

Status of green water in North Khorasan Province

Kazem Taherian Ghadi, Water authority head of North Khorasan province, Kazemtaherian@yahoo.com
 MirMahdi Soleymani, Tooss Ab Consulting Engineers Company, Mirmahdi_soleymani@yahoo.com
 Soheila Pourresanehmanesh, Tooss Ab Consulting Engineers Company, Sresane@yahoo.com

Introduction

The production of biomass for direct human usage as food and timber is by far the largest freshwater-consuming human activity on Earth. However, water policy and development concentrate on a fraction of the water for food challenge, namely, irrigated agriculture, which uses an estimated 25% of the global water used in agriculture, and on the industrial and domestic water supply, which corresponds to less than 10% of direct human water requirements (considering only water for food, domestic use and industry). The reason that biomass production so strongly outclasses other water-dependent processes is that water is one key element involved in plant growth. Simultaneous with the photosynthesis process, when stomata in the foliage open to take in carbon dioxide, large amounts of water are being consumed as transpiration flow and released as vapor from the plant canopy. Furthermore, this productive flow of vapor is accompanied by nonproductive evaporative losses of water (from soil, ponded water and intercepted water from foliage surfaces). Together, vapor fluxes as evaporation and transpiration, here defined as green water flow, constitute the total consumptive water use in biomass production. That volume of green water useful to product, records as the track of green water. A good sample of this is a part of rainfall useful for dry farming, wild herbs, pastures and explicated forests, also in irrigated agriculture an effective rainfall is green water. This kind of water is being used in the form of evaporation or hidden water (the water stays in the plant). This kind of product cause exploiting of green water; the water that has allocated 70% of country rainfall to itself. Nomadic life was and still is mainly based on the exploitation of green water (Razavi at al., 2014). In this study regarding to the importance of the pastures green water, have been worked on the importance of the rain management in pastures, forests and dry farming lands by using RS and GIS technologies and doing social and economic analysis then the place of green water in production cycle and its economic value from the water resources aspect has been investigated by providing different management scenarios. (Fig. 1)

Geographical characteristics of the study area

North Khorasan is a province located in North – East of Iran with an area of 2.8 million hectares. Bojnourd, its centre, is located in the area of geographic coordinates North latitude 37° 13' 13.7" to 37° 35' and East longitude 57° 2' 30" to 57° 40'. The Province includes eleven plains: Maneh, Qurimeydan, Qolaman, Safi Abad, Shirvan, Shouqan, Samolqan Ashkhaneh, RobatQarebil, Jajarm, Bojnourd and Esfarayen.

According to meteorological studies, it has dry and cold climate in plains and semi – dry and cold in highlands. The average annual rainfall is estimated about 300mm in this Province. (Fig. 2)

Situation of land use in North Khorasan

According to the information contained in the official website of the Department of Natural Resources in North Khorasan, out of total area of 2.8 million hectares, the forests and woods areas have been estimated 388 thousands hectares. Out of this area, 4 thousands hectares dense forests, 93 thousands hectares semi – dense forests, 291 thousands hectares poor forests, about 3.7 thousand hectares hand planted forests and 9.8 thousand hectares woods and shrubbery are classified. Also the total area of pastures in the Province have been estimated 1.6 million hectare which out of this, about 1.2 thousands hectares (its 6%) are dense and its 650 thousands hectares (40%) are semi – dense and the rest of it about 851 thousands hectares (53%) are poor to very poor pastures. Also about 32 thousands hectares of area of Province are rocky or barren lands and no vegetation. Table NO.1 is showing the land use situation in North Khorasan.

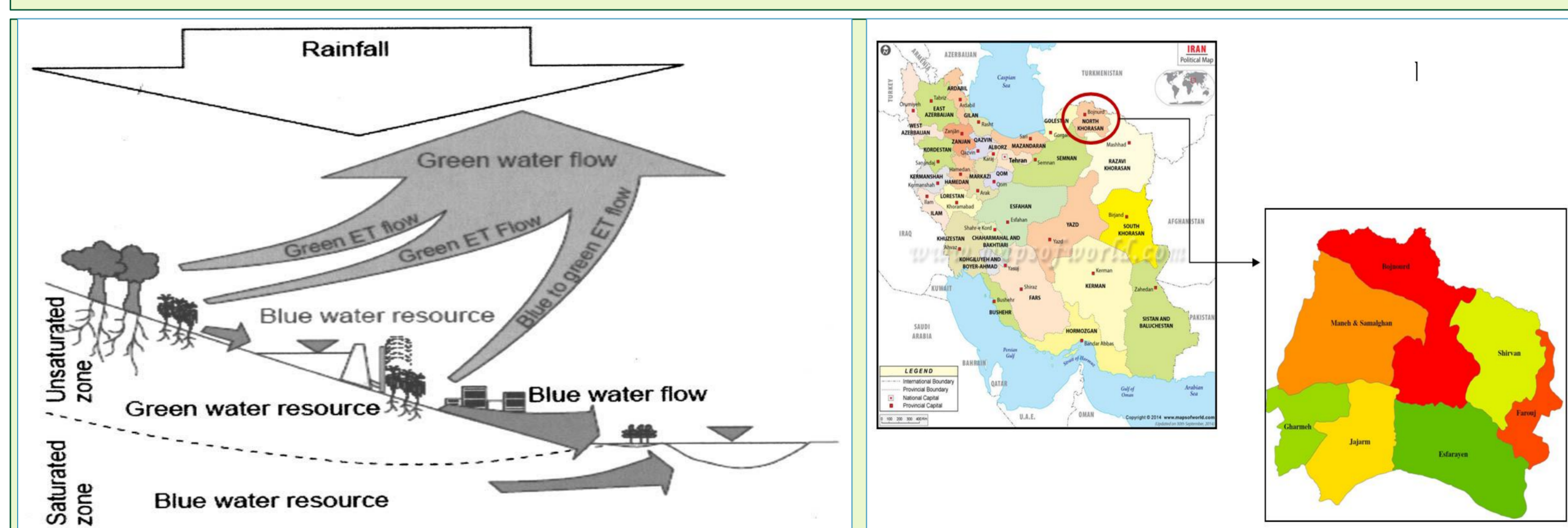
Rainfall situation in North Khorasan

Drawing isohyetal graphs have been used to calculate and determine the annual average of rainfall in different parts of the Province. These isohyetal graphs have been drawn using the average rainfall for years of rain – gauge stations, rainfall gradients and also using topographic maps in scale of .

By using isohyetal graphs, the average rainfalls and the volume of annual rainfalls by weighted method over 7 under study areas has been calculated and presented in Table NO.2 according to the separation of different land uses. As it is seen in this table, the highest and lowest rainfall is related to dense forests and arid lands respectively. According to the results of Table NO.2 rainfall share in the water resources balance of the province is 8.3 billion cubic meters per year that regarding to green water definition and climate condition (30% of rainfall change into runoff and infiltration) 5.8 billion cubic meters nearly 70% of this amount detects as green water.

In this research, it has been tried to pay more attention to the importance of green water by managers and planners in water and nature resources section.

Fig.1. Schematic view of the green water concept in nature, Fig.2. Geographical location of the study area, Table 1 – Distribution of land use in North Khorasan, Table 2 – Distribution of annual rainfall on North Khorasan lands



Row	Land use	Area (hectare)	% area
1	Irrigated agricultural -garden	342241	12
2	Dry land agricultural -fallow	438572	16
3	Barren lands-rocks-others	32072	1
4	Dense forests	3967	0.3
5	Semi-dense forests	93023	3
6	Poor forests	291579	10
7	Dense pastures	102649	4
8	Semi-dense pastures	650274	23
9	Poor pastures	851180	30
10	Residential-urban areas	6987	0.2

Row	Land use	Area (hectare)	Average annual rainfall (millimeter)	Annual rainfall volume (Trillion cubic meter)	% Annual rainfall volume
1	Irrigated agricultural -garden	342241	265	0.91	11
2	Dry land agricultural -fallow	438572	318	1.40	17
3	Barren lands-rocks	32072	170	0.05	1
4	Dense forests	3967	650	0.03	0.3
5	Semi-dense forests	93023	320	0.30	4
6	Poor forests	291579	341	0.99	12
7	Dense pastures	102649	351	0.36	4
8	Semi-dense pastures	650274	330	2.14	25
9	Poor pastures	851180	262	2.23	26
10	Residential-urban areas	6987	275	0.02	0.2
11	Entire of the Province	2832500	300	8.3	100

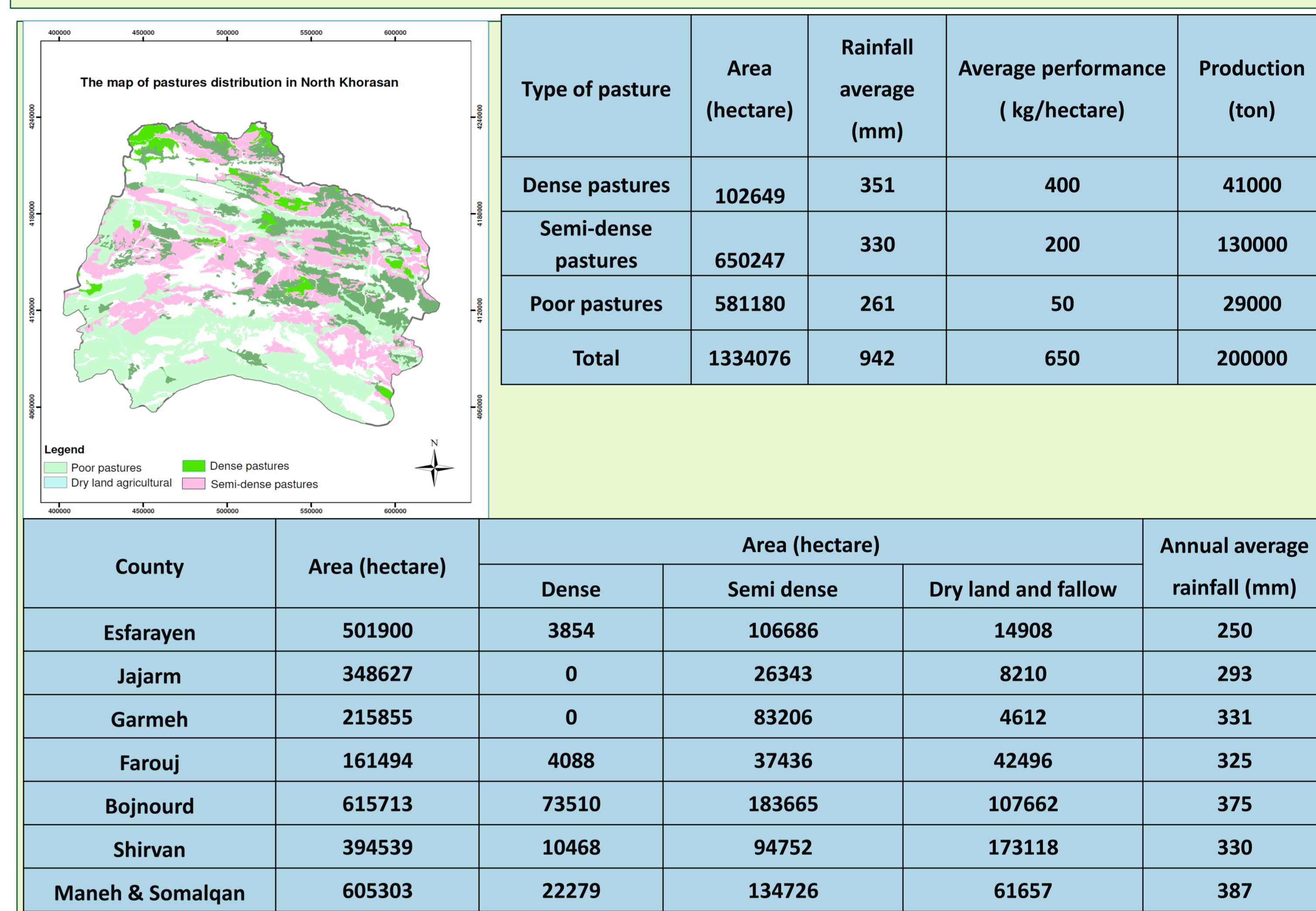
Pastures situation in North Khorasan

Based on production and quality of forage, pastures are divided into dense, semi – dense and poor:

1. Dense pastures: vegetation of these pastures is enough for livestock grazing and most of the

2. Semi – dense pastures: vegetation in them is not suitable and it is only enough for few numbers of animals to graze, the lands are more susceptible to destruction so it should be helped to revive of them with a special planning.
 3. Poor pastures: vegetation is too low and most of the growing plants are non-edible for livestock.
- According to above definitions and with land use maps and ARCGIS technique, pastures distribution map in North Khorasan will be as follow (Figure 5). Based on available studies and reports, the average production of hay in dense, semi-dense and poor pastures is 290, 29 and 25kg per hectare respectively (Moein-E-Din, 1993). But in North Khorasan due to climate conditions and topography the average production of hay in dense, semi-dense and poor pastures is higher than the average of national level and it is 400, 299 and 50kg per hectare per year. However although the amount and volume of rainfall in pastures is nearly equal to farm lands (dry land farming – fallow) , but the amount of harvestable produced forage in country pastures in general and in this province pastures in particular is too low in comparison with farm lands (dry land farming – fallow). On the basis of available statistics, total area of North Khorasan pastures is about 752 thousands hectares. Table NO.3 is showing the amount of current production in these kinds of pastures and annual harvestable production at present situation of the Province. Also in Table NO.4, distribution of dense and semi-dense pastures and dry farming lands has been presented separately in counties.

Fig.5. The map of pastures distribution in North Khorasan, Table 3 – Area of dense, semi-dense and poor pastures, the forage production and annual harvest, Table 4 – Distribution of dense and semi-dense pastures and dry farming lands in North Khorasan divided by counties



Study scenarios:

So according to this topic some scenarios can be described as follows:

1. Increase performance 80 to 50 percent on dry-farming lands respectively in dense and semi-dense pastures where the average annual rainfall is more than 300mm.
2. Increase performance 50 to 25 percent on dry- farming lands respectively in dense and semi-dense pastures where the average annual rainfall is more than 300mm.

So, by using GIS software the rainfall layer and land use (dense and semi-dense pastures) were combined, pastures was identified due to the aforementioned limitation for average annual rainfall (over 300mm) and the results have been presented in Fig and Table NO. 6.

Discussion and conclusion

By combination of land use maps and isohyetal graphs in GIS, area for those dense and semi-dense pastures which have average annual rainfall over 300mm, were calculated 90,000 and 533,000 hectares respectively (over 80% of total dense and semi-dense pastures in Province).

If the mentioned scenarios are exercised, In dense pastures, production will be increased 2.4 and 1.5 times respectively in scenario NO.1 and NO.2 and in semi-dense pastures 3 and 1.5 times respectively in scenario NO.1 and NO.2.

Suggestions

Achieving the goal to prevention of pastures degradation and their reclamation is possible when at first correct methods of pastures operation will be determined and ownership problems will be specified so that a comprehensive plan to supervise the usage and reclamation of pastures will be done by different organizations and departments with cooperation of beneficiaries.

Some solutions to increase the proper use of green water in order to raise forage production in pastures are including: preparation and implementation of rangeland plans, implementing the rehabilitation of pastures, seeding native species, changing low yields dry- farming lands into hand planting pastures, managing the surface running water in order to increase the forage production, etc.

Fig.6. The distribution map of dense and semi dense pastures with rainfall over 300 mm Table 6 – Results of study scenarios

