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***Research Article***

# ASSESSMENT OF WATER RESOURCES POTENTIAL FOR COMMON USE OF COW AND GOAT BY GIS: A CASE STUDY IN ALESHTAR RANGELAND, ALIABAD

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## ABSTRACT
Water resources suitability is one of the most important factors to sustainability utilization of natural potential by rangeland grazing suitability. To determine this factor in short time with low cost and high accuracy is most challenging for experts and ranchers. This study is a model for quantitative, qualitative and spatial distance assessment of water resource's propriety for goat and cow grazing based on geographic infor-mation systems (GIS) in Aleshtar Aliabad rangeland, Lorestan province, Iran 2013. In this research by combining three factors such as quantity, quality and water resource's distances; final model of degree of propriety of water resources for goat and cow grazing was characterized. Results showed that access to water resources in which the slope factor was the reason of this limitation, is considered as limiting factor of propriety of water resources, so in terms of access to water resources about goat grazing, 4021.1 ha (82.8%) and 853.3 ha (18.2%) located in S1and S2 classes and about cow grazing 830.44 ha (17.1%) located in S1 classes, 1592.9 ha(32.8%) in S2 classes, 1359.7 ha(28%) located in S3 classes and 1073.26 ha (22.1%) located in N classes respectively. According to the study area that is mountainous and have cold semi arid climate, the amount of rainfall is relatively too much. Water quantity and quality sub models results showed that there is no limitation factor in this regard, and all of samman units are located in S1 classes.

***Keywords:*** *Water Resources, Suitability, Aliabad, GIS, Iran*

## INTRODUCTION
Rangeland ecosystem's correct management needs recognizing water, soil and plant resources, which are basic resources for production. Correct programming for suitable utilization not only decreases rangeland degradation but also cause conservation and improvement of these resources. Thus, one of the most important factors and also difficult in analysis and evaluation of rangelands is utilization based on the potential and abilities. Recognition of factors affecting these has special importance for its desirable use and for suitable management of rangeland. One of the main problems of developing countries such as Iran is utilization of natural resources without ecological disturbances and this leads to destruction of soil, water and plant. Most area of Zagros mountains include rangelands with of them have no suitable quality and quantity of forage, also access to water resources. This causes more erosion for requirement of providing water and forage of livestock. These factors affected by rangeland utilization history (Moghadam, 1998). FAO (Food and Agricultural Organization) guided a standard evaluation system to assessment of land. In 1972 it prepared the background and in the next year wrote the first format then final format of land evaluation issued in 1976. It subsequently issued the guidelines for land evaluation for different land uses such as dry farming (FAO, 1983), forestry (FAO, 1984), dry land farming cultivation (FAO, 1985) and expanded grazing (FAO, 1991). On the first hand we need suitable uses and land resources balancing, more information and its utility to different systems relevant to the earth such as natural resources and on the other hand use of advanced methods and technology (Makhdom, 2001). RS (Remote Sensing) and GIS (Geological Information System) methods are the technologies that are vastly used in natural science (Malczwski, 1990). Suitable utilization of rangeland need to recognize its

parameters, therefore determination of rangeland suitability is one of the most significant factors and more difficult for rangeland analysis (Mohtashamnia, 2000). To determine livestock grazing suitability we must investigate some factors such as plant cover properties, topography, pedology, climate, geology, geomorphology, sediment and erosion, rivers network, water resource. Pay attention that all factors of ecosystem have role in animal grazing and there is no possible to recognize all of them so must recognize the most important factors and select them to use by abilities of geographical information system to decrease time and increase accuracy for preparation of information layers and integrate them. Kind of animal which use rangeland can be different according to physical factors such as slope, dimension of range, natural barriers, water resource spreading, soil properties, soil sustainable, soil sensitive to erosion, percent of plant cover, soil cover and forage production (Moghadam, 1998). 70 percent of Iranian livestock rely on rangeland, so to better uses of rangeland potential need to investigate of limitation and none limitation of animal grazing in rangeland suitable determination which one of them is water resource, therefore Aleshtar Aliabad regions selected according to more number of livestock like sheep. Beside using rangeland forage for grazing of livestock must be enough water to drink during grazing season that cause on maximizes using of forage by livestock for producing animal products (Schacht *et al.*, 2003). In some cases there is enough water but its propagation is not good, therefore animal cannot use all of the forage in rangeland (Scarlett, 2002). In fact it is important to provide enough water for drinking livestock and wildlife. As a general rule one of the effective factors in site selection of grazing is water distance (Lotfollahzadeh, 1999). Livestock and wildlife often more graze plants in the vicinity of water (Bailey, 2004). When water is the most significant limited factor for using forage, it affects on animal movement. So it is important for management of rangeland to find distance of animal to water resource which must cover the distance and amount of forage uses in the course of movement (Vallentine, 2001). Generally access ability to water resource depends on maximum distance where livestock can be far way form water resource to forage grazing. The distance depends on topography, utilization season, age and kind of animal and plant cover (Arnold and Dudzinaski, 1995). Several factors affect on water consumption such as kind, age and breed, topography, quality and quantity of forage accessibility, grazing season and distance from water (Bagley *et al.*, 1997). Water with more salinity or with poisonous elements may endanger animal health or make meat and milk uneatable. Also water with unsuitable quality affect on forage productivity. To determine usable water we must consider area situation, age and breed of animal and nutrition composition (Mahdavi, 1999). In fact animals prefer to drink fresh water (Moghadam, 1998).

The aim of this study was conducted to use geographical information system in preparing water resource sustainable model to animal based on FAO method (1991), and rangeland uses ability to animal grazing in terms of suitable uses of these lands based on water resources existing.

## MATERIALS AND METHODS

### *Study area*

The study area is located in Aliabad, Aleshtar in Lorestan Province in the centre of Iran. Aliabad

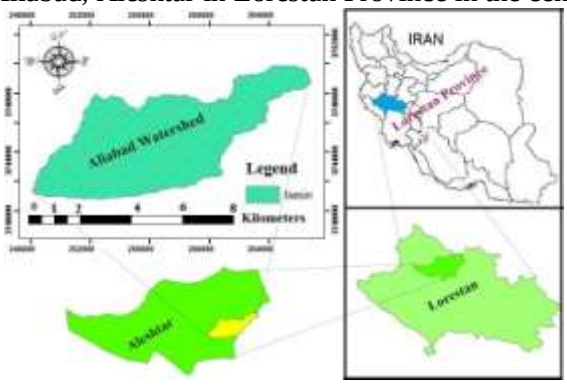


**Figure 1: Location of the study area, Aliabad**

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Watershed with the area of 8289.5 ha is located in the longitude of 48°16´48" to 48°28´45" E and latitude of 33°46´27" to 33°52´06" N. Maximum and minimum height rates of region are 3577.9 and 1619, respectively. Its mean annual precipitation and mean annual temperature are 582.42mm and 8.5C° (Figure 1).

***Water resources of the area***

There is one permanent river in the basin in form of a spring which its name is Sarab Honam, that is divided into, too many main water resources and secondary ones. Also there are many permanent and seasonal springs in the area. To determine contour distance map from water resources first, distance from water resources map was prepared (Figure 2).

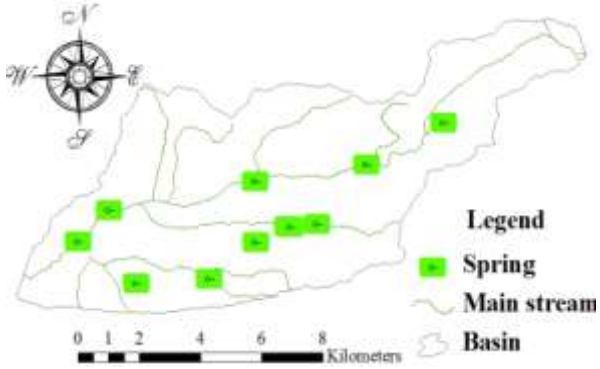


**Figure 2: The map of basin hydrological networks and springs**

***Criteria of water resources suitability***

The model is made of three sub models that are water resource distance, quality and quantity. According to these sub models in each types of rangeland and combine them together, water resource suitability in the area for goats and cows grazing determined. The water resources suitability consists of three sub-models which include: water remoteness, quality and quantity. In this study, location, quantity, quality and remoteness of water resources in each traditional boundary was determined (Figure 3).

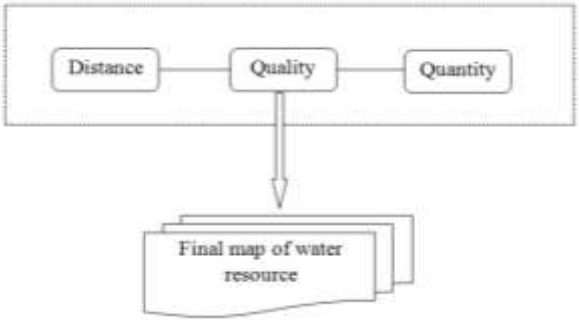


**Figure 3: The final model of water resources suitability for goat and cow grazing**

*Water accessibility sub-model***:** First, the slope maps of the study areas were classified and water remoteness in each slope class was calculated and the related map was extracted by using ArcGIS®9.3. Overlaying both maps led to the final water accessibility model. The distance from water resources suitability classes in livestock (goats and cows) usage are illustrated in 'table 1-2 and (Figure 4-5).

**Table 1: Water resources distances (m) and its suitability for grazing cow classes**

| Suitability class | Slope class (%) | | | |
|---|---|---|---|---|
| | 0-15 | 15-30 | 30-45 | >45 |
| S1 | >3000 | >2000 | >800 | N |
| S2 | 3000-4000 | 2000-3000 | 800-1500 | N |
| S3 | 4000-5000 | 3000-4000 | 1500-2200 | N |
| N | >5000 | >4000 | >2200 | N |

**Table 2: Water Resources distances (m) and its suitability for grazing goats classes**

| Suitability class | Slope class (%) | | | |
|---|---|---|---|---|
| | 0-15 | 15-40 | 40-75 | >75 |
| S1 | 0-4200 | 0-3700 | 0-1200 | N |
| S2 | 4200-6200 | 3700-6000 | 1200-4500 | N |
| S3 | 6200-8000 | 6000-7500 | 4500-5100 | N |
| N | >8000 | >7500 | >5100 | N |

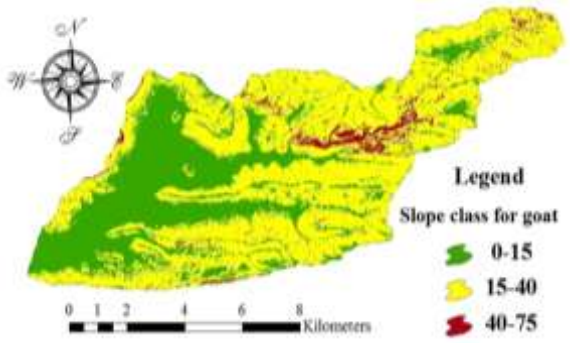


**Figure 4: Slope class for goats**

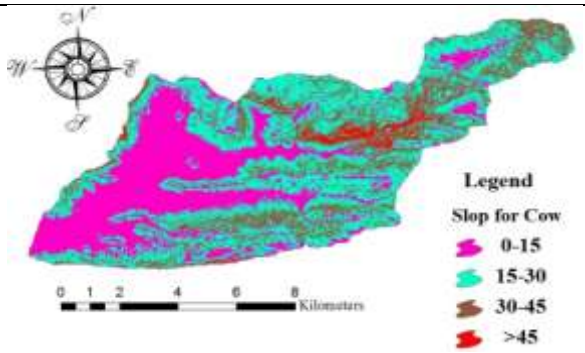


**Figure 5: Slope class for cows**

*Water quantity sub-model:* In this step, the location and discharge of water resources were determined and summed up within each types of plant boundary to calculate water availability. Comparing animal water demand with available water indicates the results in the water quantity suitability sub-model. According to climatic conditions, vegetation characteristics, grazing season and animal type, animal water demand were estimated for goat and cow. The suitability categories were then determined by comparison of the available water with the water needed by the livestock (Table 3).

**Table 3: Water resource suitability classes**

| Available water in pasture ration to livestock need (%) | >76 | 51-75 | 26-50 | <25 |
|---|---|---|---|---|
| Suitability classes | S1 | S2 | S3 | N |

*Water quality sub-model:* In this study, water quality data of water resources such as; [Acidity (pH ), Electrically conductive (EC), Total Dissolved Salts (TDS), Sodium (Na), Claire (Cl), Bicarbonate (HCO3-), Magnesium (Mg), Sulfate (SO4¬), Calcium (Ca), Total Hardness (TH), Sodium absorption ratio (S.A.R), Potassium (K+)] were acquired from local offices, Lorestan water management and other researches and compared with standards to determine water quality suitability. Finally these three sub-models were integrated to make the final water resources suitability model for extensive grazing.

## RESULTS AND DISCUSSION

In this study, a model for water resources suitability assessment for grazing of Sarab Sefid rangeland in Iran was elicited. Based on previous studies and field experiences, three limiting conditions for grazing (FAO 1991) were taken into account. A model was proposed for each given criteria.

### *Suitability model of water resource*

*Suitability model of water resources quality:* The suitability categories of this model were determined by using the combination of three criteria such as quality, quantity and distance from water resources. Based on the water resources quality and considering the water quality, there were no limitation in the study range area, and the whole range area fell within the S1 suitability category. Results show that Total Hardness (TH) based on standard is good for sheep. Also these results are similar to Cl (0.25 mg/Li), pH (7.82 mg/Li), NO3 (4.4), EC (424 mimhos per cm), TDS (268 mg/lit) and other factors except SO¬4. For the last factor (SO4) there is a little limitation for drinking by sheep.

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*Suitability model of water resources quantity:* The results revealed that there were no limitations for the amount of water in the region, so all of them fell into the S1 suitability category, because of high precipitation of the region which is between 500 to 700 mm per year (annually) and it has good intensity during year. In mountain and high elevations precipitations are most as snow and cause to save it, and its result is producing spring in the basin which is suitable water quantity for sheep as Loree local breed. In this basin there is enough water during grazing season for livestock and wildlife and it is more than water needed based on determined grazing capacity.

*Distance from water resources suitability for goats and cow:* The results of the sub-model on the distance from water resources suitability for goats grazing revealed that 4021.1 ha (82.8%) and 853.3 ha (18.2%) located in S1and S2 classes and about cow grazing, 830.44 ha (17.1%) located in S1 classes, 1592.9 ha (32.8%) in S2 classes and 1359.7 ha (28%) located in S3 classes, and 1073.26 ha (22.1%) located in N classes, respectively (Figure 6-7) and Table 4'.

**Table 4: Area of categorize of distance form water resources suitability for cows and goats**

| Categorize of suitability | | Area (ha) | Area (%) |
|---|---|---|---|
| For goats | S1 | 4021.1 | 82.8 |
| | S2 | 853.3 | 18.2 |
| | S1 | 830.44 | 17.1% |
| For cows | S2 | 1592.9 | 32.8% |
| | S3 | 1359.7 | 28% |
| | N | 1073.26 | 22.1% |

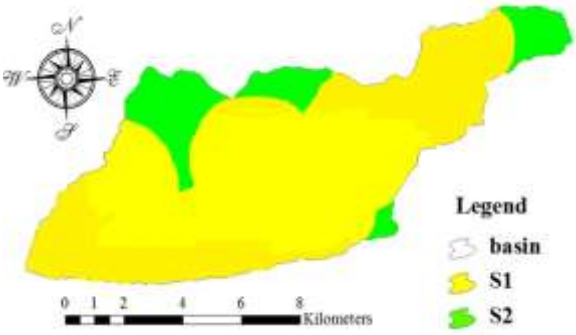


***Figure 6: The model of water resource suitability for goats***

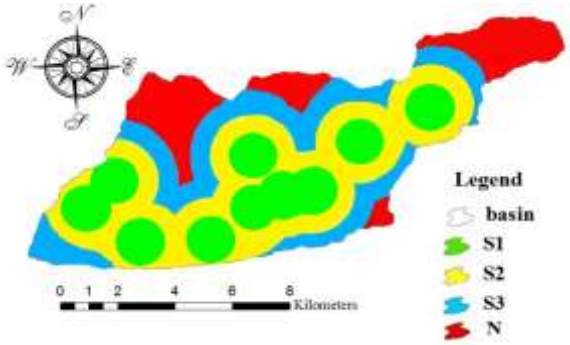


***Figure 7. The model of water resource suitability for cows (final model)***

***Final water resources suitability***

The region in question had no problems regarding the quantity and quality of the water resources; it was only the distance from the resources that mainly determined the suitability of the rangeland with respect to water resources for cow (Figure 7).

***Discussion***

In Iran, as in most parts of the world, animal husbandry is the most productive use of Zagros Mountains. Keit (2000) showed that for determining water resource suitability for cattle grazing assessment of two factors is needed such as slope, number of water resources, steep slope and suitable distance from water resource. He explained that, these are significant factors in spreading and suitability which the present study reaches to similar results. In studies of Jangjoo Borzelabadi (1996), Mohtashamnia (2000), Yoosefi khanghah (2004), Arzani and Yoosefi (2006), for determining animal grazing suitability carried out three factors such as forage production, water resource and soil sensibility based on FAO (1991) method that the present research path same method and showed the same results. Minor (2002) for determining rangeland grazing capacity of Fergosen-California region used RS and GIS abilities. He applied three sub-models such as plant coverage, slope and precipitation for determination of final model of grazing

capacity and declared that the results by GIS had acceptable accuracy for management of rangeland. The results are based on Paul Tueller and Reno Nevada (2001) opinion in for using RS technique to investigate rangeland forage production. The results of the study showed that the quantity (number of permanent water resources), quality and the distance from the water resources did not impose many limitations on the rangelands suitability for grazing livestock. However, the steep slopes along the livestock path to the water resources resulted in the formation of an 'unsuitability' category for livestock. Valentine (2001) reported on the importance of the slope factor in reaching the water resources, and declared that by increasing the slope the ability to graze decreases and increases the livestock demand to expend lots of energy. The quality and quantity of the water resources in the rangeland did not impose any limitations. The result of the research indicates the slope as the reducing and sometimes limiting factor in the range suitability. Hence, the slope factor is of considerable importance in determining the suitability of the pasture for grazing. As slope increases the water retention time on the ground decreases, the rate of penetration decreases, and the amount of water run-off increases. Cook (1954) explained that on slopes of more than 60 degrees little forage is grazed. Amiri (2009) and Gavili *et al.,* (2011) defined the slopes with more than 60 percent as useless for all kinds of livestock, while Holechek *et al.,* (1995) reported slopes of more than 60 percent, and Arzani *et al.,* (2006) defined slopes of more than 60 percent as useless for livestock grazing. On such steep slopes wild animals would graze better than livestock. Guenther *et al.,* (2000) in determining the suitability of a rangeland in Australia noted the two factors of slope and water resources as the suitability limiting factors of rangeland for grazing cattle. Due to the existence of numerous permanent water resources in Sarab Sefid rangelands, the water resources factor does not impose many limitations on the suitability of the rangeland. However, the slope factor in reaching the water resources in limited areas of the rangeland was a suitability limiting factor. It must be noted that the results reported by Guenther *et al.,* (2000) was similar to that observed in the present study.

***Conclusion***

In this research, recent developments of using GIS as a smart tool in supporting the ranchers and pasture owners for monitoring land suitability for livestock feeding purposes was challenged. This study showed that water resources are unlimited factors for livestock grazing. As FAO argues, different land units have different qualities for certain utilizations.

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