FERIC

FOREST ENGINEERING RESEARCH INSTITUTE OF CANADA

INSTITUT CANADIEN DE RECHERCHES EN GENIE FORESTIER

Technical Report No. TR-12
January 1977

Evaluation of Farmi JL30 Logging Winch

M. P. Folkema

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Foreword

This report provides information from a study of certain technical and operating characteristics of the Farmi JL30 logging winch.

Since both the range of conditions and the period of observation were limited, this study cannot be expected to predict long-term productivity and costs under all circumstances. The results presented in this report should be considered only as a guide to realistic expectations of machine performance. The reader should apply his own experience and judgment, using the procedures presented in the report, to develop his own estimates of how a machine will suit his future needs.

In line with past reports of this series, details of study procedures and analyses have been omitted for the sake of brevity. If needed, such details will be supplied on request.

All quantitative data throughout the report are given in Imperial units with "SI" (Système International d'Unités) equivalents appended within parentheses.

Grateful appreciation for help and cooperation during the study is extended to Mr. J. Hermelin, director of the New Brunswick Forest Extension Service, to Mr. F. Robertson, a staff member of the same Service, and to Mr. G. Young, R.P.F., manager of Woodlot Service Ltd., Fredericton, N.B.

Technical assistance provided by FERIC employees J. Dymond, E. Vajda, and J. Crawford is also gratefully acknowledged.

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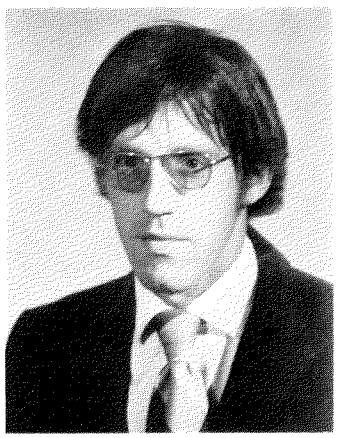

M. P. Folkema received his B. Sc. Forestry from Lakehead University in 1973. From 1973 to 1975 he was employed by the forestry department of Saskatchewan Forest Products Corporation. In 1975, he joined the staff of FERIC in Pointe Claire, Quebec, to work on machine evaluations and related projects.

He is a member of the Canadian Institute of Forestry and of the Woodlands Section, Canadian Pulp and Paper Association.

Summary

For anyone who conducts part-time logging operations on a woodlot, the cost of even a small skidder will usually be high enough to discourage or prevent the mechanization of his skidding. The special requirements of these small operations have stimulated the development of light, versatile logging winches which can be installed on a farm tractor at a modest capital cost ($2,000 to $3,000), for use when the tractor would otherwise be idle.

Such a piece of equipment is the Farmi JL30 logging winch, of Finnish design and manufacture, now available in both Europe and North America. It is designed to be mounted on farm tractors with power ratings in the range 35 to 60 hp and equipped with a three-point hitch.

The winch is attractive chiefly because of its low cost ($1,300), with another $1,200 or so being required for modifications to the tractor to equip it for logging. The combination of tractor and winch enables a farmer or small woodlot owner to engage in efficient and economical wood harvesting activities to supplement his normal sources of income.

Operations with the Farmi winch usually take the form of tree-length skidding, the trees being felled and limbed at the stump and then skidded to a landing. The winch can serve as the basis for an efficient one-man operation, but it can also work effectively with larger crews. In the case of a three-man crew, for example, the work may be divided into felling and limbing, operating the tractor, and bucking at the landing.

The FERIC study of the Farmi JL30 was conducted in July 1976 on thinning operations near Fredericton, N.B., where one Farmi JL30 and one operator were observed in two different stands. The first stand was composed of uneven-aged hardwoods, in which the volume of harvested trees averaged 10.4 ft^3 (.37 m^3). The second stand was even-aged and composed mainly of softwoods, in which the average harvested tree had a volume of only 2.2 ft^3 (.08 m^3).

Productivity in stand 1 averaged 1.3 ct (3.7 m^3) per productive machine hour (PMH), based on an average load volume of .33 ct (0.9 m^3), a skidding distance of 386 ft (118 m), and a time per turn of 15.2 minutes.

In stand 2, the productivity was substantially lower, due mainly to smaller tree size. Productivity averaged only 0.8 ct (2.3 m^3) per PMH, based on an average load volume of .18 ct (0.5 m^3), a skidding distance of 167 ft (51 m), and a time per turn of 13.3 minutes.

Tractor travel speed empty and loaded averaged 134 ft (41 m) per minute and 99 ft (30 m) per minute, respectively, in the two stands.

Loading was the most time consuming phase of skidding with the Farmi, as it required almost one half of the total time per turn. The Farmi loading sequence is more time consuming than that of a wheeled cable skidder because, with the Farmi, medium size trees are often winched one at a time until a load is accumulated. The wheeled skidder with its more powerful winch can usually winch several trees at a time.

In both stands, delays accounted for approximately one third of the total time. Some of these delays were the result of crew inexperience.

Estimates of operating costs were based on a purchase price of $9,000 for the winch and tractor and on both favourable and unfavourable estimates of other cost factors. This approach resulted in a considerable but still realistic range of expected costs: $7.07 to $16.53 per ct ($2.50 to $5.84 per m^3) for tree-lengths skidded to the landing.

Widespread interest in the Farmi JL30 has resulted in sales to date of over 800 units in eastern Canada. The main appeals of the Farmi are its low basic cost and its simple yet functional design.

The main drawbacks of the Farmi winch observed during the field studies were its limited pulling capacity and the restricted manoeuverability of the tractor on unfavourable terrain. If large trees, say over 20 in (50 cm) in d.b.h., are to be harvested, a larger more powerful winch, such as the Farmi JL45, should be used. Also, the JL30 and tractor are not suitable for rough terrain or on slopes exceeding 15%.

Sommaire

Toute personne qui effectue la coupe à temps partiel sur une terre à bois sait que le coût d'une débusqueuse même petite est trop élevé pour permettre la mécanisation du débusquage. Les exigences particulières à ces petites exploitations ont stimulé la mise au point de treuils d'exploitation forestière légers et d'utilisation pratique, qui peuvent être installés sur un tracteur de ferme moyennant un coût modique ($2,000 à $3,000) et qui peut être utilisé lorsque le tracteur n'est pas employé à d'autres fins.

C'est dans cette catégorie que se classe le treuil d'exploitation forestière Farmi JL30, conçu et construit en Finlande et maintenant disponible en Europe et en Amérique du Nord. Il est conçu de manière à être installé sur des tracteurs de ferme dont la puissance varie entre 35 et 60 chevaux et dotés d'un dispositif à trois points.

Le treuil est intéressant surtout en raison de son faible coût ($1,300) auquel s'ajoute $1,200 environ pour les modifications à effectuer au tracteur afin de le rendre utilisable pour l'exploitation forestière. La combinaison tracteur-treuil permet à un cultivateur ou à un petit propriétaire de terre à bois de se livrer à des activités forestières pour suppléer aux sources normales de revenus.

Habituellement, le treuil Farmi sert à traîner les arbres abattus et ébranchés à la souche, jusqu'à une jetée. Le treuil peut constituer la base d'un système efficace pour un seul homme mais peut aussi donner de bons résultats avec des équipes. Dans le cas d'une équipe à trois, par exemple, le travail peut être réparti en abattage et ébranchage, conduite du tracteur et tronçonnage à la jetée.

En juillet 1976, FERIC a effectué une étude du Farmi JL30 lors de coupes d'éclaircie effectuées près de Frédéricton, N.-B. au moyen d'un Farmi JL30 avec un opérateur, dans deux peuplements différents. Le premier comprenait des feuillus d'âges variés et le volume moyen des arbres coupés était de 10.4 pi. cu. (.37 m^3). Le deuxième était composé surtout de résineux d'âge égal et le volume moyen des arbres abattus n'était que de 2.2 pi. cu. (.08 m^3).

La productivité dans le peuplement numéro 1 était d'en moyenne 1.3 ct (3.7 m^3) par heure productive de machine (HPM), sur la base d'un volume de charge moyen de .33 ct (0.9 m^3), une distance de

débusquage de 386 pieds (118 m) et une durée de virée de 15.2 minutes.

Dans le peuplement numéro 2, la productivité était passablement inférieure, surtout en raison de la petite taille des arbres. La productivité moyenne n'a atteint que 0.8 ct (2.3 m^3) par HPM, sur la base d'un volume de charge moyen de .18 ct (0.5 m^3), une distance de débusquage de 167 pieds (51 m) et une durée de virée de 13.3 minutes.

La vitesse moyenne du tracteur, à vide et en charge, était de 134 pieds (41 m) par minute et 99 pieds (30 m) par minute, respectivement pour les deux peuplements.

Le chargement s'est avéré la phase la plus longue du débusquage avec le Farmi. Elle exigeait presque la moitié de la durée totale d'une virée. La séquence de charge du Farmi demande plus de temps que celle de la débusqueuse à roues équipée de câbles car, avec le Farmi, les grumes de dimensions moyennes sont souvent tirées une à la fois jusqu'à ce qu'une charge soit complétée. La débusqueuse à roues, grâce à son treuil plus puissant, peut habituellement tirer plusieurs grumes à la fois.

Dans le cas des deux peuplements, les retards ont absorbé environ le tiers du temps total. Certains de ces retards étaient dus au manque d'expérience des équipes.

Les estimations de coût d'utilisation ont été basées sur un prix d'achat de $9,000 pour le treuil et le tracteur et tenaient compte d'estimations favorables et défavorables des autres éléments de coût. Cette approche a donné une gamme très étendue mais réaliste de coût estimé: $7.07 à $16.53 par ct ($2.50 à $5.84 par m^3) pour les grumes tirées jusqu'au terrain de dégagement.

Le vif intérêt suscité par le Farmi JL30 s'est soldé par des ventes atteignant jusqu'à maintenant plus de 800 unités dans l'Est du Canada. Les caractéristiques les plus intéressantes du Farmi sont un coût de base faible et une conception simple bien que pratique.

Les principaux inconvénients du treuil Farmi, notés durant les études dans les conditions réelles, sont la capacité de traction limitée et la manoeuvrabilité restreinte du tracteur sur terrain accidenté. Dans le cas d'arbres assez gros, par exemple, 20 pouces (50 cm) de d.h.p., il convient d'utiliser un treuil plus puissant, tel que le Farmi JL45. En outre, le JL30 et le tracteur ne devraient pas être utilisés sur des terrains accidentés ou des pentes dépassant 15%.

INTRODUCTION

Small woodlots, whether they be farm woodlots or other small tracts, are important suppliers of raw material for Canada's forest industries, particularly in eastern Canada. Wood production from small woodlots in eastern Canada is often hampered by a low level of forest management, by a general lack of economic incentives, and by unsuitable or costly logging methods. These problems are discussed in a recent report by J. D. MacArthur [5].

Since most of today's logging equipment is designed for clearcutting on large, contiguous forest areas, it may not suit the needs of the small woodlot owner, particularly if he prefers to own his equipment and do his own logging.

One piece of logging equipment which has attracted much interest among woodlot owners, here as well as abroad, is the Farmi winch. The main reasons for this interest are: the low cost of the winch, plus the fact that it can be easily mounted on most medium to large farm tractors. The Farmi winch has been in use in Finland for more than 10 years but has only recently become available in Canada. In Finland, winches mounted on farm tractors have proven very popular for logging in small woodlots. Between 1963 and 1973, over 20,000 winches for use in skidding with farm tractors were sold in Finland, with approximately 70% of these being Farmi winches [6]. To date over 800 Farmi winches have been sold in Canada, mainly to farm woodlot owners.

TECHNICAL INFORMATION

The Farmi JL30 is a logging winch designed to be mounted on virtually any medium-size tractor with a three-point hitch and a power rating of 35 hp or more. Large tractors, rated at 60 hp or more, require a larger winch such as the Farmi JL45, which develops a 9900 lb (4500 kg) line pull.

The JL30 winch weighs approximately 400 lb (180 kg) and develops a 6600 lb (3000 kg) line pull. The power required to operate the winch is delivered through the universal shaft of the tractor power take-off. The maximum winch speed depends on the engine and transmission of the tractor, and varies between 100 to 200 ft (30-60 m) per min. Stability during winching is provided by two adjustable legs attached to the winch (see Fig. 1). Manufactured in Finland, the Farmi JL30 can be purchased in Canada for approximately $1300. For more details refer to Appendix E.

OPERATING SEQUENCE

The operating sequence of the Farmi winch resembles that of a wheeled cable-skidder, except that with the Farmi, trees are often winched one at a time until a load is collected. In comparison, the more powerful winch on the wheeled skidder is usually capable of winching several trees at a time. The complete operating sequence for the Farmi follows:

Travel empty begins at the landing, from where the machine travels on the skid trail to the cutting area. Here the machine manoeuvers into position for loading with the front of the tractor facing the landing. Before dismounting, the operator lowers the three-point hydraulic hitch, to anchor the stabilizer legs of the winch to the ground.

After dismounting, the operator unreels the cable from the (free-wheeling) drum and carries it to the felled trees. Upon reaching one or more such trees he fastens one end of a chain choker around the tree(s) attaching the other end to the cable. Returning to the tractor, he then activates the winch by pulling the cluth cord. After winching in the tree(s) the operator loosens the chain choker from the cable and hooks it into the notched beam. This sequence is repeated several times until a full load is obtained.

Remounting the tractor, the operator raises the three-point hitch, which lifts the ends of the trees from the ground. He then skids the

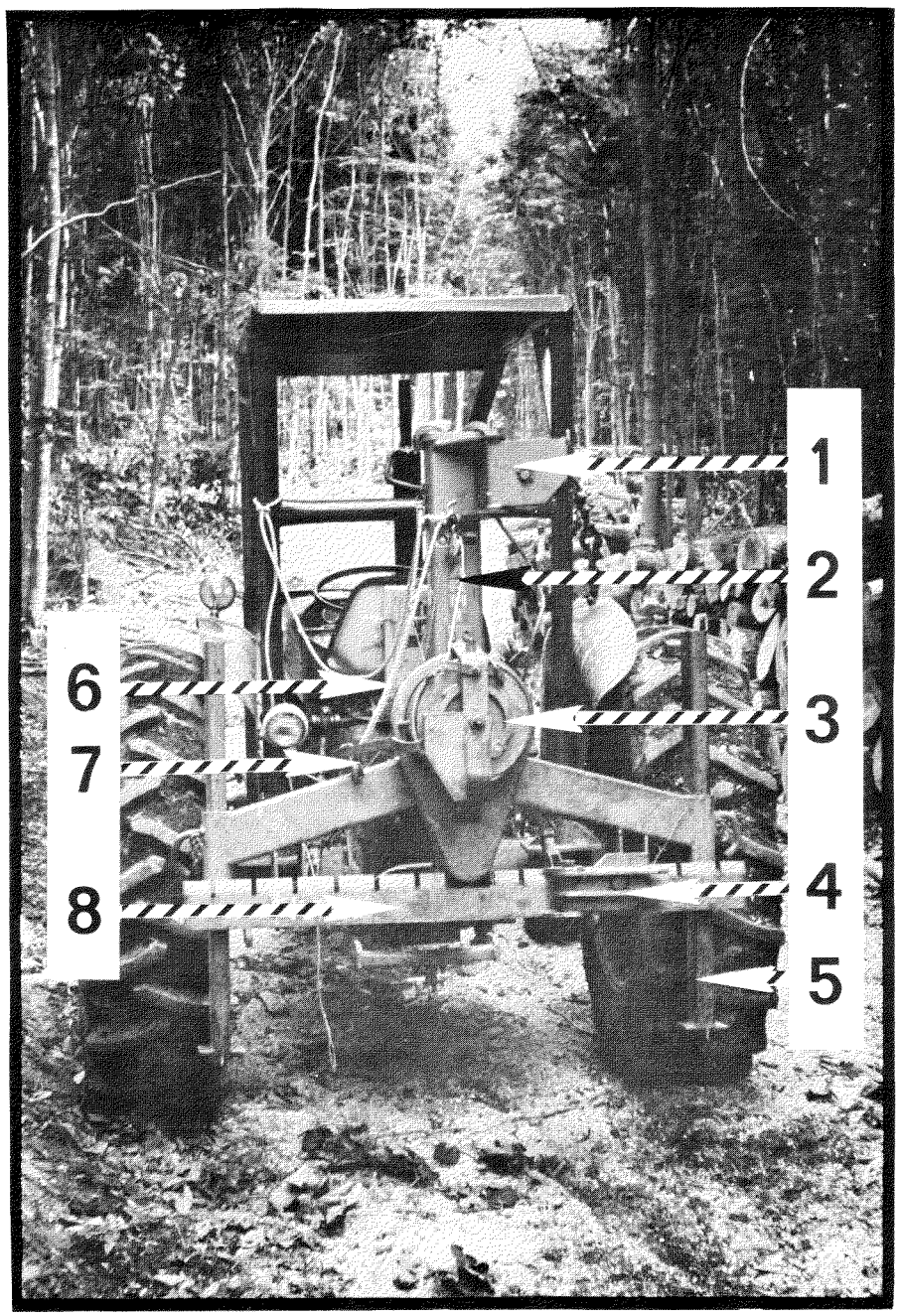

Fig. 1. The Farmi JL30 Logging Winch. The main components are: 1) upper pulley; 2) column; 3) winch drum; 4) lower pulley; 5) stabilizer legs; 6) clutch rope; 7) clutch lever; 8) notched beam.

load to the landing. At the landing the Farmi is unloaded by lowering the winch and unhooking the chain chokers which are usually stored in the column of the winch (see Fig. 1). A detailed definition of the time elements may be found in Appendix A.

FIELD STUDIES

A Farmi JL30 winch, mounted on a 1-year-old, 38 hp International Model 444 farm tractor, was studied by FERIC in July 1976 on the harvesting operations of Woodlot Service Ltd. near Fredericton, New Brunswick.

Modifications to the tractor included 500 lb (227 kg) of weights mounted on the front of the tractor, heavy duty tires, a radiator protector, and a protective canopy for the operator. Other uses of the tractor not related to the study, included brush cutting, chemical spraying and snow removal during the winter.

The objectives of the FERIC field study were:

1. To assess the productivity of the Farmi winch when winching or skidding on thinning operations in different stands under measured conditions and operating factors.
2. To draw conclusions and make recommendations as to operating layout, operating techniques and equipment requirements under Canadian conditions.

The study, which extended over a 5-day period, was conducted in two stands located within the same general area:

Stand 1 — Thinning operations were carried out in a stand of uneven-aged hardwoods of poor quality (excessive forking and poor form), the result of selective logging for various products in the past. The dominant species were beech, maple and yellow birch. In order to make the residual stand more homogenous, most of the remaining large trees were harvested. The effect of this treatment was the creation of large openings in the residual stand, often making the resulting tree spacing less than ideal.

Stand 2 — Here thinning operations were carried out in an even-aged, 35-year-old mixed stand of balsam fir, spruce and white birch. Spruce and balsam trees intended for future sawlog operations remained as residual trees.

Most of the trees harvested in these two stands were left as tree-lengths for skidding, except several very large or crooked trees in stand 1, which were bucked into two parts to facilitate both winching and skidding. All trees harvested were skidded to the haul road, which also served as a narrow landing, on which the trees were finally bucked either into firewood or into 4 ft (1.2 m) pulpwood.

During the FERIC study, the work was shared by a four-man crew. One man felled and limbed, a second man operated the tractor and winch, while two other crew members did the bucking and piling of short lengths on the landing.

The field study clearly indicated that the work distribution on a Farmi logging operation must be kept as flexible as possible to avoid unnecessary and costly delays.

RESULTS

Productivity

While under study, the Farmi JL30 winch and tractor were operated by a retired farmer with 3 months of experience on this type of equipment. Neither the tractor nor the winch required any repairs during the entire 5 days of time studies.

In stand 1, the average total time per turn was 15.2 minutes with an average production of 1.3 ct (3.7 m^3) per productive machine hour (PMH). The average load volume was 0.33 ct (0.9 m^3) while the average skidding distance was 386 ft (118 m).

In stand 2, the average total time per turn was 13.3 minutes with an average production of 0.8 ct (2.3 m^3) per PMH. The

average load volume was 0.18 ct (0.5 m^3), while the average skidding distance was 167 ft (51 m).

The higher productivity in stand 1 resulted mainly from larger tree size. In stand 1, the average volume per tree harvested was 10.4 ft^3 (.37 m^3), while in stand 2 it was only 2.2 ft^3 (.08 m^3).

For more details refer to Table 1 and Fig. 2.

Travelling

Travel speeds were similar in the two studies, averaging 134 ft (41 m) per min for travel empty and 99 ft (30 m) per min for travel loaded.

High stumps and moderate inclines on the skid trails presented some difficulties for the tractor when travelling loaded. The tractor sometimes had difficulty in driving over stumps higher than 8 in (20 cm). Also, short inclines with 15-20% slope caused the tractor tires to spin while travelling loaded. On the study area these limitations had only minor importance.

Table 1. Average Productivity Data

	Stand 1		Stand 2	
Travel distance, ft (m)	386	(118)	167	(51)
Travel speed empty, ft/min (m/min)	136	(41)	132	(40)
Travel speed loaded, ft/min (m/min)	103	(31)	95	(29)
Volume per tree harvested, ft^3 (m^3)	10.4	(.37)	2.2	(.08)
Trees per load	3.2		8.4	
Volume per load, ft^3 (m^3)	33.3	(0.9)	18.2	(0.5)
Total time per turn, min	15.2		13.3	
Productivity, ct (m^3) per PMH	1.3	(3.7)	0.8	(2.3)

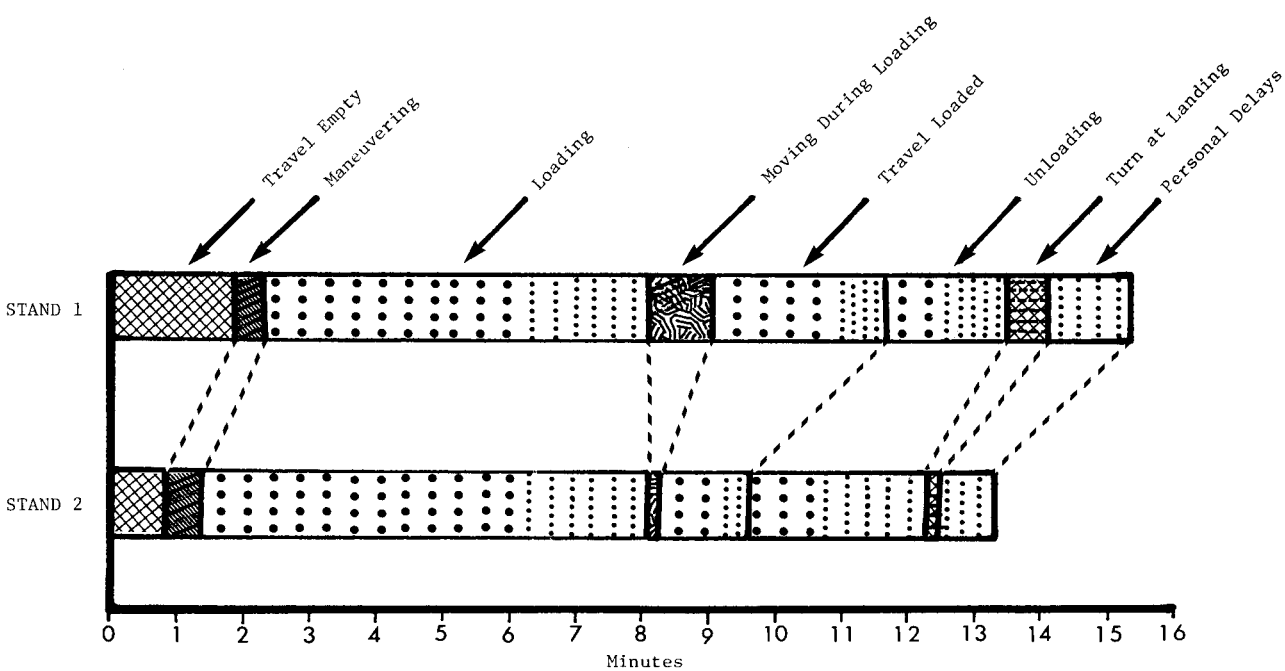

Fig. 2. Average time elements per turn. Delays are shown as small dots within the time element during which they occurred.

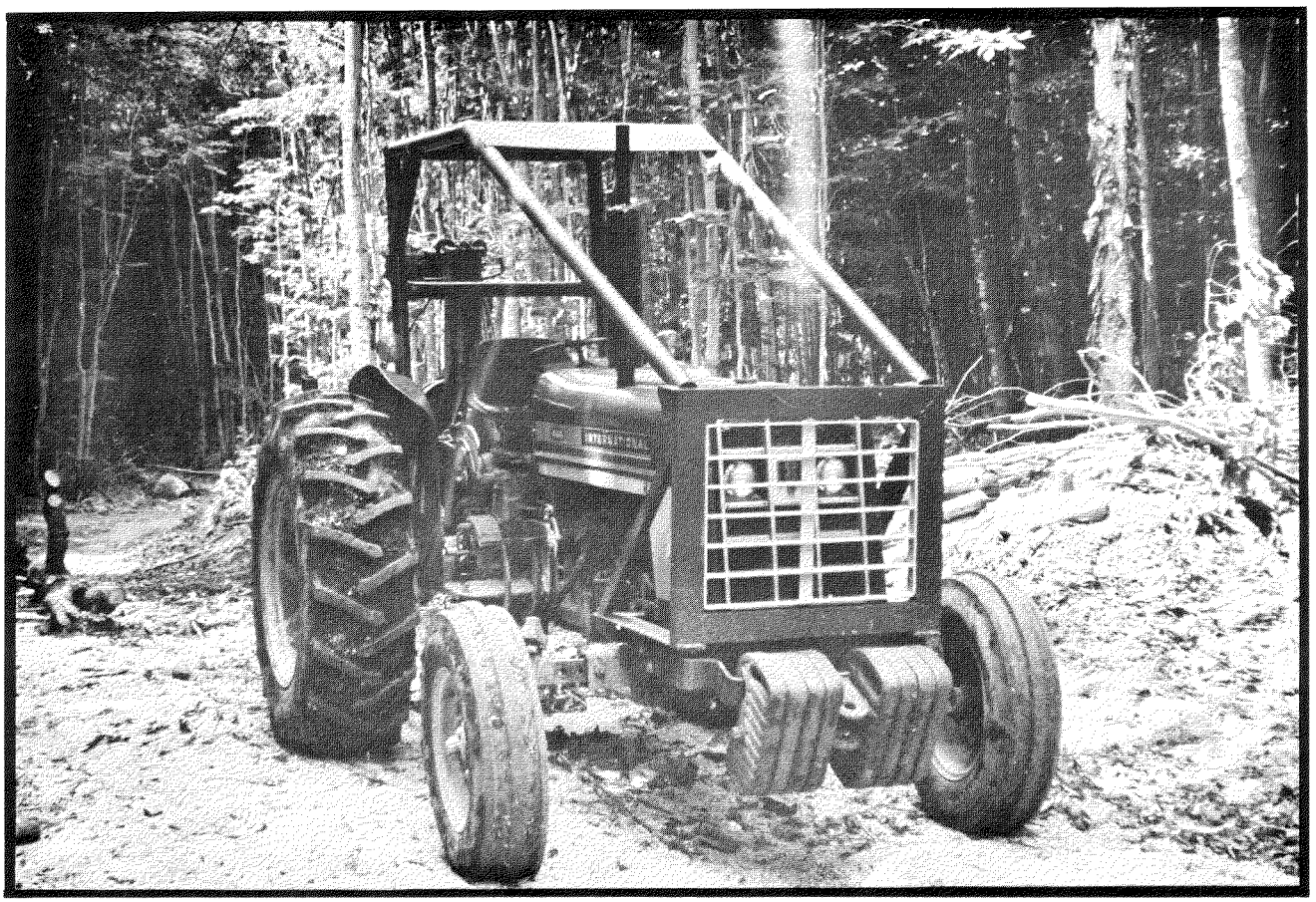

Fig. 3. Oblique view of tractor, showing modifications required for logging. The steel bar holding the weights requires bracing. The iron lattice in front of the radiator is too open for good protection.

Fig. 4. Left — Operator is winching in a tree. Right — Operator attaches a chain choker.

Loading

Loading was clearly the most time consuming work element recorded in the two studies. Loading (plus associated manoeuvering) accounted for 47% of the total time in stand 1 and 55% in stand 2 (see Fig. 2). The average volume per load in stand 1 was 33 ft^3 (0.9 m^3) and in stand 2, 18 ft^3 (0.5 m^3). Data on the elements of loading time are presented in tabular form in Appendix D.

Tree size was the most important factor affecting the load volume. In stand 2, where trees were smaller, the operator normally arranged several stems into a bundle prior to fastening the chain choker, a practice that rarely occurred in stand 1.

Winching

The number of trees per winching averaged 1.0 in stand 1 and 2.3 in stand 2, with average winch volumes of 11 ft^3 (0.3 m^3) and 5 ft^3 (0.15 m^3) respectively.

Twelve of the winch loads observed in stand 1 were single large logs (more than 25 ft^3 (0.8 m^3)), which had a marked tendency to snag behind all brush or other small obstacles. A nose cone or drag claw, if used, would undoubtedly have been useful in preventing winching difficulties. The maximum tree size suitable for the Farmi under good skidding conditions is 25-35 ft^3 (0.7-1.0 m^3).

Delays

Delays accounted for 29% of the total time recorded in stand 1, and 33% in stand 2. A summary of the delays is presented in Table 2.

A high proportion of observed delays may be attributed to a lack of experience and motivation among some crew members. In stand 1, 46% of total delay time involved waiting for felling and limbing, waiting for buckers, helping other crew members, and problems arising from poor directional

Table 2. Summary of Delays

Delay Classification	Percent of total delay time	
	Stand 1	Stand 2
GENERAL		
Personal delays or talking to crew	9	7
Helping other crew members	10	4
Miscellaneous delays	9	7
LOADING		
Waiting for felling/limbing	3	26
Clearing brush around the winch	1	3
Difficulty in pulling cable off drum	5	1
Difficulty in positioning choker	1	1
Trees, stumps and brush impeding winching	19	5
Poor directional felling, impeding winching	15	5
TRAVELLING LOADED		
Dropping a tree (pick-up)	5	4
Obstacles on trail impeding travel	5	1
UNLOADING		
Waiting for buckers	18	36
ALL DELAYS	100	100
ALL DELAYS AS PERCENT OF OBSERVED TIME	29	33

felling. The same factors — largely, if not entirely, avoidable — accounted for 71% of the delay time in stand 2.

The operation studied was probably fairly characteristic of other Farmi operations, since most Farmi crews consist of farmers who are likely to lack general logging experience.

Some of the delays that occurred during loading require additional comments:

One of the most common delays, especially in stand 1 where the trees were larger, occurred when trees being winched would become jammed behind a residual tree or a stump. The operator would then usually pry the tree away from the obstacle and resume winching. The use of winching aids (Fig. 5) would have likely reduced the delays due to hang-ups during winching.

Poor directional felling occurred in both stands, but resulted in nearly four times as many delays in stand 1, where the trees were larger, since large trees are difficult to winch when they are incorrectly felled. When such incorrectly felled trees were encountered, the operator usually winched them away from the landing, dropped the load on the skid trail, turned the tractor 180° and reloaded the opposite end of the trees.

When the cable was tangled on the winch drum, the operator sometimes could not pull it out by hand. In such cases, he was delayed by the need to fasten the end of the cable to a tree and drive the tractor forward, with the drum disengaged.

GENERAL COMMENTS

This section includes general information and recommendations on equipment requirements, operating layout, and mechanical problems, not limited to the results of the FERIC field study. The guidelines in this section have been developed from discussions with J. Hermelin and F. Robertson of the New Brunswick Forest Extension Service, from the FERIC study, and from the literature cited.

Equipment Requirements

The Farmi JL30 winch should normally be equipped with 150 ft (46 m) of ⅜ in (.95 cm) solid-core wire cable. Five to seven choker chains are also required. For best results, the tractor should be equipped with power steering and have a minimum of 40 hp.

Additional equipment and tractor modifications recommended for safe, profitable logging are discussed below (see also Fig. 5, 6):

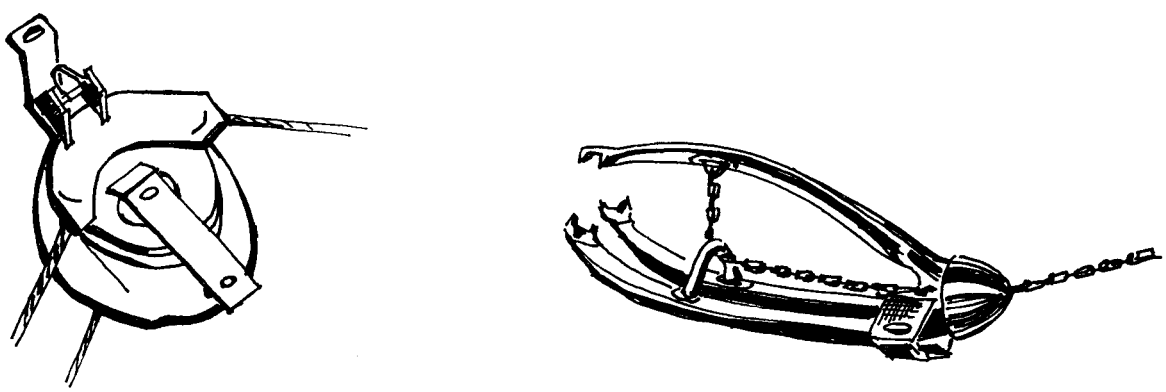

Fig. 5. Snatch block and tow grapple.

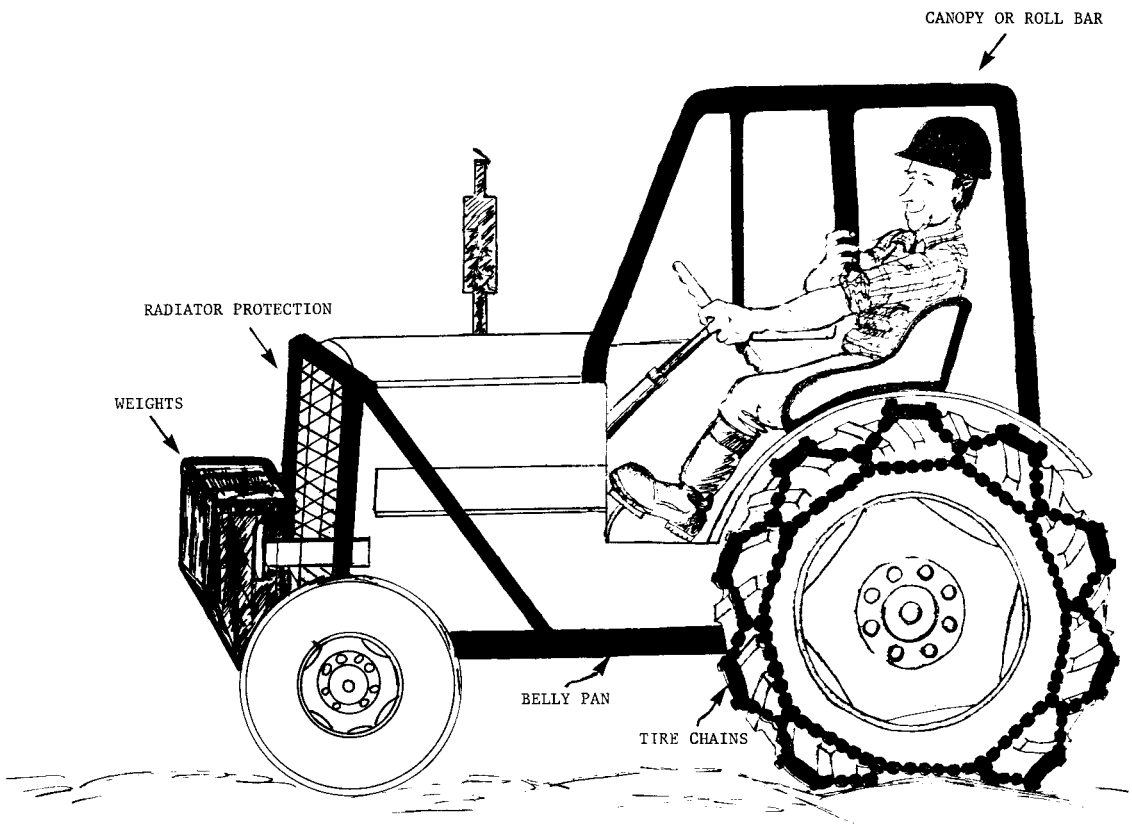

Fig. 6. Tractor modifications for logging.

Winching Aids

Two grapple ($25) — A three-pronged grapple that allows larger tree butts to slide along the ground and over obstacles.

Snatch block ($30) — A self-opening snatch block is used to winch around obstacles or "corners". It can also be used to prevent damage to standing trees. This is a very useful piece of equipment for Farmi operators.

Tractor Modifications

Farm tractors are normally designed for agricultural use and require modifications before being used for logging (see Fig. 6):

Canopy or roll bar — The operator must have this protection in case of a tractor roll-over.

Radiator protection — A steel grill should be installed to protect against radiator damage.

Belly pan — A piece of heavy-gauge sheet metal should be installed to protect exposed parts on the underside of the tractor.

Reinforced tires — Heavy duty tires and valve stem protectors are required for logging applications.

Tire chains — When the tractor operates on soft ground or snow, tire chains are required.

Weights — Weights on the front end of the tractor improve the tractive effort of the machine and also prevent the front end of the tractor from rising off the ground (see Fig. 3). A rule of thumb for the amount of weight required is 100 lb (45 kg) for every 10 hp (e.g. a 40 hp tractor requires 400 lb (181 kg) of weights).

Operating Layout

The operating guidelines for the Farmi winch which are presented here apply to the tree-length method of logging. Limbing and topping are normally carried out in the stump area, while bucking and sorting (if any) are done at the landing.

Logging plan — Before the start of operations, a logging plan should be drawn up. This includes the making of a rough map of the area, taking into account the available roads, trails, suitable landings, and the direction of the transportation. All planned skid trails, roads and landings should be indicated.

Skid trails — Skid trails should be about 10 ft (3 m) wide, large enough to accommodate the tractor. To provide optimal working distances, they should be about 200 ft (61 m) apart and 600 ft (183 m) in length. To facilitate skidding, the trails should be at an angle to the haul road (see Fig. 7).

Trees on the skid trails should be felled squarely at ground level and skidded first. It is important to avoid any sharp-angled stumps which are likely to cause tire punctures.

Winching — When the winch is in operation the tractor should always be positioned in line with the direction of the pull with the operator standing at the side of the tractor. The upper pulley on the Farmi is used for most winching activities.

Winching up steep slopes is a practice that should be avoided. Maximum slopes when winching up-hill should not exceed 15%. Also, the tractor should not be driven along the contours on slopes. On steep inclines the tractor should be backed up onto the slope as far as possible, and the whole length of the cable should be used, with all winching and skidding in a downhill direction.

The question is sometimes asked — *"Should the butts come first or should the tops come first when winching?"*. The answer to this question depends on the size of the tractor, the size of the trees, and the terrain.

Winching top first takes less work, because several stems can usually be winched at the same time on separate chokers, since the tops have less tendency to snag than the butts. When tops are winched first it is also easier, when skidding on steep terrain, to let the winch cable out, drive forward, and then winch in the load again.

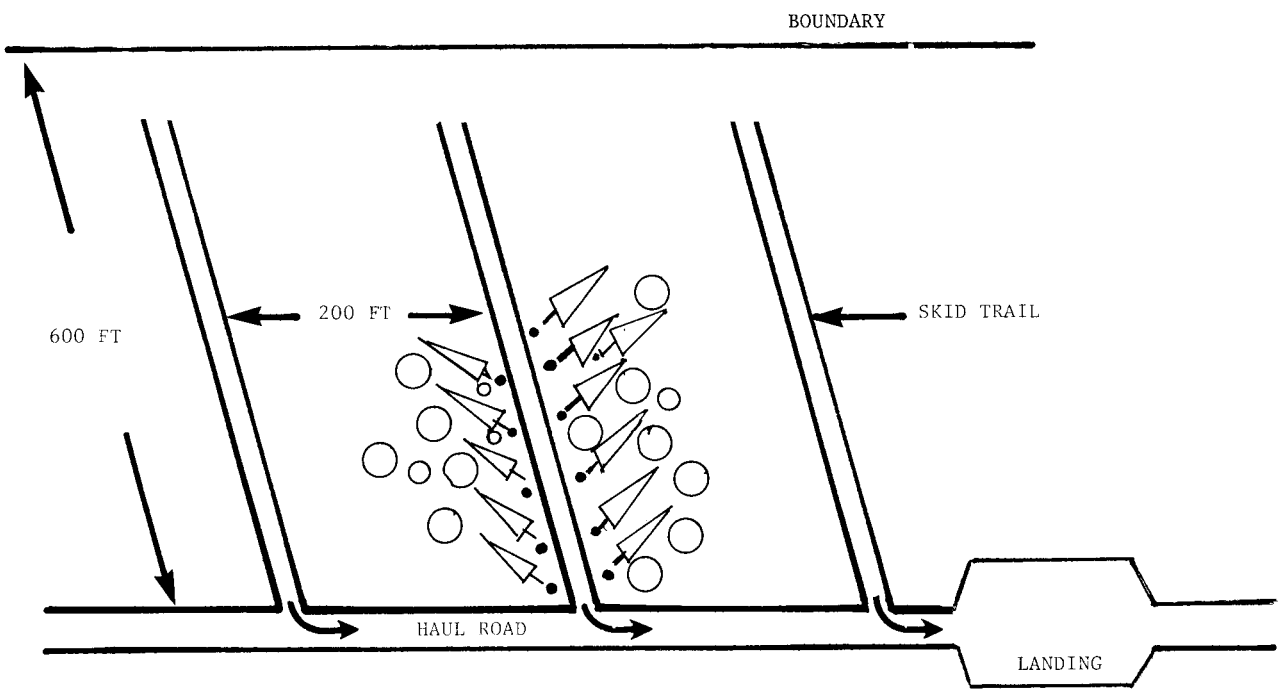

Fig. 7. Operating layout.

The main advantage of winching butts first is the increased weight on the rear tractor wheels, which improves the traction considerably.

Landings — The location of landings is an important factor to consider in the planning stage, since the landing must often be large enough to accommodate several sorts. It is frequently more advantageous to transport the wood several hundred feet extra in order to reach a functional landing area. Skids should be used for bucking, and should be placed firmly so the tractor can drive over them. If long lengths (≥8 ft (2.5 m)) are to be produced on the operation, a front-end loader may be required.

Mechanical Limitations

Winching ability — The Farmi JL30 winch has a rated line pull of 6600 lb (3000 kg) with a speed that varies between 100-200 ft (30-60 m) per minute, depending on the tractor. In comparison, a wheeled skidder in the 95 hp class will usually have a line pull rating of 23,000 lb (10,400 kg) with a maximum winch speed of 300 ft (90 m) per minute.

During the FERIC studies, logs and tree-lengths more than 20 in (50 cm) in diameter usually presented problems during winching due to the limited pulling capacity of the winch.

Durability — The Farmi JL30 is a simple, well-built winch but, like other machines, it will not stand up to rough usage or abuse. Potential damage to the tractor can be minimized by using adequate safeguarding measures (see Fig. 6). During the FERIC field study no downtime was recorded to repairs. Haapamaki and Haataja [2] reported that the Farmi winch was susceptible to damage from the impact of logs jarring against the Farmi frame during winching. This type of damage can be prevented by a careful operator.

Manoeuvering — Farmi winches are designed for farm woodlots where the terrain is favourable. Since farm tractors are less stable and less manoeuverable than wheeled skidders they are not recommended for use in rough or steep terrain. Slopes should not exceed 10-15% and stumps on the skid roads should be cut as low as possible.

Clutch adjustment is required periodically on the winch to obtain the maximum winching power available. According to Mr. F. Robertson, of the New Brunswick Forest Extension Service, many Farmi owners do not know how to make the necessary adjustments. Instructions from the Farmi distributor at the time of purchase are recommended.

Expected Costs

The skidding costs presented below are considered to represent a range of costs that may be expected in view of the uncertainties entering into some of the estimated values. The total cost ($/ct) has been calculated from the following equation:

$$\$/ct = \left[\left[\frac{I}{L}\left(1 + \frac{i\,(N+1)}{2}\right) + M + W\right]\frac{100}{U} + F\right]\frac{1}{P}$$

where:

Known Values

I = Purchase price: $9,000 (tractor plus winch)
F = Fuel and lubricants: approximately $2.00 per PMH
W = Operator's wages: $6.00 per SMH
N = Depreciation period: 4 years
i = Interest and insurance factor: 0.13

Estimated Values

	Favourable	Unfavourable
L = Economic life of machine (SMH)	12,000	9,000
M = Maintenance cost (75% and 125% of fixed cost, $/SMH)	.75	1.66
P = Productivity, ct/PMH	1.5	0.8
U = Machine utilization, %	90	80

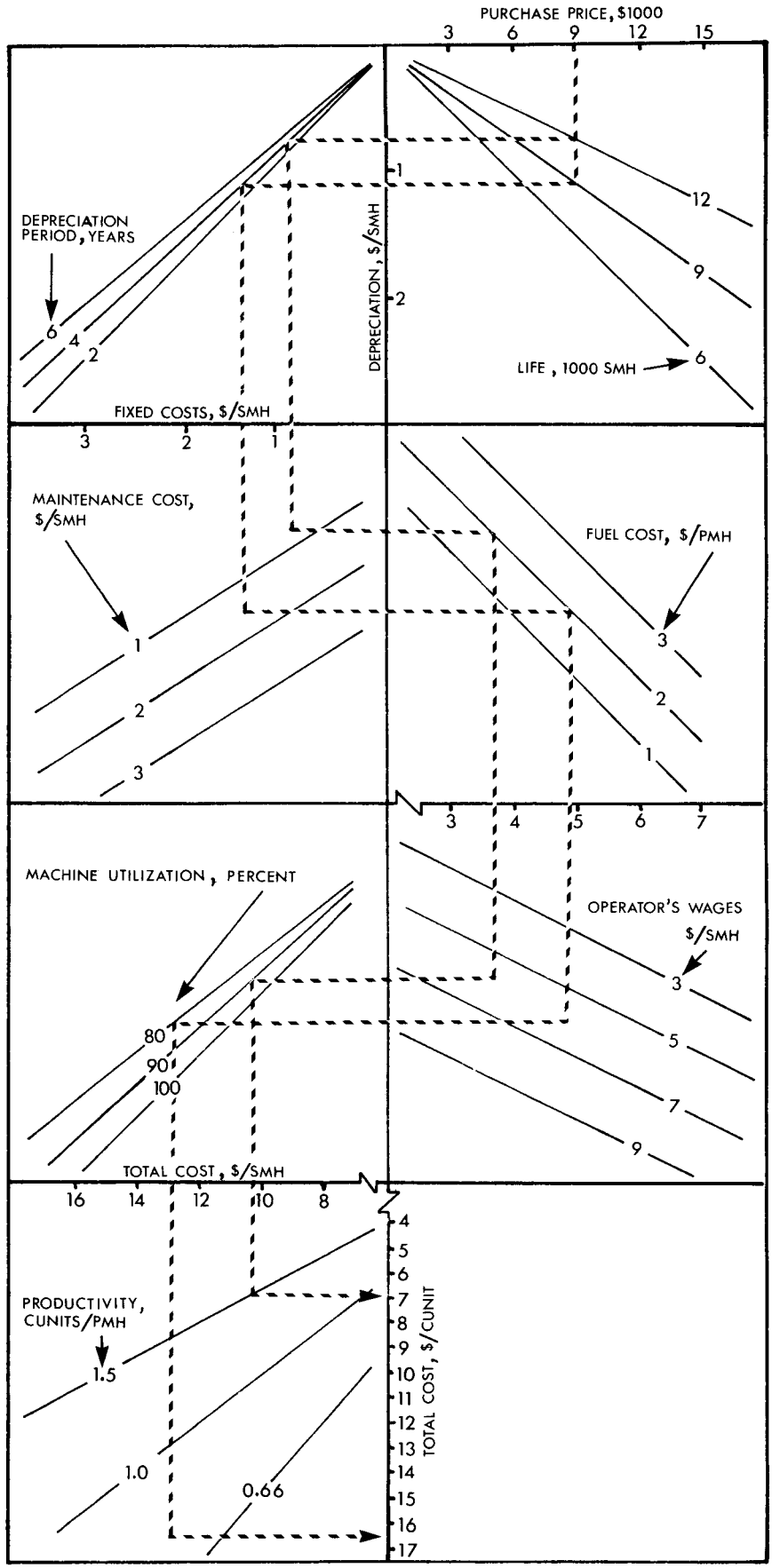

Fig. 8. Cost Nomogram

Using the above values in the equation gives the following results:

	Favourable	Unfavourable
Total cost, $/PMH	10.60	13.23
Total cost, $/ct	7.07	16.53

The examples above do *not* include the cost of associated activities such as felling, limbing, bucking, and piling. The cost nomogram (Fig. 8) shows clearly that the operator's wages and, to a lesser extent, the fuel cost will greatly influence the total cost of logging with the Farmi winch.

Cost Nomogram

The cost nomogram shown in Fig. 8 represents the equation above. The cost nomogram can be useful to readers who wish to predict the cost of winching and skidding with the Farmi winch on their own operations. The reader can use the capital cost of the tractor and winch which is most suitable for his situation. The values should be plotted directly onto Fig. 8 in the following manner:

Start with the purchase price and proceed to the machine life and the depreciation period. The expected maintenance costs are plotted next (variation in maintenance cost between operations is substantial and is usually subject to some uncertainty). Next, the fuel cost is plotted, followed by the operator's wages, which finally leads to the total cost of skidding per cunit.

APPENDIX A

PROCEDURE FOR EVALUATING PRODUCTIVITY

To assess the productivity of the Farmi JL30 time studies were carried out covering a range of tree and stand factors. Elements of the harvesting cycle for the trees were timed using an electronic watch board. Productive time of the machine was divided into the following elements.

1. Travel empty: begins when the tractor starts moving from the landing towards the felling area, and ends when forward motion stops, so that manoeuvering can begin.

2. Manoeuvering: begins when the forward motion of travel empty stops, and ends when the tractor is positioned, ready for loading to begin.

3. Loading: begins when the operator leaves the tractor seat to reel out the mainline and ends when the load has been secured. Loading may be separated into several sub-elements:

3.1 Outhaul cable: begins when the operator leaves the tractor seat, or completes a previous winch, and ends when a choker has been placed on tree(s).

3.2 Walkback: the time required to walk back to the tractor from the tree(s) that has been choked.

3.3 Winching: the time required to winch in tree(s).

3.4 Securing tree: after tree(s) has been winched in, the choker chain is usually attached to the notched beam.

4. Moving during loading: the moving time between loading points. It begins when the operator starts the machine and ends when the move is completed.

5. Travel loaded: begins when loading is completed and ends when the tractor stops at the landing.

6. Unloading: begins when the tractor stops at the landing and ends when the load is dropped.

7. Turn around: the moving time required to position the tractor so that travel empty can begin.

8. Delays: include operational delays, mechanical breakdowns, and personal delays. These are allocated differently depending on their duration.

0 - 10 cmin:	are included in the above elements (1-7).
10 cmin - 10 min:	are recorded as "delays".
>10 min:	are not considered as part of productive time (PMH) and are therefore excluded.

APPENDIX B

Table B.1. Stand 1: Average Condition and Operating Factors

Factors	Imperial Units		SI Units	
	Mean	Range	Mean	Range
Before logging:*				
Stand volume, ct/a (m^3/hectare)	18.3	12.8-26.9	128	89-188
Trees per acre (per hectare)	505	370-660	1248	914-1631
Saplings, per acre (per hectare)	322	130-1350	793	321-3336
After logging:**				
Stand volume, ct/a (m^3/ha)	12.0	7.5-13.3	84	52-93
Trees per acre (per hectare) (no saplings remained)	405	260-520	1001	643-1236
Slope	± 10%			
Species	53% maple *(Acer spp.)* 39% American beech *(Fagus grandifolia* Ehrh.) 7% yellow birch *(Betula alleghaniensis* Britton)			

*Based on 11 sample plots
**Based on 6 sample plots

Table B.2. Stand 1: Summary of Times per Turn

Time Elements	Mean, cmin	S.D.*	Range
Travel empty	182	62	54-317
Manoeuvering	50	33	0-222
Loading	386	170	60-993
Moving during loading	88	116	0-559
Travel loaded	210	77	88-420
Unloading	101	41	20-218
Turn at landing	63	54	0-373
Total time minus delays	1080	274	462-1729
Total time	1520	887	506-2539

Based on 56 turns
*S.D. = standard deviation

APPENDIX C

Table C.1. Stand 2: Average Condition and Operating Factors

Factors	Imperial Units		SI Units	
	Mean	Range	Mean	Range
Before logging:*				
Stand volume, ct/a (m^3/ha)	29.9	22.9-37.7	209	160-264
Trees per acre (per hectare)	725	610-890	1794	1507-2199
Saplings per acre (per hectare)	653	450-760	1615	1113-1879
After logging:*				
Stand volume, ct/a (m^3/ha)	12.7	9.0-19.7	89	63-138
Trees per acre (per hectare) (no saplings remained)	187	90-280	461	222-692
Slope	Negligible			
Species	55% balsam fir *(Abies balsamea* (L.) Mill.) 23% white spruce *(Picea glauca* (Moench) Voss) 19% white birch *(Betula papyrifera* Marsh.)			

*Based on 3 sample plots

Table C.2. Stand 1: Summary of Times per Turn

Time Elements	Mean, cmin	S.D.*	Range
Travel empty	76	51	18-315
Manoeuvering	57	37	0-242
Loading	491	151	191-816
Moving during loading	19	49	0-391
Travel loaded	108	66	0-420
Unloading	113	50	15-244
Turn at landing	23	12	0-131
Total time minus delays	888	251	387-1633
Total time	1326	397	683-2286

Based on 51 turns
*S.D. = standard deviation

APPENDIX D

Table D.1. Summary of Loading Time

Time Element	Stand 1		Stand 2	
	Mean	Range	Mean	Range
Haul out cable & fasten choker, cmin	54	0-170	68	0-195
Walk back to tractor, cmin	20	5-114	15	0-69
Winching, cmin	31	0-174	27	0-109
Fasten chain choker, cmin	20	0-168	23	0-111
Distance winched, ft (m)	31 (9)	0-125 (0-38)	28 (8)	0-90 (0-27)
Trees per winch	1.0	1-3	2.3	1-6
Volume per winch, ft^3 (m^3)	11 (0.3)	1.5-50 (.05-1.5)	5 (0.15)	0.6-15 (.02-.45)
Trees per load	3.2	1-6	8.4	4-14
Volume per load, ft^3 (m^3)	33 (0.9)	13-64 (0.4-1.9)	18 (0.5)	10-33 (.3-1.0)

APPENDIX E

MANUFACTURER'S SPECIFICATIONS

The Farmi JL30 winch is manufactured in Finland by ORION-YHTYMÄ OY.

The Canadian distributors are George White Farm Sales in London, Ontario and St. Hyacinthe, Quebec, and Maritime Farm Supplies, Moncton, New Brunswick.

Farmi JL30 Technical Data

Pulling capacity:	6600 lb (3000 kg)
Drum capacity:	165 ft (50 m) of 3/8 in (.95 cm)
Winching speed:	100-200 ft (30-60 m) per min.
Clutch:	Mechanical friction plate clutch
Power transmission:	Universal shaft from tractor P.T.O. and by 5/8 in (1.58 cm) chain on winch. Chain tension adjustable
Mounting:	Tractor three-point hitch
HP requirement:	35 hp or more
Optional:	Loading unit
Shipping weight:	400 lb (181 kg)

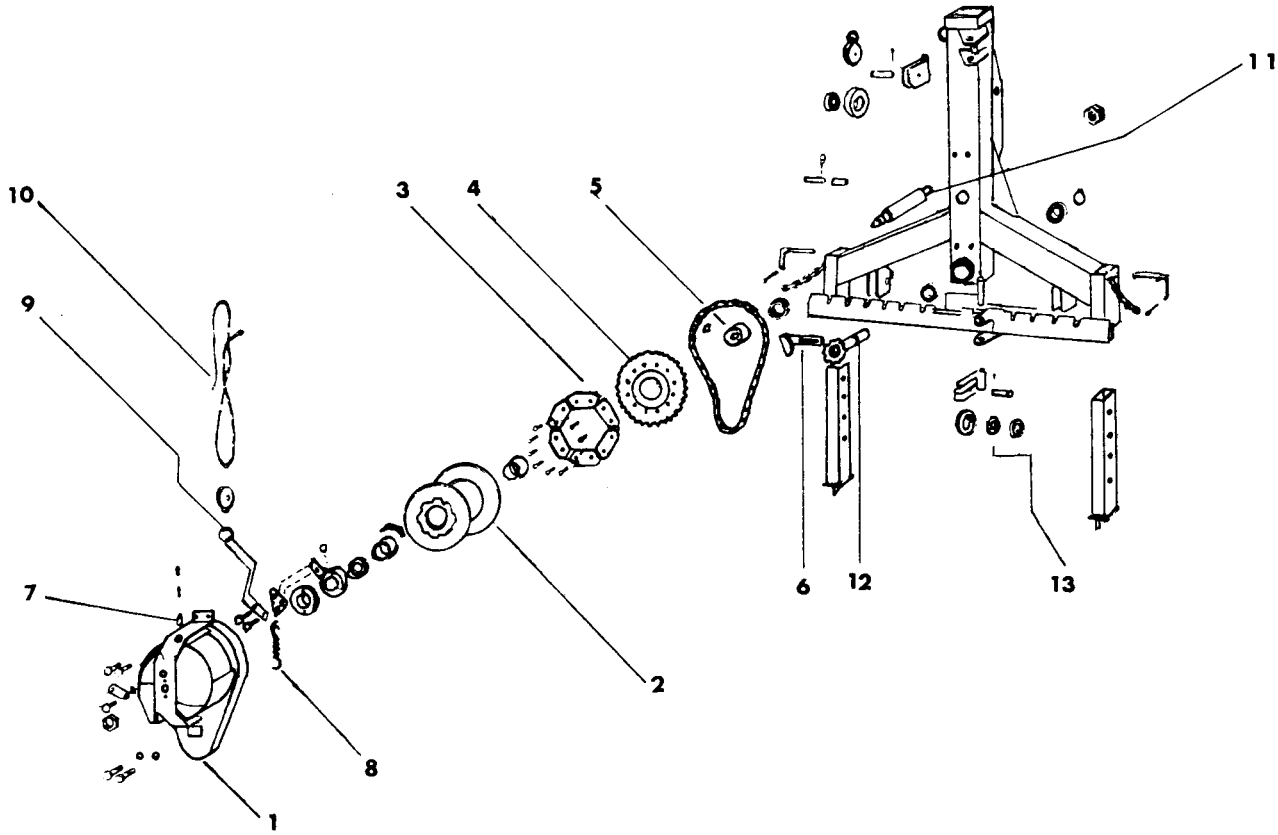

Fig. 9. Exploded Diagram of the Farmi Winch. The main components are: 1 = drum guard, 2 = drum, 3 = friction plate, 4 =big chain wheel, 5 = double rolling chain, 6 = chain tightener, 7 = brake, 8 = clutch spring, 9 = clutch lever, 10 = clutch rope, 11 = drum axle, 12 = small chain wheel, 13 = lower pulley.

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FERIC EVALUATION STUDIES

This is a list of FERIC Evaluation Studies published since April 1975. These publications are available, free of charge, to members and their employees and at the indicated prices to others.

A complete list of all FERIC publications is available upon request.

Technical Report No.	
TR-1	FMC 200 BG Grapple Skidder. R. Legault, L. H. Powell. Dec. 1975. pp. 27. $2.00.
TR-2	The Logging Development Corporation Processing Head, Model 421. M. P. Folkema, R. Legault. Jan. 1976. pp. 17. $2.00.
TR-3	Lajoie "Fibre'Flow" Harvester Head. E. Heidersdorf. Apr. 1976. pp. 16. $2.00.
TR-5	Timmins "Fel-Del" Harvester Head. M. P. Folkema, W. P. Novak. June 1976. pp. 33. $2.00.
TR-7	Koehring Feller-Forwarder, Model KFF. R. Legault. Sept. 1976. pp. 24. $2.00.
TR-8	Cable Logging Systems in Interior B.C. and Alberta. P. L. Cottell, B. A. McMorland, G. V. Wellburn. Sept. 1976. pp. 52. $6.00.