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Full Length Research Paper

Effects of utilized trees' diameter on the residual stand in the Savadkooh forest in Northern Iran

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Cutting of trees, like other stages of utilization, causes many damages to the residual stand. Recognition of the type and severity of damages and the factors causing such damages may be important. This research was performed to study the effect of fallen trees' diameter on the residual stand in the forest of Mazandaran province in northern Iran. At first, 50 trees (20%) out of 250 signed trees were selected at random, as per the diameter classes, and then considering the sample, a number of 50 trees were considered in a semi-circle with an area of 1500 square meters. Quantity (diameter breast height (D.B.H.) and height) and quality (up-rooted, crown break, injury to the bark and peeling of the bark) specifications were recorded before and after cutting. Results of the study indicate that thorax diameter of fallen trees, except for the up-rooted trees, may have a significant impact on the range of crown and trunk break, injury of the trunk and peeling of the trees. The most damaged stand happened when a diameter of 80 cm and more was used in cutting trees.

Key words: Damage, utilization, residual stand, diameter classes, D.B.H.

INTRODUCTION

Location of valuable and industrial forests in mountainous areas, uneven age and oldness from one side and limitation of sylvan sources on the other side requires that utilization be performed while observing the scientific principles and regulations in order to decrease the range of damages to the timbers. Despite all the efforts and facilities, the authors observe great damages during utilization of timbers. The range of damages in cutting operations is of great importance. Determination of factors causing damages to the standing crop and trees at the time of cutting is also of great importance. One of the factors influencing the range of damages in cutting operations on the standing trees is the fallen trees' diameter. Since the trees' diameter has a direct relation with the height and volume of the trees' crown, it may directly impact a wide area at the time of falling and then, it may damage the remaining standing trees. Considering the above, the main objective of this research is to study the impact of fallen trees' diameter on the range and type of damages, such as crown and trunk break, up-rooting of trees and damages to the trunk of standing trees, after cutting operation (Jennifer et al., 1996; Scott et al., 2002). The general purpose of clarifying the damaged result of cut field slope would be as follows:

1. The effect of diameter on the path of cutting trees. The rate of injuries on slope and mass (piles) congestion such as sharp break, crown break, de-rooting and damage to the bodies (like sharp slash).

2. Distinguish the effect of cutting trees' diameter on the number and kind of damaged trees in variety diameters classes.

The surveys theory

- The diameter of cutting trees' effect on residual stand is used in considering the kind and number of damage done on the stand. Thick diameter in cutting operation will cause more damage on the residual stand.
- Cutting trees consist of the entire operations which are done to cut down the starting trees and make them ready for exportation.
- Operations that include falling down the standing trees, measuring the span of the body to distinguish span of delimbing, log length and changing bodies (and in case of

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peeling this part) will be dependent on each other like a chain and every stage will be effective on the improvement of other stages, the time of acting, the charge and finally, the income.

Symbolization of trees according to the separation, species diameter and quality could be effective on cutting trees. Cutting and changing of trees are a stage of utilization that will play the most incoming role, because correct cutting will result to less damage, while suitable changing will cause a variety level of division. Finally, a move value will be made and vice versa. In respect of the standing trees' damages caused by cutting operation and considering the importance and sensitivity of the issue, a number of researches has been performed, some of which are presented.

Hosseini (1994), while studying the damages caused by utilization from the forest in northern Iran (Darabkola - Sari), concluded that damages to the stigma groups were greater than damages to other reproduction (seedling and shell) groups. Also, deep injuries to the trunk of the remaining trees were in the first two meters of the trunk (Hoseini, 1994, 1996). Tashakori (1997), while studying the damages to the standing crop in northern Iran (Golandrood) caused by utilization, concluded that the greatest damages happened in the growth stage of stigma in hornbeam, beech and linden species and also in standing crop with a diameter of more than 7 centimeters, when the volume of horn beam and beech species presence was considered. Naghdi (2004), in studying and comparing the utilization of all the trunk and log, evaluated the cutting ditches and concluded that 19.04% of existing trees in the sample plots has been damaged due to fallings. The greatest damage is related to trees with diameters of less than 35 cm. While stigma reproduction sustained the most damages (18.5%), seedlings sustained the least (10.6%) (Sari department general of natural resource, 2005). Studies and researches of Scott et al., in forests of Bolivia, on the damages of residual stand caused by the utilization, indicated that the damages on standing crop of timbers were due to cuttings during the utilization period, which includes 2% of total fallen trees and 26% of the total remaining trees. The study also revealed that utilization operations caused great damages to the vegetation, soil texture and decrease of potential reproduction in the area. This research indicated that the damages were mostly due to uprooting, root damages, injury to the trunk and cambium layer (Tashakori, 1996). Cedergren et al., 2002 performed a study titled "possibility and profitability of selecting the proper direction of falling trees in tropical rainy forests ". The study indicated that control range of damages, caused by utilization, is a main factor in producing intact and proper timber and the suggested methods such as limbing prior to cutting and selecting the proper method and direction for falling. The trees intend to control the range of damages. The study selected 141 trees with diameter of 62 to 165 cm for studying the impact of the falling direction. The trees were felled by an experienced person. To determine the impact of limbing on the damages, limbing was carried out one year before cutting the trees. The study indicated that selection of method for cutting and limbing may prevent the damages done to the residual stand and this decreases the range of damages (Cedergren et al., 2002). Forshed et al., 2006 performed a research titled "Effect of supervised utilization and limbing before cutting compared to traditional utilization" in Malaysia Forests and achieved good results. In their research, two different methods, that is, traditional method and supervised utilization, along with limbing, determination of cutting direction and routes for transportation of timbers were compared with one another. The results indicated that cutting direction, falling of trees and timber transportation route in aligned shape and in definite intervals may be effective in the decrease of damages done to the standing crop compared to the traditional method. Using this method, they succeeded in keeping the middle canopy free from damages or less damage, which may be desirable for the reproduction and productivity of the forest in the future (Forshed et al., 2006).

MATERIALS AND METHODS

Studied area

Vellila district, the third district of watershed district (63B) located in the north of Zirab town, Savadkooh, relates to the district that is under the activity of Traverse saturation factories of Shirgah in the control area's department, Mazandaran general province in northern Iran (Sarikhani, 1991). Forests of this district are located in an east longitude of 53˚1′ 45″ to 53˚ 5′ 2″ and northern altitude of 36˚14′ 20″ to 36˚17′ 15″. Parcel no.5 with the least and most altitude between 840 and 1080, respectively, has an area of 66 ha. A gradient of 0 - 30% was selected for the study (Sarikhani, 1991).

In the area, there is no metrology station, but the nearest station to this district is the pluviometer station of Pole - sefid (with an average rain fall of 635.5 ml) and climatology station of Shirgah (with an average rain fall of 1043.6 ml). The isohyets lines plan prepared by the specialists of climatology organization indicates that this district is adjacent to 900 ml isohyets area and 14 degree isotherms area. All months of the year in this region is humid and there is no dry season. Climatology and metrology studies indicate that Vellila district is usually found in high humid (as per Do marten climatograph) and humid (as per Amborge climatograph) areas (Sarikhani, 1991).

Utilization background

Forests of this district, which in the past included a part of forestry plan of seedling forest, have been under utilization since 1963 with the possibility of an annual output of 6623 cubic meter by the state executive. This district was submitted to the Islamic Republic of Iran Railways in 1986 for providing a part of the needed sleeper and timbers. The Railways Company exploited 28159 cubic meters of timber within 1986 to 1990 in parcels 4, 5, 6, 7, 12, 14, 15, 22, 24 and 25. For the second time in 1996, 2045 cubic meters was exploited from plot 4, 5 and 12. Subsequently, marked parcels 4, 5 and 14 were benched (Sarikhani, 1991).

Table 1. Frequency of different species in sample area.

Species	Beech	Hornbeam	Alder	Maple	False lote	Mountain elm	Total
Frequency	604	628	105	246	90	30	1702
Percent	35.5	36.8	6.2	14.5	5.3	1.8	100

Table 2. Frequency of different species in different diameters.

Species / Diameter class	Beech	Hornbeam	Alder	Maple	False lote	Mountain elm	Total
20-35	393	569	39	135	77	29	1242
40-55	90	46	31	92	13	1	283
60-75	79	7	23	15	-	-	124
>80	62	5	2	4	-	-	53
Total	604	627	105	246	90	30	1702

Research method

Data were collected according to primary and library studies, forestry plan booklet of Vellila district and bench marking minutes of the meeting (cutting license) held in the year 2007. Also, data were collected from field studies including measurements prior to and after cutting operations in the forest (Sarikhani, 1991). Considering the symbolization, the whole damaged surface is 375000 ha and the statistical tests surface is 1500 m^2.

According to general tendency, the shape of the typical sample has been chosen to be a semi circle, whose radial would be ± 5 m more than the highest tree in files of wood due to expenses reduction. Measurement of standing mass (pries) before cutting, after the typical sample became distinguished (parts) in all trees' situation according to the qualities and quantities have been measured to be more than 7.5 cm with its own information registered in its own plot. The species have been registered and divided into two groups of intact and damaged (defective) pillar. Apparently, damaged pillars have been divided into sharp spectral damaged pillars and broken crown, whereas whole dry, half (mid) dry and damaged pillars are result of previous exploitation operation.

The measurement of standing piles after cutting tree

Damage on the body, in the shape of wound slash, have been measured based on the number of slash to be seen in 3 classes: (1) one wound, (2) 2 - 3 wounds and (3) more than 3 wounds.
- The intensity of depth wounds have been measured based on: (1) damage to the skin and (2) damage applied to the cambium. The tools below have been used in the survey for taking sample and identifying the desirable factors:

1. Forms sample plots.
2. Clinometers
3. Tape measurement and strap
4. Caliper
5. Chain saw (Engines)

Typical and strap were used in measuring the surface sample, while metal caliper was used for measuring the D.B.H of typical trees and standing piles of D.B.H that are more than 7.5 cm. Obni level was used for cutting the typical trees used from a 3 member group including one professional person working with the engines saw and two co – workers maintaining the engines saw, fuel and safety tools.

Damage on the body, in the shape of wound slash, have been measured based on the number of slash to be seen in 3 classes: (1) one wound, (2) 2 - 3 wounds and (3) more than 3 wounds.

- The intensity of depth wounds have been measured based on: (1) damage to the skin and (2) damage applied to the cambium. In this research, 20% of all bench marked stocks (250 trees) were randomly selected for measurements and considering the highest tree, 29.1m and 30.91 m circle, with an area of 1500 square meters, were designated around the tree. Based on the sample trees, the related area was designated and the following data were collected prior to and after cutting (Sarikhani, 1991).
- First stage: species, diameter (as per diameter class), density of the trees and registration of quality specifications of the sample trees to be mentioned in the minutes of the cutting meeting.
- Second stage: The statistical tested samples have been done and registered in typical forms in two stages, that is, before and after cutting operation in char autistics of the quality and quantity of cute species and the characteristics of the qualities and quantities of all available species in the typical sample and the way of cutting. After classifying all the data's quantity and quality by p-valve, an investigation was done on all of them, after discovering that the differences became meaningful, in considering the first and second data (expected and predicted) before and after cutting the trees with the test of k-square.

RESULTS

Study of the residual stand's status prior to falling sample trees

Quantity status

After determination of the sample area, all trees with a diameter of above 17.5 cm were surveyed (as per Table 1). Hornbeam and beech species were the most frequent (72%) and scotch mountain elm was the least frequent species (1.8%).

Frequency of different species in different diameters (Table 2) indicates that diameter class of 20 - 35 cm has

Table 3. Species quantity and quality status prior utilization of different diameters.

Status / Species	Health	Defective			Total
		arid and semi- arid	natural defects in crown	previous utilization	
Beech	537	14	33	30	604
Hornbeam	511	52	39	25	627
Alder	93	4	7	1	105
Maple	193	10	36	7	246
False lote	72	6	11	1	90
Mountain elm	22	6	2	-	30
Frequency	1428	92	118	64	1702
Percent	83.9	5.4	6.9	3.8	100

Table 4. Definite diameter class and frequency in selected trees.

Status / Different diameters	Beech	Hornbeam	Alder	Maple	False lote	Mountain elm	Total	Percent
20-35	3	4	3	2	3	1	16	32
40-55	5	1	3	1	1	-	11	22
60-75	7	1	4	1	-	-	13	26
>80	8	1	1	-	-	-	10	20
Total	23	7	11	4	4	1	50	100
Percent	46	14	22	8	8	2	100	

Table 5. Categorization of damages and frequency trees.

Diverse	Uproot	Break of trunk	Break of crown	Gash in trunk	Total
Frequency	9	39	51	58	157
Percent	5.7	24.8	32.5	37	100

the highest frequency and that of over 80 cm has the lowest frequency. Since the forest has all types of diameter classes, it is considered to be an uneven age forest.

Quality status

The bases were categorized according to the health of intact and defective species. Defective species (as arid and semi- arid), species with natural defects in crown and trunk and species damaged during previous utilization were analyzed.

Table 3 indicates that 83.9% of bases were intact and 12.3 and 3.8% of trees have been damaged by natural factors and previous utilizations, respectively. For the fact that previous utilization has been performed based on corrective and healthy basis, then all bent, cheats, broken and arid trees have already been felled and the forest has an acceptable and justifiable appearance regarding quality and health of the trunk.

Selected trees

Selected marked trees including beech, hornbeam, alder, maple, false lote and mountain elm species were categorized in Table 4, after measuring the diameter of species in definite diameter class.

Study of residual stand's status after falling sample trees

All trees were inspected after cutting the sample trees and damages on the bases due to falling were studied and recorded based on the type of damages. As a whole, in 1702 trees studied, from the first 50 sample plot, 157 trees (9.2% of all trees) were damaged after cutting operation.

Since damaged bases of residual stand were studied, categorization of damages and frequency of each damage is shown in Table 5.

Table 6. Frequency of various damages in diameter class.

Damages / Diameter class	Uproot	Break of trunk	Break of crown	Gash in trunk	Total
20 - 35	0	2	1	5	8
40 - 55	1	4	14	13	32
60 - 75	2	14	10	13	39
>80	6	19	26	27	78
Total	9	39	51	58	157

Table 7. The result of χ^2 test.

Pear son chi-square	Value	Df	Asymp.sig (2-sided)
Uproot	17.381	6	0.008
Break of trunk	43.024	9	0.000
Break of crown	9.804	9	0.036
Gash in trunk	32.166	9	0.000

Effects of utilized trees' diameter on the damages of residual stand

Cutting of trees with different diameters has various effects on the damages to the residual stand. This influences fallen trees' diameter on damages to the residual stand. Table 6 shows the range of such damages in different diameter classes.

Uprooting of trees

Cutting of trees with different diameters has various effects on the range of damages to the residual stand while uprooting the bases. Table 6 shows the range of such damages in different diameter classes. The least damages relate to 20 - 35 cm diameter class and the most damages relate to over 80 cm class. The result of χ^2 test indicates that increase of the trees' diameter has no significant impact on the range of the damages while uprooting (P-value 0.008, Table 7).

Break of trunk

According to the data given in Table 6, it is evident that the trees' diameter has significant impact on the trunks; so that in 20 - 55 cm category, cutting 54% of sample trees caused 15% damage and in over 60 cm category, cutting 46% of sample trees caused 85% damage to the residual stand as break of trunk (Tables 4 and 6). The result of χ^2 test indicates that increase of fallen trees' diameter has a significant impact on the increase of damages to the residual stand as break of trunk and the highest impact relates to over 80 centimeter category (p - value/ 000 , Table 7).

Damage of the trees' crown

According to Tables 4 and 6, cutting 54% of trees in 20 - 35 and 40 - 55 centimeter category caused 29.3% of damage and cutting 46% of trees over 60 cm category caused 70.7% damage to the residual stand. According to χ^2 test, it was indicated that the diameter of fallen trees has a significant impact on the damages done to the crown of trees (p-value 0.036, Table 7).

Damages to the trunk as injury and scratch

According to Table 6, the highest damage, due to cutting, is related to the trees of over 80 cm category and the least damage is related to 20 - 35 cm category. Data of Tables 4 and 6 indicates that in 20 - 35 cm category, cutting 32% of sample trees causes 8.6% of damages and in over 80 cm category, cutting 20% of sample trees causes 46.5% of damages as injury and scratches on the trunk of the tree. The result of χ^2 test indicates that increase of fallen trees' diameter has a significant impact on the range of damages as injury and scratches on the trunk of the forest's residual stand (P-value 0.000186, Table 7).

DISCUSSION AND CONCLUSION

In this study, 1702 trees were measured in 50 sample plot and it was found that 157 trees (9.2 %) out of the trees in the sample plots were damaged. Naghdi, in his research, described the range of damages to the residual stand as 19.04%, which is almost two times the range found in this study. It should be mentioned that in this research, the least damages as uprooting was found to be related to trees with diameter of over 80 cm and the highest damages as injury of the trunk relates to trees that have a diameter of over 80 cm. Considering that the diameter of trees was studied as an influencing factor, it is important to note that after analysis of data, the following results were found:

- Although, the diameter of fallen trees caused uprooting of trees with over 80 cm, the results indicate that this factor may not be an influencing factor in uprooting the residual stand in Momard region.
- Considering the results of statistical analysis, it can be concluded that the diameter of fallen trees may cause an increase of crown break, break of trunk and damages to the trunk as injury and scratch in sample plots.
- As indicated in the results, damages to the residual stand, due to cutting of trees with diameter of over 60 cm in sample plot, constitutes more than 85% of the trunk's break. Also, cutting of trees with diameter of over 60 cm in sample plots constitutes 70.7% of the damages to the crown of the standing crop and cutting of trees with diameter of over 80 cm in sample plots, constitutes 46.5% of damages as injury and scratch of the trunk.

Then, it may be concluded that with an increase in the fallen trees' diameter, the range of damages to the residual stand increases. Moreover, since thicker trees with dense crown and greater height filled larger spaces at the time of falling, greater damages may result from it (Scott et al., 2002). The study of damages, due to cutting of trees, on the residual stand of Bolivian forests reached similar results as uprooting, injury and damages to the trunk, bark and cambium layer. The damages on residual stand, as a result of cutting, have been studied on derooting, sharp bereaving, crown breaking, depth and shallow scratches on bodies. Also, Scott and his colleague study on damages of cutting trees to the stand of reaming trees in Bolivia Forests result as derooting and body and skins damage. In this survey, 7.1% residual stands in different shapes have been damaged, which in cash survey, damage to the stands in cutting hole (19.04%) has been announced. Damages as derooting are 7.5%, while body and crown damages are 31 and 41.8%, respectively.

The techniques of cutting and choosing the correct path will affect the rate of damage, that is, 59, 58.8 and 58.6% from sharp breaking, crown breaking and slashing of trees, respectively, would be the result of an uncorrected cutting of all trees (28%) that were felled. Olleforshed and his colleague's survey in Malaysian Forest got the result that delimbing and selecting correct ways and direction of cutting, in reducing destruction, would be influential. Also, Cederjen and his colleague in their study in tropical forest have gotten the same result. The slope of forests equality and cutting of trees (88%) in a slope limitation of 0 - 30% made the damages to the residual stand not to be effective. In this survey, congestion of stands did not affect the rate of destruction. Increasing the number of damaged pillar in the class of 26 - 40 cm will explain that in this classification, most of the cutting trees' damages have already been done.

Beech species with 11.1% and mountain elm species with 3.1% have got the most and the least damage in relation of presentation. The most damage to the trees happened in a diameter classification of 10 to 35 cm. Naghdi, also in his survey, announced that the most damage has been done towards the classification of less than/ 35 cm diameter. In this survey, 52 ml trees in the volume of 22.171 m^3 (being the result of 50 ml trees in the volume of 172. 532 m^3) applied the sever damage (derooting, sharp breaking and whole crown breaking) that makes them exit the production cycle. It means that for every cute tree, one tree from the forest's standing piles could be very dangerous. The most rate of damages to the remaining standing piles happened when cutting operation in the class of 80 – 115 cm, congestion class of 26 - 40, slope class of 30 - 50% and selecting the uncorrected path were performed.

SUGGESTIONS

- The necessity of continuum training of cutting group and delimbers.
- Symbolizing the trees for the purpose of sylviculture close to nature.
- Delimbing is for cutting trees which have congested limb branches.

REFERENCES

Cedergren J, Falck J, Garcia A, Goh F, Hagnet M (2002). Feasibility and usefulness of directional in a tropical rain forest. J. Trop. For. Sci., 14(1): 179-190.

Forshed O, Udarbe T, Karisson A, Falck J (2006). Initial Impact of supervised Logging and pre-Logging Timber cutting Compared with conventional Logging in adipterocrap rainforest in Sabah Malaysis. For. Ecol. Manage., 221(1-3): 233-240.

Hoseini M (1994). The study of shock in forest because of utilization. M.Sc thesis in Tarbiat Modares University.

Hoseini M (1996). The important points in utilization. For. Pasture Magazine. Volume 30, 32.

Jennifer J, Paulo B, Christopher U (1996). Logging damage during planned and unplanned Logging operation in the eastern Amazon. For. Ecol. Manage., 89(1-3): 59-77.

Naghdi (1994). The study of log and whole trunk method. Ph.D. thesis in Tarbiat Modares University. Sari department general of natural resource. 2005. Management Forest Plan of the water shad 63B

Sarikhani N (1991). Forest utilization. Tehran University. p. 580.

Scott M, Jackson T, Fredericksen J, Malcom J (2002). Area Disturbed and residual stand damage Following Logging in Bolivian tropical Forest. For. Ecol. Manage., 163(1-3): 209-215

Tashakori M (1996). The study of shock in forest because of utilization. M.Sc thesis in Tarbiat Modares University.