

Qualitative Assessment of land rating and estimation the biomass net production (BN) and yield potential(Y) for alfalfa in Jaydar plain of Poledokhtar-Lorestan (Iran)

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ABSTRACT

Today, the need of optimized usage of agricultural lands is more and more because of the population growth. The study area is about 3864 hectares which is mainly in the West and South West of Poldokhtar city in the Lorestan Province and that was carried out in 33° 6' - 33° 10' north latitude and 47° 37' - 47° 44' east longitude. The study area is considered as an area with desert and hot climate and the winter is midland humid and the summer is long, hot and dry. The average of annual temperature is 22.6°C, the annual evaporation is about 2800 mm and the rainfall is more than 360 mm. The maximum average of the temperature is 27.2°C and the minimum average of it is 16.5 °C. The maximum amount of rainfall and the minimum amount of temperature according to the data gathered in the synoptic meteorological station, is in January and December. The data that is achieved based on general American classification shows that the soil in the studied area belongs to Inceptisols and Entisols groups. One way to increase the production rate and optimized usage of the lands is recognizing the production capacity of the land and choosing the appropriate application of it based of production capacity. In this method, the operation is computed regardless of each kind of limitation such as soil, water and management. One important and applicable method in order to have optimized usage of the soil resources is determining the capacity and potential of the lands. One of these methods is to estimate the potential of the product operation in ideal and optimized conditions. In this method, the operation is computed regardless of each kind of limitations, such as soil, water and management. In this research the net production of biomass (Bn) and operation potential(y) of the alfalfa in Jaydar lands in Poldokhtar in Lorestan by the use of the weather reports of synoptic station of Poldokhtar is estimated. The result shows that the amount of operation for alfalfa regardless of soil, water and management limitations equals 9tons and 203 kilograms in dry matter hectare, and 16 tons and 565 kilograms in humid matter hectare. Considering this matter that the observed operation in this area equals 9 ton in each hectare, we can increase this amount to 16 tons and 565 kilograms by applying proper management and eliminating the reparable limitations. Also, the Qualitative assessment of the land proportion for alfalfa was done in Jaydar based on the parametric method. The results showed that for producing alfalfa in this area proportion class in from S₂ to N₂ and the most limiting factors in these lands are slope, wetting, percentage of calcium carbonate, Salinity and alkalinity subsequently.

Keywords: Qualitative Proportion of Lands, Net production of Biomass, alfalfa, Jaydar Soils

INTRODUCTION

population growth and food security were old goals of human and we have also seen an increase in population and food supply are two major world issue and must be balanced between these two categories to avoid the problem of food security. With the development of various branches of soil science and the creation of innovative software

applications, Guidelines for evaluation in regional scale by spending less time and more accurate planning and efficient use of land are provided which The logical basic planning studies and land evaluation to determine their value will be provided for specific purposes [1]. Farming has been the primitive job of today's civilized human that is changed from traditional farming in to developed and exact farming the population growth and the progress of civilization caused people to habit in one area, and know more productions and farm in one place for many years [2]. In order to stop more destructions of these resources, their capacity and proportions for special efficiencies must be considered by the agricultural practitioners [3]. The soil is one of the most valuable and important natural resources and it is the most basic. Forming factors of civilization so that we can say there is correlation between the human civilization progress with soil and the howness of using it. Land assessment is the process of predicting and determining the land potential according to the land characteristics for special application. In general assessment methods the land is assessed for total usages [3].

Now one of the most basic possible solutions to deal with problems such as overpopulation, Land and water pollution and soil fertility decline, Land capability evaluation and assign them to the best and most profitable, yet stable operating system Which in recent years has been considered as land evaluation [4]. In today's world, as a result of increasing growth of population and the expansions of cities, increasing the cultivating lands is decreased gradually therefore there is a serious need for an optimized usage of the lands. The main purpose of assessment of the lands is to have an optimized and stable usage of the lands by investigating the physical, social and economically aspects [5]. Agriculture, is the most basic occupation of Modern human which cultivation from traditional changed to precision and advanced agriculture Population growth and the development of civilization has led to people living in an area, to know more products which come and grow in one place for consecutive years [2] Land evaluation is Prediction process and determination of land potential for general or specific uses based on their characteristics. The goal of land sustainability evaluation studies is the sustainable and optimized use of land through the physical, social and economic aspects of the lands. Qualitative evaluation is type of classification which the degree of appropriateness is determined in a qualitative way. Classes will be determined based on the land production potential and suitability without calculating the exact proportion of income and costs is investigated [2,6]. Qualitative or physical evaluation make an appropriate decisions to maximize use of resources provides. A significant amount of research with quantitative and qualitative evaluation of land suitability and land capability has been determined which can mention to qualitative land classification for wheat, barley, alfalfa and safflower with parametric method in arzoyee plain in Kerman by Jafarzadeh *et al* [7], Alfalfa is probably the first plant to produce forage which is cultivated in prehistoric. Some consider the origin of alfalfa in the Mesopotamian Since believe that this plant has been released to Saudi Arabia and then to the Mediterranean region. The plant in bad conditions have dormancy and can be resistant in very hot and cold temperatures. In dry areas with mild winters, alfalfa during the winter continues to grow But its growth rate is reduced. During the hot summer months, growth will be limited. So temperature can sepecify lenth of growth cycle, growth rate and finally plant production. Alfalfa needs deep soil and fertile soil with enough calcium. In heavy texture soil and low pH have not enough growth. Young alfalfa plant is sensitive to soil salinity and The establishment of the plant in such a situation is very difficult. Perfect plant has relatively good resistance to salinity and can tolerate 0.03 percent sodium carbonate. Alfalfa is permanent plant with one main and strong root which this root can penetrate to 250-300 centimeter of soil. in irrigated land about 30 percent of it's root in the 15 cm nad 70 percent in the 60 cm of the soil [8]. For the first time in Iran the studies of assessment of land proportion in a qualitative way by the use of land assessment rules of FAO was done by Naeini [9] in Northern lands of Iran for important agricultural products of Gorgan. Baninema and seyed Jalali did the qualitative and quantitative assessment of land proportion in Behbahan areas for important cultivation products. Sustainable land management's a possible solution for the natural resources [10]. Wilson [11] did the land assessment for Musmmenjulaten area in Australia for sugarcane, banana, palm tree, manys, avocado, tea, vegetables pumpkins, pineapple, sorghum, corn, sweet corn, soya, peanut, potato, rye rise and improved pastures. The limitations were: land, the amount of food elements of the soil, soil saltiness, available water, soil wetness. Physical condition of the soil, to pography, flood prevention rocky outcrops and erosion. Kooshafar & mohammadi [12] done the Qualitative land suitability evaluation with FAO method in four hundred-hectare farm breeding research stations and providing seedlings of Karaj for Wheat, barley and maize and showed that seventh runnel soil series have the least suitability for mentioned products. The most limitations factors were soil depth and gravelly soil. Jafarzade *et al* [7] with qualitative and quantitative land suitability in research station in Khaltpooshan in the west of Azerbaijan showed that the most important factors for onion, potato, alfalfa and maize cultivation are climate parameters, lime, pH, Organic Matter, soil texture and surface gravel.

MATERIALS AND METHODS

Study Area

The study area is named Jaydar and is about 3864 hectares. That is mostly located in west and south of Poldokhtar, in Lorestan province. This area is placed between 47 degrees and 37 minutes to 47 degrees and 44 minutes of eastern longitude and 33 degrees and 6 minutes to 33 degrees and 10 minutes northern latitude. The studied area is considered as an area with desert and hot climate and the winter is mild and humid and the summer is hot, long and dry, there the average of annual temperature is 22.6°C, The annual evaporation is about 2800 mm and the rainfall is more than 360 mm. the maximum average of the temperature is 27.2°C and the minimum average of it is 16.5 °C. The most amount of rainfall and the minimum amount of temperature according to the data gathered in the synoptic meteorological station, is in January and December. In this area the soil is classified in to 9 series (soil series number 1,2,3,4,5,6,7,8,9) and A total of 33 areas have been identified.

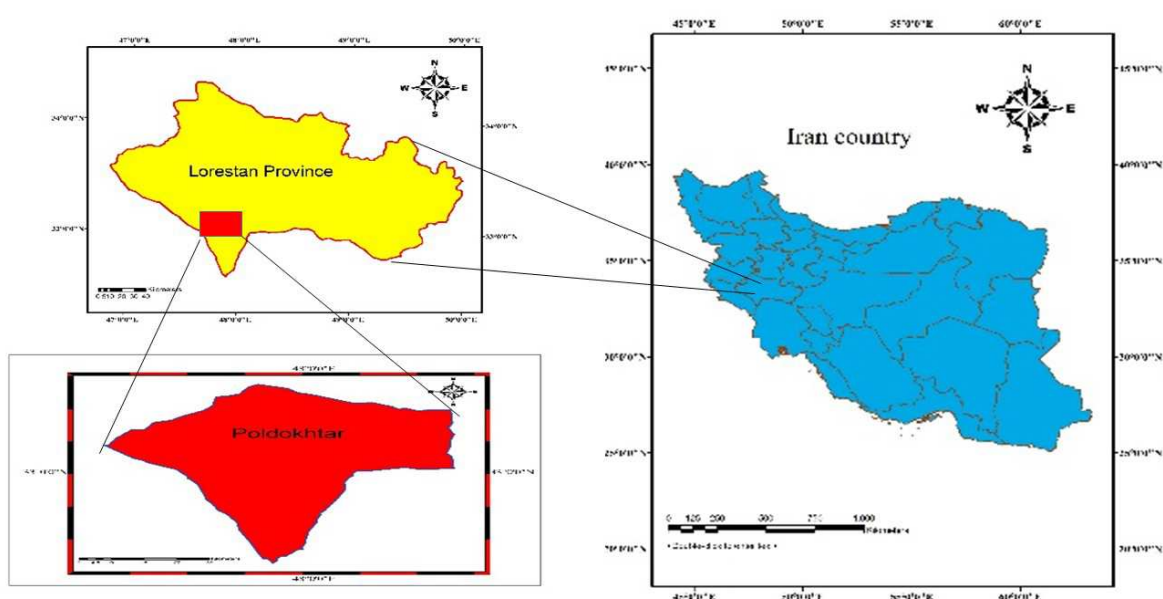


Fig1. Geographical location of Poldokhtar city

Qualitative Assessment of Land Proportion for Special Plants (Classifying the Lands by the Use of FAO Method) [13]

This method has some stages:

A: Gathering and processing the required data about the characteristics of the lands. In this stage, land characteristics are divided in to two groups, climate characteristics and land characteristics and for each group, the required information was gathered.

B. Determining the growth requirements

By the use of soil information that is gained through explaining the soil profiles and the studies that are done and comparing them with soil requirements of the products is presented as a number between 0 to 100.

C: Determining the qualitative classes and subclasses of the land proportion.

The last stage of qualitative assessment of land proportion growth requirements of the plant with climate and land condition and class and subclass determination for this research the parametric method is used(second root).

1) Determining the qualitative classes of land proportion.

Parametric Method

In this method a 0 to 100 gradation based on the characteristics of the land is specified.

For computing the proportion gradation for each land climate characteristic, if the characteristic is sustainable and quantitative, the linear technique was used. And if the characteristic is qualitative, for example the class of soil texture, the average of the two gradations that the texture class in placed between them, was considered as the proportion gradation of that characteristic.

Climatic index was computed by use of the second root and finally was changed in to climatic rating by the help of one of these relations. From the second root relation, Land index was gained.

$$CI, LI = R A/100 \times B/100 \times C/100. .$$

$$CR= 16.67+0.9 \times CI \text{ if } 25 < CI < 92.5$$

$$CR=1.6 \times CI \text{ if } CI < 25$$

In these relations:

It is the land index CR is climatic Rating, R min is the minimum rating gradation among all rating gradation and A,B,C, is the rating gradation.

By computing the land index, proportion class for each land was obtained.

2) Determining the qualitative classes of land rating the kind of limitations that take a land to one class, are the determiners of subclasses of land rating. Subclass is placed after the class symbols and they are showing with small Latin letters that are chosen by contraction.

The Method of Estimating Biomass Net Production Rate (Bn) and Production Potential (Y)

In order to determine the production potential of alfalfa in the mentioned area, the thermal- radiation production potential was used this model estimates the net production of the plant and also the operation of the production for the best variety in desirable. For computing Biomass net production we use function(1)[14]:

$$Bn=(0.36 \times bgm \times KLAI) / ((1/L) + 0.25 \times ct) \tag{1}$$

In relation 1, Bn is the net production rate of Biomass (kg/hectare),ct is the respiratory rate that is gained from relation 2. Bgm is the maximum net production of Biomass (Kilogram CH₂O in hectare in hour),KLAI is the correction factor for LAI < 5m²/m², L is the number of days required for production to be gained.

$$ct=C30(0.044+0.0019t+0.001t^2)\tag{2}$$

C 30 is the respiratory rate that for plants except legume is 5% 108, T is the average temperature by C. Production is computed by relation 3.

$$Y=Bn \times Hi \tag{3}$$

In relation 3, Y is production (kilogram / hectare) and HI is harvest index.

Table 2: The results of qualitative land Evaluation in different land units for Alfalfa

| Amount | Computing the maximum net production of Biomass(bgm) |
|--------|--|
| 39 | Maximum leaf photo synthesis (Kilogram CH ₂ O in hectare /hour): Pm |
| 489.19 | Maximum gross production of Biomass in clear weather (kilogram / hectare during the day): bc |
| 216 | Maximum gross production of Biomass in cloudy Weather(kg/hectare during): bo |
| 0.17 | f : The ratio of days that the weather is not clear(1-n/N) |
| 0.83 | 1-f : The ratio of days that the weather is not clear(n/N) |
| 598 | The maximum net production of Biomass (kg CH ₂ O/hectare/day time) |
| | Computing the net production rate of Biomass(Bn) |
| 0.0108 | Respiratory rate for all accept legume:C30 |
| 0.01 | Respiratory rate: Ct |
| 120 | The until number of day harvest: L |
| 0/95 | correction factor: KLAI |
| 18820 | Bn: Biomass net production rate |
| 0/45 | Harvest index: HI |
| 8469 | Alfalfa production potential (kg/hectare/dry matter) |
| 9654 | Alfalfa Yield (kg/hectare): Y |

Table 2: The results of qualitative land Evaluation in different land units for Alfalfa

| Alfalfa | | product |
|------------|------------|-----------|
| Land Class | Land index | Land unit |
| S3t | 47/9 | 1:1 |
| S3t | 46/6 | 1:2 |
| N2t | 7 | 1:3 |
| S3t | 46/2 | 2:1 |
| N1t | 15/3 | 2:2 |
| N2t | 10/8 | 2:3 |
| S3t | 46/3 | 3:1 |
| N2t | 9/9 | 3:2 |
| N2t | 3/2 | 3:3 |
| S3w | 33 | 4:1 |
| S3w | 33/8 | 4:2 |
| S3w | 35 | 4:3 |
| S3w | 27 | 4:4 |
| N1w | 23/9 | 5:1 |
| N1w | 24/8 | 5:2 |
| N1w | 21/4 | 5:3 |
| N1w | 14/5 | 5:4 |
| S3w | 25/8 | 5:5 |
| S2t | 71/1 | 6:1 |
| S2t | 51 | 6:2 |
| S2t | 51 | 6:3 |
| S2s | 68/5 | 7:1 |
| S2s | 68/3 | 7:2 |
| S2s | 61/4 | 7:3 |
| S2s | 61/4 | 7:4 |
| S2s | 67/9 | 7:5 |
| S2n | 70/2 | 8:1 |
| S3w | 41/3 | 8:2 |
| S3n | 39 | 8:3 |
| S2tw | 53/8 | 9:1 |
| S2w | 58/9 | 9:2 |
| S2n | 50/6 | 9:3 |
| S2w | 48/9 | 9:4 |

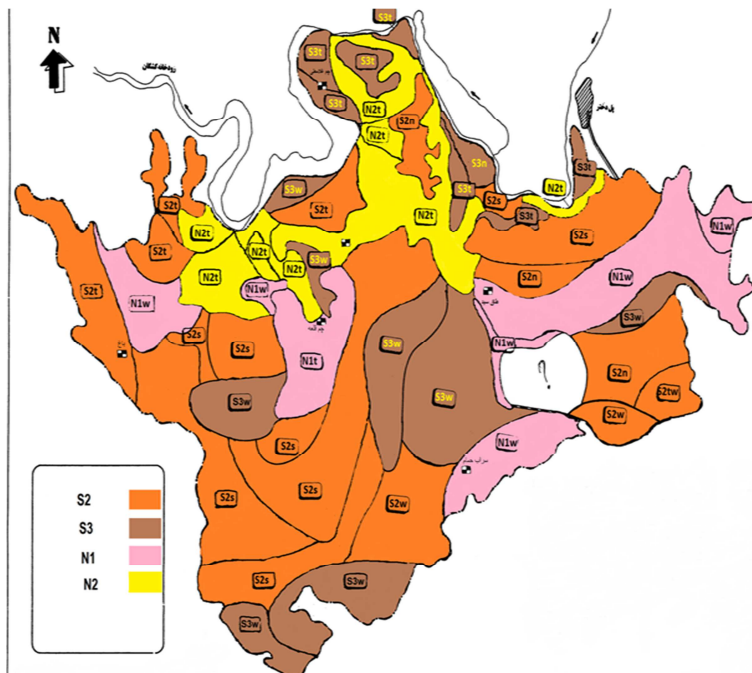


Fig. 2.Land suitability map for alfalfa in Jaydar. Parametric-Square root method

RESULTS AND DISCUSSION

In order to have a qualitative assessment first land assessment was done for alfalfa. The land for alfalfa was 79.93 by parametric method and it show that the land class is S1. Totally, the results of the qualitative assessment show that for alfalfa, the rating class is form S2 to N2 and the most limiting factors in these lands are land slope, wetness, the amount of lime and salinity and alkalinity subsequently. The results of this study show that 46 percent of them show moderate suitability, 23 percent show crisis rating (S3), 15 percent show unsuitable rating (N1), 16 percent show unsuitable rating (N2). Climatic properties and soil properties show that cultivating some agricultural products is possible all the year. In other words, climatic properties create no limitation for producing alfalfa. It is recommended that assessment for land capacity should be done in order to use the resources in the best way, and some vital policies of agricultural section must be taken in order to increase the operation of important products, to stop excess import of products

As table 1 show yield for alfalfa in Jaydar without soil, water and management limitations, equals 16 tons and 565 kg, and considering the observed operation, in this area is 9 ton in hectare, it can be concluded that by having proper managements and the repairable limitation, we can reach this yield.

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