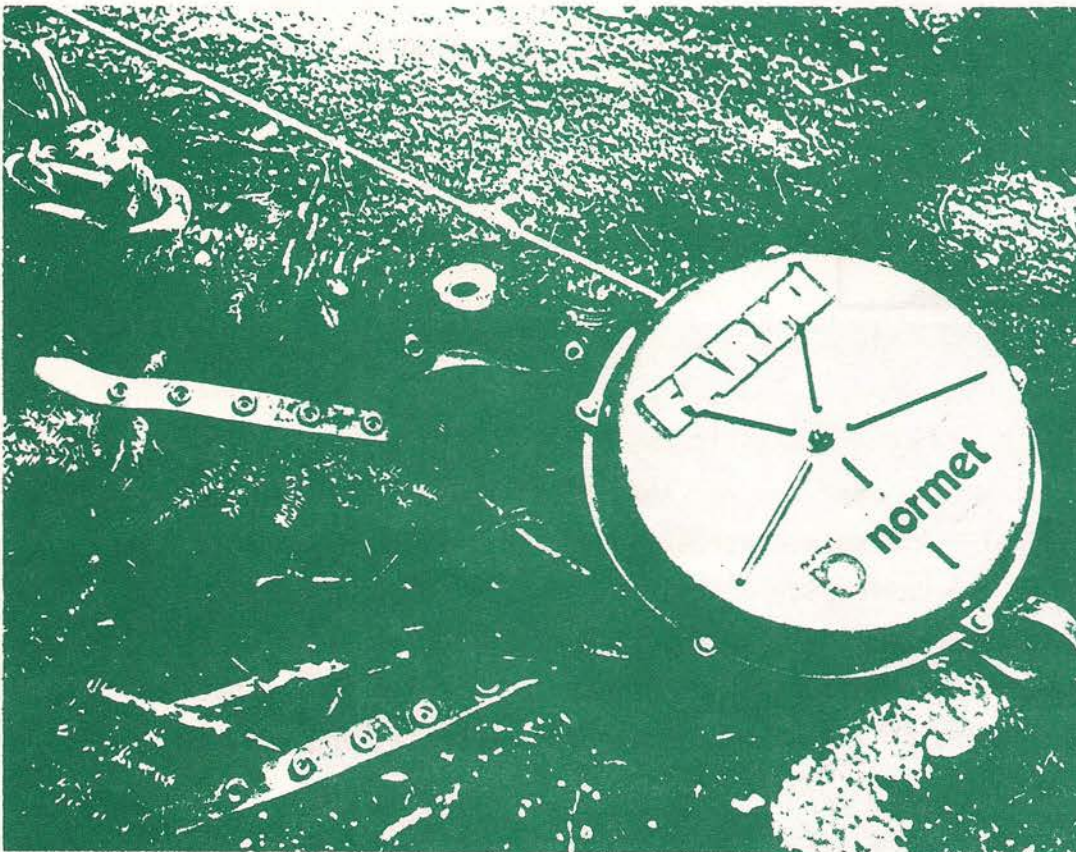


Figure 9. Skogskompis. A 90 foot, retractable winch control line carried on the operator's back.

control line to activate the winch, walking back to the tractor as the load is winched in. This facilitates one-person operation and enables the operator to free the load if it gets caught without having to walk back and forth to the tractor. In the absence of such a device, a nylon or polypropylene line may be used, though care is needed to prevent tangling in slash. Inexpensive retractable clotheslines up to 40 feet in length are available but the cord is not durable and will require early replacement.

OPERATING TECHNIQUE

The transportation of forest products begins with cutting the tree. By felling in the direction in which the logs will be moved, "directed-felling", the total transport distance can be reduced. Subsequent movement requires dragging or carrying the wood. Of the two, carrying on wheels is by far the more efficient, but equipment suitable for use with small tractors is not readily available. Consequently, skidding or dragging is a method most commonly used.

Skidding consists of two steps - accumulating or gathering (bunching) the individual pieces which make up the load, called a "turn", and transportation of the load to roadside. In cases commonly used with small tractors, the work of transporting logs and pulpwood to roadside follows this sequence.

1. The tree is cut (directionally-felled), limbed and bucked to length.
2. This cut to length material is bunched into piles of "suitable" size. Pile, or bunch, size depends on the extraction equipment and ground and terrain conditions (dry, frozen, steep slope, flat ground) and product size. The optimum bunch size will be determined as you develop operating experience (Figure 10).
3. The bunches are winched to road or trail side and piled to await further transportation. Piling is done easily when using a sled (Figure 11).
4. The accumulation of piles will make up a load. In the case of piles located at roadside, they are usually loaded onto a truck and delivered to a point of sale. When piles are at trailside (not on a truck road) they are usually forwarded to roadside using some machine of larger capacity. In the case of woodlot owners and harvesters with only a small tractor, the tractor will usually serve as a skidder. In this instance, additional time is required for skidding and the rate of production drops. This, in turn, translates into a lower hourly return to the operator. The decision to use the small tractor as skidder should be balanced against other economic alternatives.

Figure 10. Bunches ready for winching. Ends should be even and elevated off the ground for easy chocking. Bunches should be oriented for easy access to the trail and should be of optimum size for the winching trail and should be winched in a sled. Tree lengths should be winched at an angle to the road as shown in Figure 3 and may be winched with grapples or small sleds, depending on tree size.

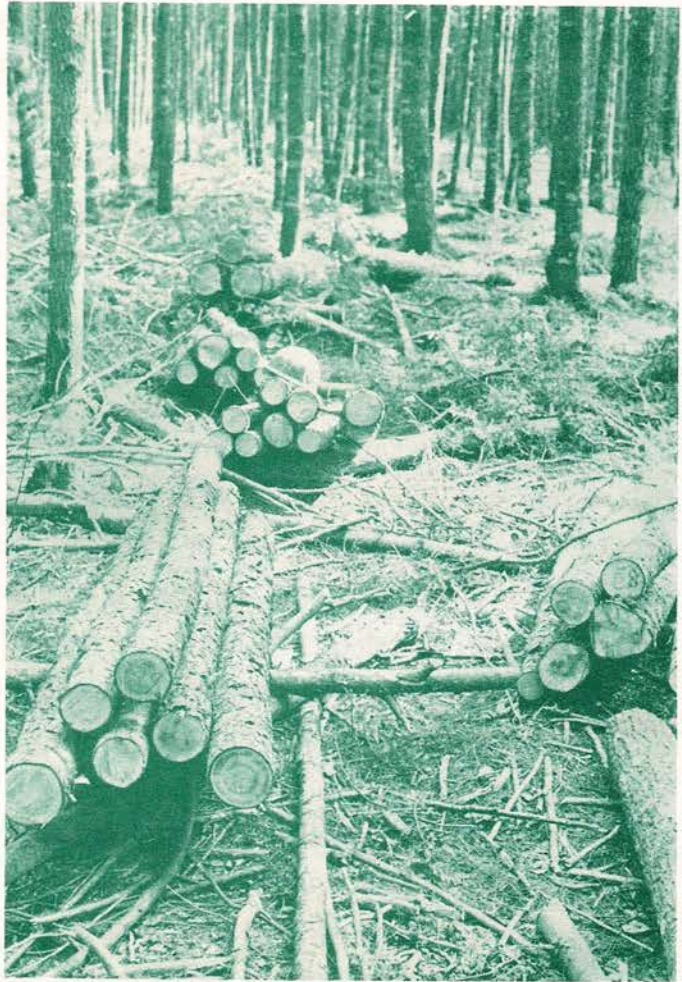
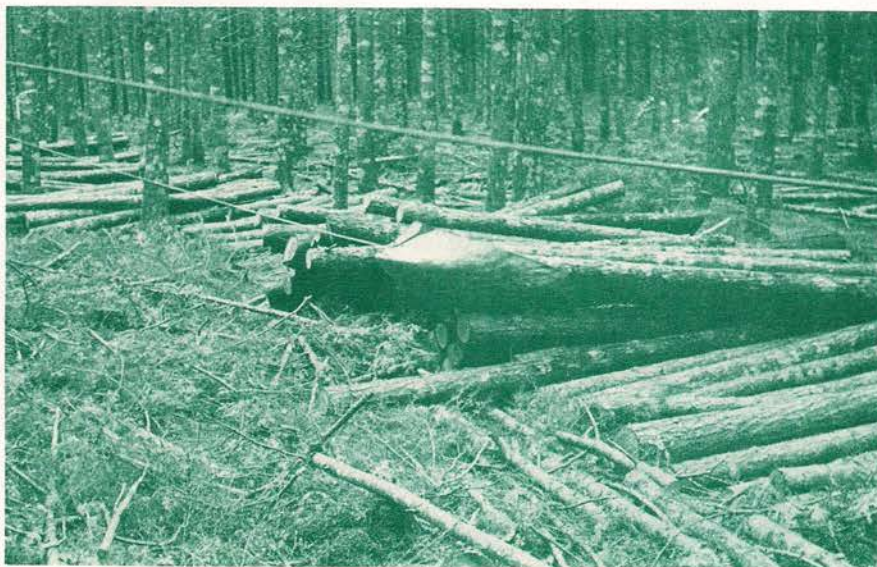
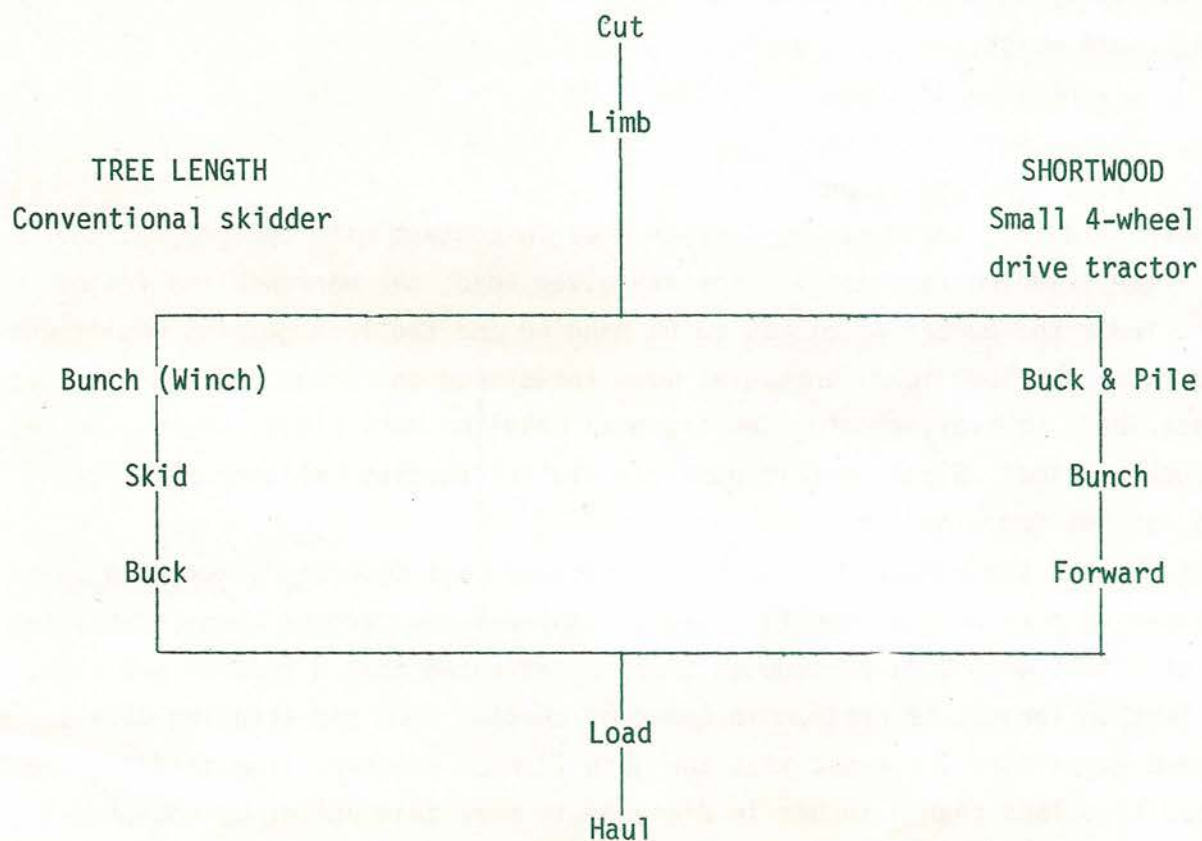


Figure 11. Logs piled at trailside using a sled.



The use of a small tractor using the techniques described here can be collectively described as a "shortwood" logging method in that the trees are bucked nearby the stump. When the cut trees are skidded full length to roadside prior to bucking, the logging practice is commonly referred to as the "tree-length" method. Figure 12 is a flow diagram illustrating the sequence of steps in the two methods.

Figure 12. Flow diagram comparing SHORTWOOD timber harvesting method with TREE LENGTH.



Trail Quality

When skidding or forwarding with small equipment, trail quality is an important factor in skidding cost. The smoother and straighter the trail, the higher the travel speed and productivity, the lower the cost per cord, and the less the operator fatigue. Similarly, the more favorable the grade, the higher the production, up to a point. Steep grades slow uphill travel and are dangerous for downhill skidding. In addition to travel speed, trail quality also affects skidding resistance.

Operational Efficiency When Skidding

Several factors influence skidding efficiency of farm tractors.

- 1) Turn weight
- 2) Orientation of tops
- 3) Turn length and width
- 4) Topography and slopes

When skidding, the more log surface area in contact with the ground, the greater the skidding resistance. For any given load, the narrower and longer it is, the fewer the number of pieces to be handled and the less gouging resistance of log ends, but long loads encounter more resistance on curves and when passing by obstacles. However, shorter lengths mean handling more pieces which requires more choking time. Sleds or skid pans can aid in reducing resistance, as described earlier for winching.

The length and number of pieces are probably best determined for each operation based on tree weight, length, sweep, limbiness, and ground conditions. Two years of trials with a 21-horsepower tractor indicated that a turn of 6-8 logs, 22-30 feet in length, is optimum in terms of choking time and skidding delays. This same experience indicated that the gain in wood recovery from skidding crooked hardwood tops less than 3 inches in diameter is more than offset by additional skidding and choking delays. A rule of thumb for determining the ground skidding capacity of small tractors, based on observations at the University of Maine is 0.01 cords per horsepower. Thus, a 16-horsepower tractor could skid 0.16 cords per trip or in six trips deliver approximately one cord of wood to the roadside. This figure can be increased by using sleds and other skidding aids.

Improving Productivity

It is best to restrict equipment operation to good trails because:

- 1) Skidding and compaction damage to the tree roots and butt logs of residual trees is minimized and
- 2) Skidding speed and productivity increase as trail quality improves.

Production studies at the University of Maine have investigated several relationships pertaining to the use of light tractors and winches in forest stands. A brief summary of the findings may provide some help to other operators.

- 1) A person dragging a light cable and chokers in the stand can move faster and does less damage than a tractor.
- 2) Winching a load over rough ground with an elevated snatchblock is faster than skidding.
- 3) Moving the snatchblock from tree to tree to new locations is faster than repositioning the tractor to accomplish the same end result.
- 4) More wood can be winched to one snatchblock setting than to one tractor setting.

Therefore, to maximize production and minimize damage to the stand, use the winch to move the wood from the stand to the trail, and restrict the tractor operation to the trail. Winch as many bunches as possible to each tractor setting, using a snatchblock. Even after a full turn of logs has been accumulated at trailside, continue to bunch to that area for additional loads and thereby save tractor positioning and set-up time.

OTHER REFERENCE

Readers interested in more information on logging sleds and other devices useful to small scale timber harvesting should refer to "Appropriate Technology Fuelwood Harvesting" publication noted in the Additional Reading section which follows. Line drawings of a three-horsepower yarder, hand-drawn sulky and small sled are included along with description of use and technique.

The use or reference to commercially manufactured machines or accessories by the Cooperative Extension Service does not constitute endorsement.

GLOSSARY

- Arch -- A supporting device mounted on or towed behind a skidding vehicle. Used to lift one end of a log or logs to reduce sliding resistance and/or transfer the weight of a load to a skidding vehicle.
- Block -- A pulley used in wire-rope logging to change direction of motion or increase pulling power.
- Buck -- To saw felled trees into shorter lengths.
- Bunch -- To gather logs into small piles either for winching, in the case as described, or for skidding.
- Butt -- The base of a tree or large end of a log.
- Forward -- The movement of logs in the woods by a machine that carries its load clear of the ground.
- Grapple -- Any tong-like device used in skidding or loading logs. Skidding grapple--a 3-pronged device used to skid logs.
- Harvesting -- To remove timber from the forest for utilization.
- Hitch (three-point hitch) -- The group of parts transmitting the pull of a tractor to its load. The three-point hitch may be used to mount implements or equipment and also serve as drawbar.
- Limb -- To remove the limbs from a felled tree.
- Skid -- To drag logs. Syn. -- "yard".
- Skidder -- A machine used to skid logs or trees to a landing. Usually applied to the specialized four-wheel drive rubber-tired vehicles built specifically for this operation.
- Skogskompis -- A housing containing a control line that can be carried on the back of the winch operator. Used to control winch operation from a remote location. Scandinavian terminology.
- Slash -- The debris left after logging.
- Sled (skidding or winching pan) -- A device usually made of metal or fiberglass, placed under front end of logs being skidded to reduce resistance and prevent their digging into the ground. The front end is normally rounded, or conical, to facilitate movement over obstacles.

GLOSSARY (cont.)

- Snatchblock -- A block with an open or removable side. Self-releasing snatch block-
A snatch block that will release the winch line when the load reaches the
block. Portable snatch block -- A snatch block with a large hook, similar to
a shepherd's crook, which can be quickly placed around a nearby tree. Used
to change load direction to bypass obstacles.
- Spark Arrester -- A device usually added to the muffler of an internal combustion
engine that prevents sparks from escaping.
- Sulky -- A towed logging arch mounted on wheels.
- Timber -- A term loosely applied to forests and their products.
- Tractor -- A powered vehicle for off-the-road hauling. A four-wheel drive tractor
has two axles with power transmitted to all four wheels.
- Turn (of logs) -- One load of logs pulled by a skidder.
- Winch -- a) Using a winch to pull logs.
b) A spool connected with a source of power. Used to reel and unreel
cable.
- Yard -- a) The process of accumulating logs.
b) The place where logs are accumulated.

ADDITIONAL READING

- Arveson, A. 1970. Tree-length Skidding by Farm Tractors and Frame Steered Skidders. Norwegian Forest Research Inst. No. 99.
- Cooperative Extension Service. Issued 1981. Logging-Reading List. Coop. Extn. Svc., University of Maine at Orono. 3 pp.
- Forest Engineering Research Institute of Canada. 1977. Handbook for Logging with Farm Tractor-mounted Winches. FERIC Handbook No. 2, 16 pp.
- Forest Extension Service. 1980. Snowmobile Logging. Department of Natural Resources, New Brunswick, Canada Brochure.
- Hoffman, B. F., and T. E. Christensen. Issued 1981. Appropriate Technology Fuelwood Harvesting. Coop. Extn. Svc., University of Maine at Orono, 13 pp. plus appendix.
- Simmons, F. C. 1979. Handbook for Eastern Timber Harvesting. USDA For. Serv. Handbook NA-GR-2, 180 pp.

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