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Original Article

Allowable cut calculation with regarding to Preservation of forest sustainability to ten years periodic inventory(Case study: Kheirood forest - Patom district, Noshahr, Iran)

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ABSTRACT

In order to forest sustainability conservation for wood production function, allowable cut determination is very important. Present study was performed in patom district in kheirood forest (the first district of forest of didactic of Tehran Natural Resource University). Necessary data were collected from temporary sample plot in duration two total inventory (1373, 1383). In order to allowable cut calculation with regarding to Preservation of forest sustainability has studied diameter distribution structure. These cases have studied 1- stoking rate and growth rate calculation in compartments and so determination allowable cut. Results were showed Average of compartments prediction rate growth was 2.53 percent and was higher than amount of compartments cutting and result is this forest was existed cut leakage. In order to results of this study store rate must been 0.45 percent of volume store in average (long duration goals). This amount is less than done cutting in this forest. In this method, allowable cut were purposed with 350 silve and 50 years in period and allowable cut was calculated less than growth rate and so this destroyed forest can be retried ideal store in effecting lesser cutting.

KEYWORDS: Allowable Cut, Sustainability, Uneven Aged Forest, Growth Rate, Stoking Rate.

INTRODUCTION

Forest is an important natural ecosystem. Since the creation of human on the earth, forests were the source of needs secure and wood harvesting of it had existed in early appearance of human. In the past, forest was available for human non limited. Gradually with increasing of human population and increasing of human needs and using of forest wood, human considered if he wants for having forest source, he should have programs for harvest of it. For maintaining of forest for wood production, determination of allowable cut is very important. In calculation of allowable cut, awareness about quantity and quality characteristic is very necessary in forest stand. Investigation of natural structure and suitable situation of forest stand with regarding to increment rate have major role in determination of allowable cut and forest sustainability.

Definitions of allowable cut: Clutter and et al., (2008) expressed that in determination of allowable cut in forest should be measured by volume stock of it and so based on amount of increment was calculated and so forest was sustainable. Banan (1961) this definition expressed for allowable cut: allowable cut is amount of wood that we can cut it annually in forest without decreasing of forest capital. Namiranian (1997): if the situation of forest is ideal and normal, timber harvesting or cutting is equal to amount of production. Ghazanfari (2004) said forestry method was the way of forest regulation. He said in his study, stock rate compared standing stock to ideal stock is the important component in forestry and forest regulation. definition of (Mohadjer, 2006); allowable cut of authorized wood harvesting in forest that is determined with regarding amount of increment in habitants and intended purpose in forestry plan.

Amount of allowable cut was calculated annual. In order to this, studies were done in Iran and world that include; Asli and Eter (1966) in a study determined species increment and tariff table (volume table) in Patom district. Darvishsefat (1984) investigated quantitative and qualitative changes resulting from one period of forestry plan in patom district. For data collection was used of square sample plot with 0/5 hectare area in district. Harvesting of patom district in ten years was 304 Sylva more than from determined and calculated amount in forestry plan. Mirbadin (1990) investigated quantitative and qualitative impacts of amount of harvest in oriental beech forest in Iran. In this study was showed amount of harvest had impact on regeneration; expand of herb, increasing of grazing damage and increasing of cut damage. Etemad (1995) investigated qualitative and

quantitative changes resulting from one period in forestry plan on stand stock in Namkhane district that located Kheirood forest. Results was showed average of volume was increased 10 Sylva per hectare and number of trees were decreased 147 per hectare. Meyer (1952) with using of equilibrium structure in uneven aged forest calculated gross yield (without regard of mortality) and so calculated normal volume of forest. Marusak and Zhilwak (2002) investigated allowable cut indicators in unregulated and uneven aged forest management. Results was showed indicator $\frac{1}{30}$ (cutting of $\frac{1}{30}$annual increment): from 3 last age class of volume structure is the best harvest of this forest and so was maintained sustainable structure and sustainable cutting. Calvonic and et al,(2000) investigated irregular and uneven aged forest structure and provided model for develop of it. Results were showed if harvest was done in 10 years cutting cycle with 25٪ intensity, forest structure will be sustainable and orderly.

Research importance and purpose: present study was done in north forest of Iran. This forest was impressed by human and trap destruction from many years ago (Faghani, 2001). General structure of these forests is uneven aged and unregulated (Aali, 1970). In Iran, allowable cut was determined in forestry plan for ten years and was not applied studies in order to creation and equilibrium and ideal forest (Eslami, 2004). North forest of Iran is very important forest for wood production in Iran. And is the only forest for wood in this region. For these reasons, this study was done.

MATERIAL AND METHOD

MATERIAL

Study Area: this study was performed in Patom district that is located in north forest of iran in Nooshahr region. Area of Patom district is 899.8 hectare. This district has 18 compartments that 103 to 107 compartments were protective and without harvesting and 101, 102, 108 to 118 were harvestable. Silviculture and forestry method was single tree selection (Patom district, forestry plan, 1994).

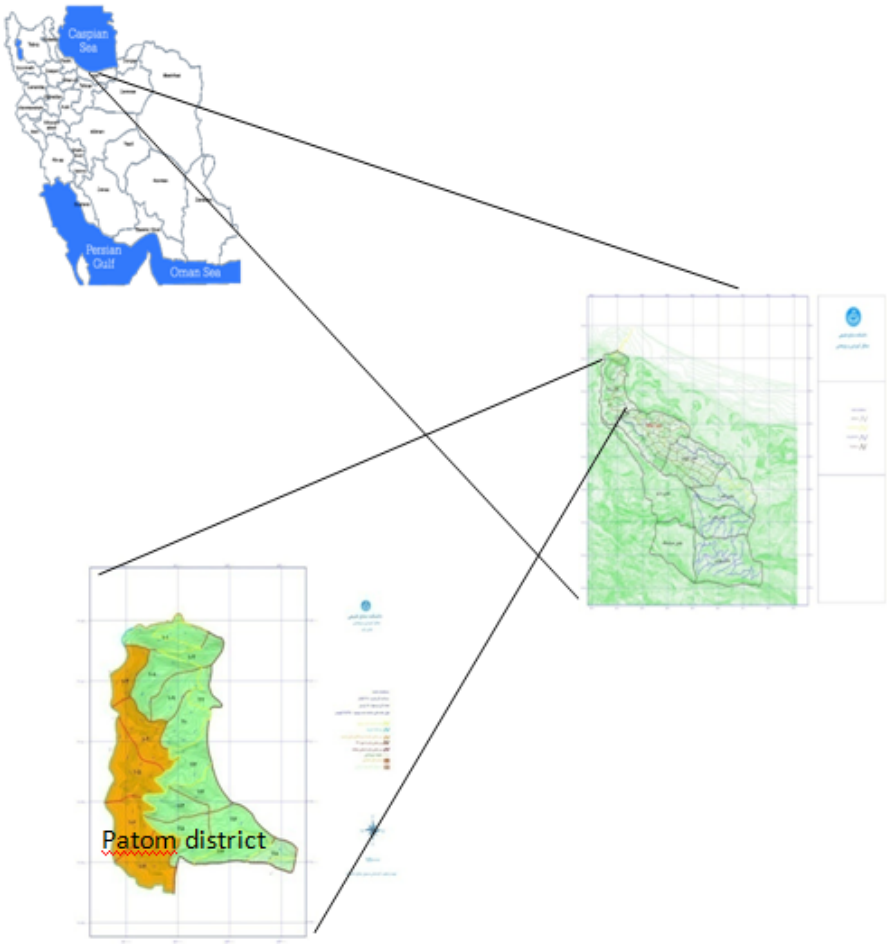

Fig. 1. patom district, Kheirood forest, Iran

MATERIALS AND METHODS

Data collection: data collection was done with using of sample plot in two periods inventory. Are of sample plots were 1000m^2 . Method of sampling was systematic random sampling. Sample plot was determined again at first on topographiy map and

so were determined on the forest surface and so were measured all of trees more than 7 /5 cm diameter in breath (table 1). For the study amount of harvest in this period in district surface and its compartments, cutting data (cutting data related to the cutting and extraction at the department of forestry in Kheirood forest) was collected.

Table1. area of harvestable compartments and number of sample plots in them

compartments	109	110	111	112	113	114	115	116	117	118
Area of compartments (hectare)	45.2	50.7	33.1	55.1	44.3	37.2	43.5	44.1	38.3	43.5
Number of sample plot (1994 year inventory)	45	53	27	60	47	35	49	45	39	45
Number of sample plot (2004 year inventory)	47	52	35	54	49	39	45	43	35	41

Study method: in order to structure and done harvest investigation in forest, data collected was analyzed.

Stoke rate calculation: for determination ideal allowable cut in forest, determination of stock rate is inevitable (relation 1). As forest haven't ideal situation , with using of stoke rate was recognized in the what situation , shouldn't be done any harvesting.

Relation 1

$$\frac{stand\ stock}{Ideal\ stock} = stocking\ rate$$

Mohadjer (2006), single tree selection forest divide in order to stand stoke in 3 classes. 1- High volume forest (400 to 500 cubic meters per hectare), 2- average volume forest (300 to 400 cubic meters per hectare), 3- low volume forest(less than 300 cubic meters per hectare). For north forest of iran this amounts are at least 250, ideal 350 and high450 cubic meter in hectares (Mohadjer, 2006). With regarding to this that Patom district was degraded forest , ideal stand volume was 350 cubic meters in hectare for long term goals (50 years). So relation 1 was used for determination of stocking rate in compartment with regarding to long term goals (Mohadjer, 2006). Calculation of volume increment in : knowing of amount forest increment is very necessary for determination of allowable cut. Calculation of amount of volume increment in forest was done in various method. In this study was used of Meyer method (Asli and Eter , 1966).

RESULTS

In order to collected data was investigated diameter distribution of harvested trees.

Table 2. investigation harvested trees in compartments in ten years .

Compartments	Number of marked trees in hectare and in year(Silva)	Volume of marked trees in hectare and in year (Silva)	Rate of annual percent of harvest in hectare to volume in hectare in compartments 1n 1995 year
109	1/16	2/99	0/83٪
110	0/21	0/29	0/1٪
111	2/15	3/26	0/94٪
112	0/58	2/02	0/6٪
113	0/93	1/97	0/88٪
114	1/7	5/84	1/51٪
115	0/7	0/37	0/15٪
116	0/88	0/66	0/23٪
117	3/27	9/3	2/37٪
118	0/58	1/65	0/44٪

Calculation of stocking rate and volume increment in Meyer method in compartments: in this stage, with using of stocking rate calculation was determined amount of harvest. Result was showed in Table 3.

Table 3. result of increment calculation with using of Meyer method and stocking rate with regarding to short term goals and calculation of allowable cut based on it.

Compartments	Standing stock (1994)	Ideal stocking in order to long term goals	Stocking rate	Annual volume increment in hectare	Difference among present stand stocking and ideal stocking	Predicted allowable cut in silva in year in hectare
109	361/1	350	1/03	8/5	present stand stocking more than ideal stocking to amount 11.1 Sylva	1/93
110	285/71	350	0/82	7/66	present stand stocking less than ideal stocking to amount 64.29 Sylva	0/25
111	345/5	350	0/99	11/05	present stand stocking less than ideal stocking to amount 4.5 Sylva	2/12
112	225/01	350	0/96	7/56	present stand stocking less than ideal stocking to amount 14.99 Sylva	1/21
113	225/01	350	0/64	6/406	present stand stocking less than ideal stocking to amount 124.99 Sylva	-1/22
114	258/33	350	1/02	8/749	present stand stocking more than ideal stocking to amount 8.33 Sylva	1/92
115	246/1	350	0/7	4/88	present stand stocking less than ideal stocking to amount 103.9 Sylva	-1/1
116	286/86	350	0/82	7/726	present stand stocking less than ideal stocking to amount 63.4 Sylva	0.28
117	392/18	350	1/12	8/96	present stand stocking more than ideal stocking to amount 42.18 Sylva	2.63
118	373/51	350	1/07	10/74	present stand stocking more than ideal stocking to amount 23.51 Sylva	2.62

Prospected allowable cut in Sylva allowable cut Investigation of tree marking and harvested in compartment was showed they were trees with different diameter and they were in irregular diameter distribution and more than of them were in average diameter classes. Important subject was existence of high diameter trees so cutting should be done more in high diameter class so be helped to regeneration expand. Results of calculation were showed in (table 4).

Table 4. calculation growth rate in compartments and compare of it with harvested growth rate in ten years period.

Compartments	harvested growth rate	Predicted growth rate	Predicted growth rate in compartments and compare of it with harvested growth rate
109	0/83	2/35	harvested growth rate is less than Predicted growth rate
110	0/1	2/68	harvested growth rate is less than Predicted growth rate
111	0/94	3/2	harvested growth rate is less than Predicted growth rate
112	0/6	2/38	harvested growth rate is less than Predicted growth rate
113	0/87	2/6	harvested growth rate is less than Predicted growth rate
114	1/63	2/5	harvested growth rate is less than Predicted growth rate
115	0/15	1/99	harvested growth rate is less than Predicted growth rate
116	0/23	2/56	harvested growth rate is less than Predicted growth rate
117	2/37	2/26	harvested growth rate is less than Predicted growth rate
118	0/44	2/76	harvested growth rate is less than Predicted growth rate

Average of periodic growth rate was 2/53 ٪ in compartments. That was more than growth rate that was achieved in result of done harvests in compartments and so in this forest existed less harvest relation to growth rate and we could perform more harvest. in order to comparing result of allowable cut calculation in method of stocking rate and comparing of it with done cutting in compartments, calculation with description was showed in table 5 that both of them were compared.

Table 5. calculation of percent of harvest in compartments with using of stocking rate method and compared with percent of done harvest in ten years period.

Compartments	Harvested growth rate	Percent of predicted growth rate in method of stocking rate	Comparing between harvested growth rate with predicted growth rate of stocking rate method
109	0/83	0/53	Is more
110	0/1	0/087	Is more
111	0/94	0/61	Is more
112	0/6	0/361	Is more
113	0/87	Without harvesting	Is more
114	1/63	0/53	Is more
115	0/15	Without harvesting	Is more
116	0/23	0/097	Is more
117	2/37	0/67	Is more
118	0/44	0/7	Is less

In order to table 5 was showed that percent of done harvest calculation in all of the compartments were more than percent of predicted allowable cut of them.

DISCUSSION

In order to results of this study percent of harvest stocking rate should be 0/45 percent of volume stocking (long term goals). These amounts were achieved based on average of percent of annual cutting in compartments. With regarding this, in this method cuttings were in order to ideal stocking 350 Sylva and duration of period (50 years), was achieved less allowable cut relative to growth rate to this degradation forest in impact of less harvests, could achieve self ideal stocking. In order to stocking rate method, harvest should be decreased in these compartments, harvests could be increased to 2/5٪ of volume stocking. With regarding to this that the goals of management should be based on maintaining of sustainability and improvement of forest special degraded forest, harvesting should be decreased to forest restored ideal stocking in long term programs. In order to stocking rate methods, harvesting should be decreased in compartments and in order to growth rate method in compartments, harvesting could be increased to 2/5٪ percent of volume stocking. It was be suggested with regarding to management goals should be based on maintaining of sustainability and improvement of forest structure special degraded forest, harvesting should be decreased to forests could be restored self ideal stocking. A result of this study was in order to opinion of (Islami, 2004) that expressed determination of allowable cut in Iran shouldn't performed from specific formula but goals should be bring equilibrium and ideal forest. Asli (1980) said with studying of natural stand, stands with ideal feature were chosen indicator of forest feature. Spoken and Biau (2001) expressed principles for maintaining of forest sustainability and they were monitoring of growth rate after harvest and determination of allowable cut after inventory. Ghazanfari (2004) expressed stocking rate (ratio between stand stock and ideal stock) was one of the most important method in determination of allowable cut, because in this method should be done extensive silviculture studies in order to determination ideal stocking in forest stand and so that was accordance of results of this study that stocking rate was the fittest method in determination of allowable cut. Asli (1990) expressed formulas were used for determination of allowable cut, sometimes had problems as deduction of harvest in the most of compartments so growth rate cant be suitable method for determination of allowable cut. Growth rate in prepared forestry plan in Patom district in pervious periods were showed in beneath:

Prepared forestry plan in 1960 …… 2/8 ٪ of volume stocking

Prepared forestry plan in 1984 …… 1/4 ٪ of volume stocking

Prepared forestry plan in 1995 …… 1/58 ٪ of volume stocking

Of course should be regarded that calculation of growth rate wasn't equal in various years. In order to growth rate calculation in this study, amount of harvest could be increased to 2/5٪ of volume stocking. Obtained growth rate from this study was

more than from growth rates of 1984 , 1995 revised plan while Patom district was destroyed forest and shouldn't be increased percent of cuttings. So we resulted , predicted growth rate in this study and used in pervious plan couldn't be restored ideal forest stocking so it was need in order to achieving ideal forest structure and volume was used of stocking rate method. It was suggested, in forestry plan, percents of harvest were determined for per compartment based on special sampling of compartments separately because compartments are different from quantity and quality characteristics. It was recommended, doing expanding silviculture study in forest so that with regarding to this were determined quantity and quality characteristics and ideal volume of forest. Existence of tramp and so tramp grazing with soil compaction by animal traffic in forests had decreasing of regeneration in this district. It was recommended with integrated and programming management in this region and decreasing of tramp and negative impact of existence of them in forest, was prepared situation for developing of natural and artificial regeneration so that wasn't achieved but resolving of livestock problems and decreasing of dependence of them to forest. One of the most important components for determination of allowable cut is calculation of forest yield in north forest of Iran was used of permanent sample plot or 100٪ inventory. Modeling of increment and forest yield had need to using of permanent sample plot and 100٪ inventory. So with using of this method, we can offer new method for determination of yield and allowable cut in forest and can be used these for similar region.

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