

هفتمین کنفرانس ملی مرتع و مرتعداری ایران

۱۸-۱۹ اردیبهشت ماه ۱۳۹۷



## Change Detection in Rangelands by Remote Sensing

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### Abstract

Evaluation of watersheds and development of a management strategy requires accurate measurement of the past and present land cover/land use parameters. Change observed in the rangelands suggest that some changes in ecological, social and economic processes are taking place in a watershed. In this paper, we evaluated the changes happened during the past 6 decades in the rangeland which is the part of Qashqai Tribal Confederacy's territory, summering grounds of two sub-tribes (Gorjaee and Machanlou) from Farsimadan tribe. Assessing Range Trend can be useful in tracking the rate of change in rangeland condition, but it doesn't always give the full picture. These changes in this paper have been shown by application of aerial photos, space photogrammetry images and satellite images (Landsat 4, 5, 7 and 8 and Spot 1 and World View 1 and Sentinel-2) during the past 6 decades. The first aerial photo applied in this paper belongs to National Geography Organization of Iran in 1955 which we suppose it as the base because community elders also stated that everything was in order at that time and the latest satellite images that we used were Sentinel-2, year 2017. We tried to use one or two satellite images in each decade according to important events and critical policies and decisions. These satellite images are Landsat 4,5,7,8, Spot 1, Worldview 1 and Sentinel2. Needless to say that, proper management of the



rangelands is required otherwise these resources will soon be lost and no longer be able to play their key role in socio-economic development of the area.

**Keywords:** Rangeland changes, Timeline, Acts, Remote Sensing, GIS, Historical events.

## Introduction

During the 20th century, we have witnessed an improvement in the quality of images available for rangeland evaluation, from the earliest mono-chromatic aerial photographs, followed by the first infra-red images, to the abundance of high resolution, multi-spectral imagery currently available (Palmer & Fortescue, 2004). Remote Sensing was introduced as an important tool in understanding and monitoring various components of rangeland function and health (McGraw and Tueller 1983, Tueller 1991, Soshany 2000).

Linked to the ability to detect change, is the need to define desired states against which change can be assessed. One of the possible solutions to making evaluation more successful is the co-operative development of desired stakeholders (Palmer & Fortescue, 2004).

Satellite imagery has been used from its earliest times for the preparation of base maps for rangeland inventory (Martin, 1984). One of the major problems has been the replicability of early multi-spectral classification techniques that, when applied to new data, will enable contemporary researchers to evaluate changes from the earlier state. In an effort to solve this problem, change vector analysis has been recommended and applied (Johnson & Kasischke, 1998).

The concept of potential is essential for any change detection effort, and has been developed from the early work of Kuchler (1973). Potential vegetation environments (e.g. habitat types, range sites, ecological sites) are important to land managers because they provide a conceptual basis for the description of potentials and

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ecological integrity (Jensen, 2001). Efforts to define rangeland condition under different land-use scenarios have only recently been presented by the help of Remote Sensing (Birch et al., 1999).



## Methods and Materials

These days, GIS digital maps are proving a really useful tool for Indigenous Peoples (IPs) to delineate their own customary territories, which are often different from official maps. Many local communities are learning how to use the technology and working with experts in participatory mapping activities (Azhdari & Farvar, 2017). In this paper, writers have used participatory technique to delineate the territory map of the Gorjaee and Machanlou Sub-tribes of Farsimadan Tribe from Qashqaii Tribal Confederacy which is located in the south west of Iran, in Fars Province (Figure 1). This area which is these communities' summering grounds and the boundary is the community's claim about their territory.

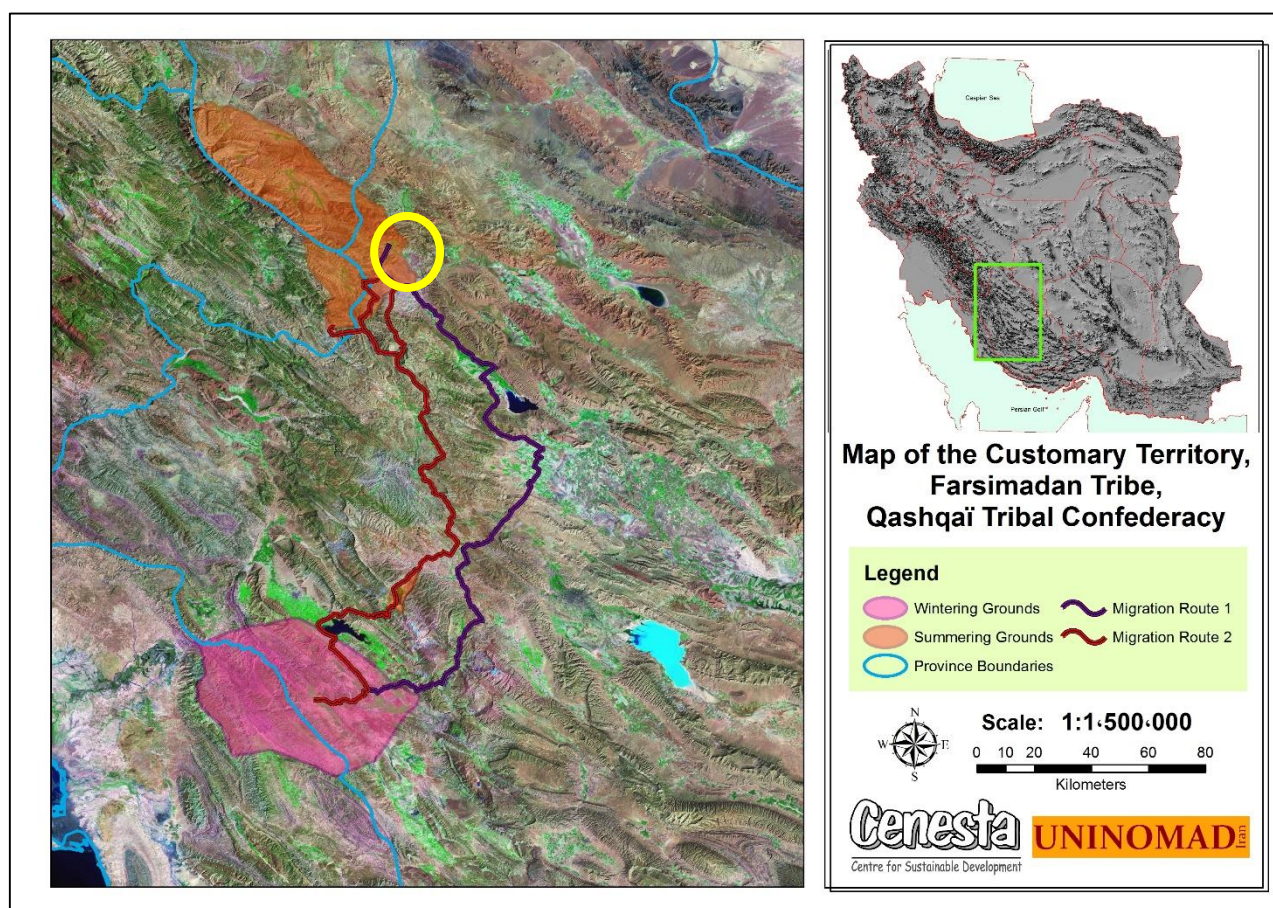


Figure 1- The location of Farsimadan Tribe's territory in Iran.



\* The area of this study designated on the map in the yellow circle.

The coordinate system of the study area is: 39R, 595658 E, 3270871 N and 598684 E, 3284381 N that is located 60 km west of Shiraz in Fars province. This territory has overlap with the Arjan-Parishan protected area. The area of the case study is 5953 ha and Arjan wetland is located within the study area.

The aerial photos and satellite images used in this study, were selected in the cultivation season and they are all easily accessible. The based natural resources condition was before 1963 which was the enforcement of Nationalisation of Forests and Rangelands Act. The first aerial photo used in this study, was prepared in 1955, belonging to army. These photos show the condition before this crucial event in the country on a scale of 1:55000. In the process of using photos and images, we used the space photogrammetry with high resolution on a scale of 1:40000. This was military photos with 2.5- to 4-metre resolution. Then we assessed the Spot & Landsat 5 Satellite Image from 1986 with 10 metre resolution. After that, Landsat 5 (1991) and 7 (2002) satellite images, respectively with resolution of 30 metres and 15 metres. For the 1991 trend, the Worldview 1 Satellite Image with high resolution (50 centimetres) was used and for the current situation, the Sentinel 2 Satellite Image, 2017 which has the period of 10 days (one shot each 10 days in Iran) was applied.

## Results

According to main acts, regulations and historical events in Iran, outcomes of enforced policies on the natural resources in two Qashqai sub-tribes (Gorjaee and Machanlou) during the past decades (from 1955 to 2017) were assessed by the satellite images and the changes in the area of rangeland and forest in our case study were digitalized. The events that we worked on are mentioned in the table 1.

**Table1- Timeline of some influential events in rangelands in Iran**

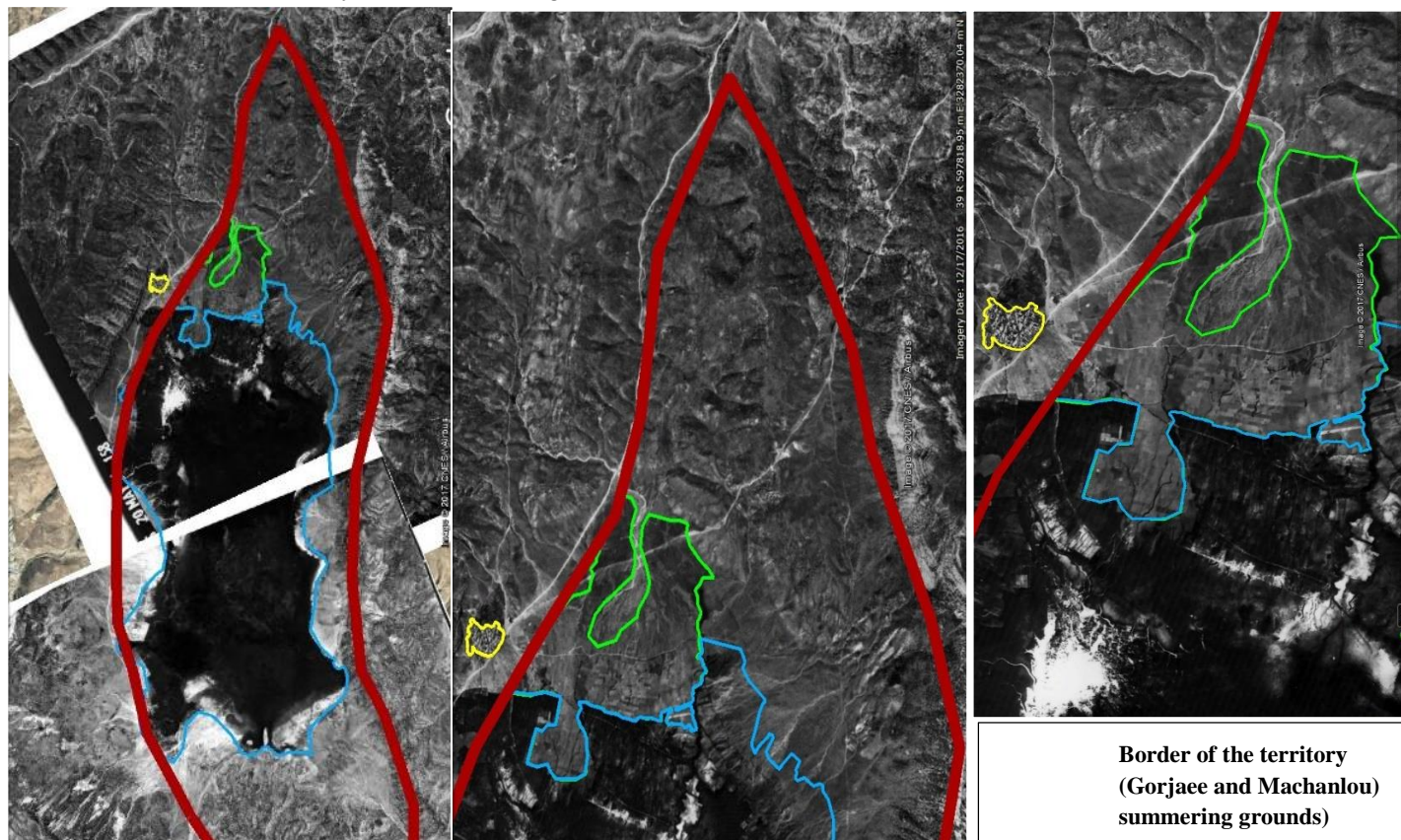
Decade	Important events
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۱	1960s	<ul style="list-style-type: none"> <li>Nationalization of Rangelands and Forests</li> </ul>
۲	1970s	<ul style="list-style-type: none"> <li>Development of Roads</li> <li>Revolution</li> </ul>
۳	1980s	<ul style="list-style-type: none"> <li>Establishment of a protected area</li> <li>War Between Iraq and Iran</li> <li>Modern aggressive agricultural technology</li> </ul>
۴	1990s	<ul style="list-style-type: none"> <li>Increasing tube wells</li> <li>Ranching projects</li> <li>Changing land use</li> </ul>
۵	2000s	<ul style="list-style-type: none"> <li>Lack of coordination between government organizations</li> <li>Intensification of agricultural production law</li> </ul>
۶	2010s	<ul style="list-style-type: none"> <li>Revolutionary guard activities</li> </ul>

In 1955, the area of the village was 7 ha, Wetland area (2750 ha) and Agricultural Land, 208 ha. The total area of the studied territory was 5953 ha (Figure 2).



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**Figure 2- Detection of territory, agricultural lands, wetland area and village area in 1955 with aerial photos**

In figure 3, the space photogrammetry of 1970 shows the changes in the area of rangelands due to enforcement of Nationalization of Forests and Rangelands Act and road construction which had 37 ha expansion in agricultural area and 3.7 ha expansion in village area and surface area of road including distance from roads for any constructions that is 4 km and 30 ha. Also, Figure 4 depicts these changes in 1986 with Spot & Landsat 5 satellite images. In 1991 satellite image, we detected the changes caused by tube wells which lead to increase the area of agriculture fields, reduction in the wetland and area of rangelands belonging to pastoralists.



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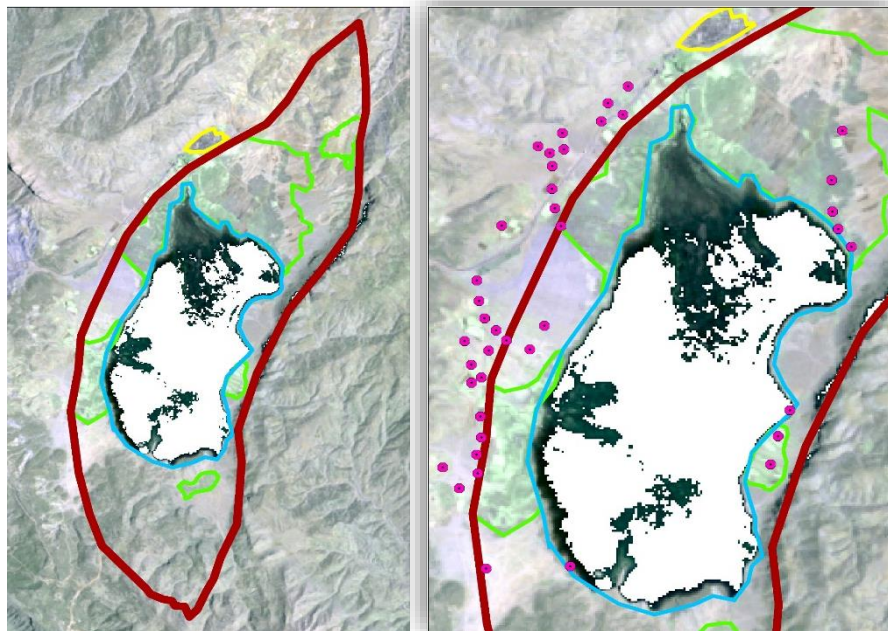
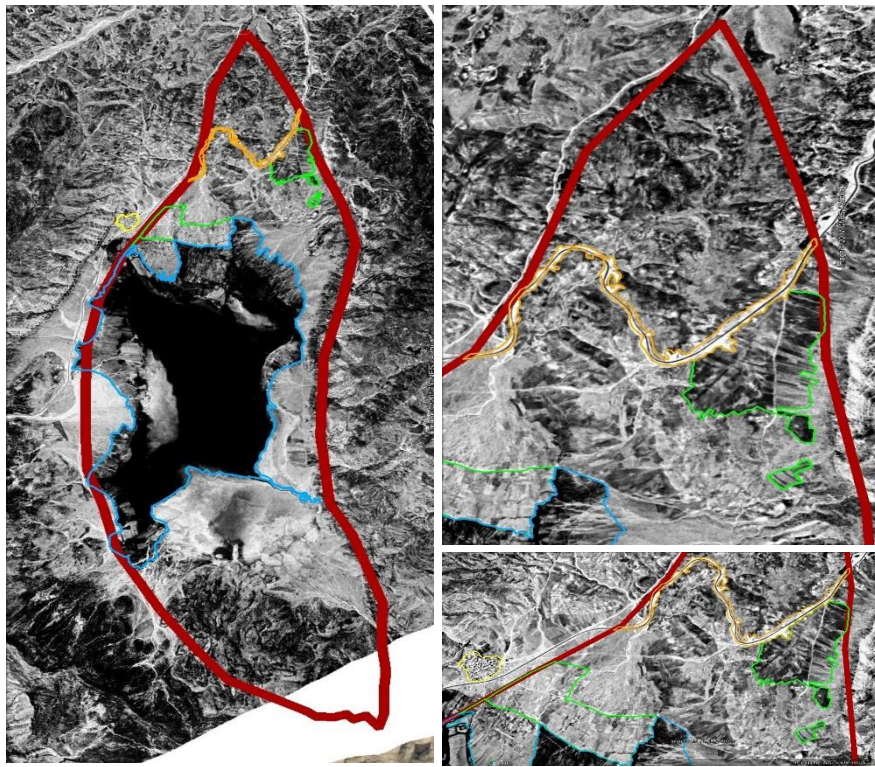


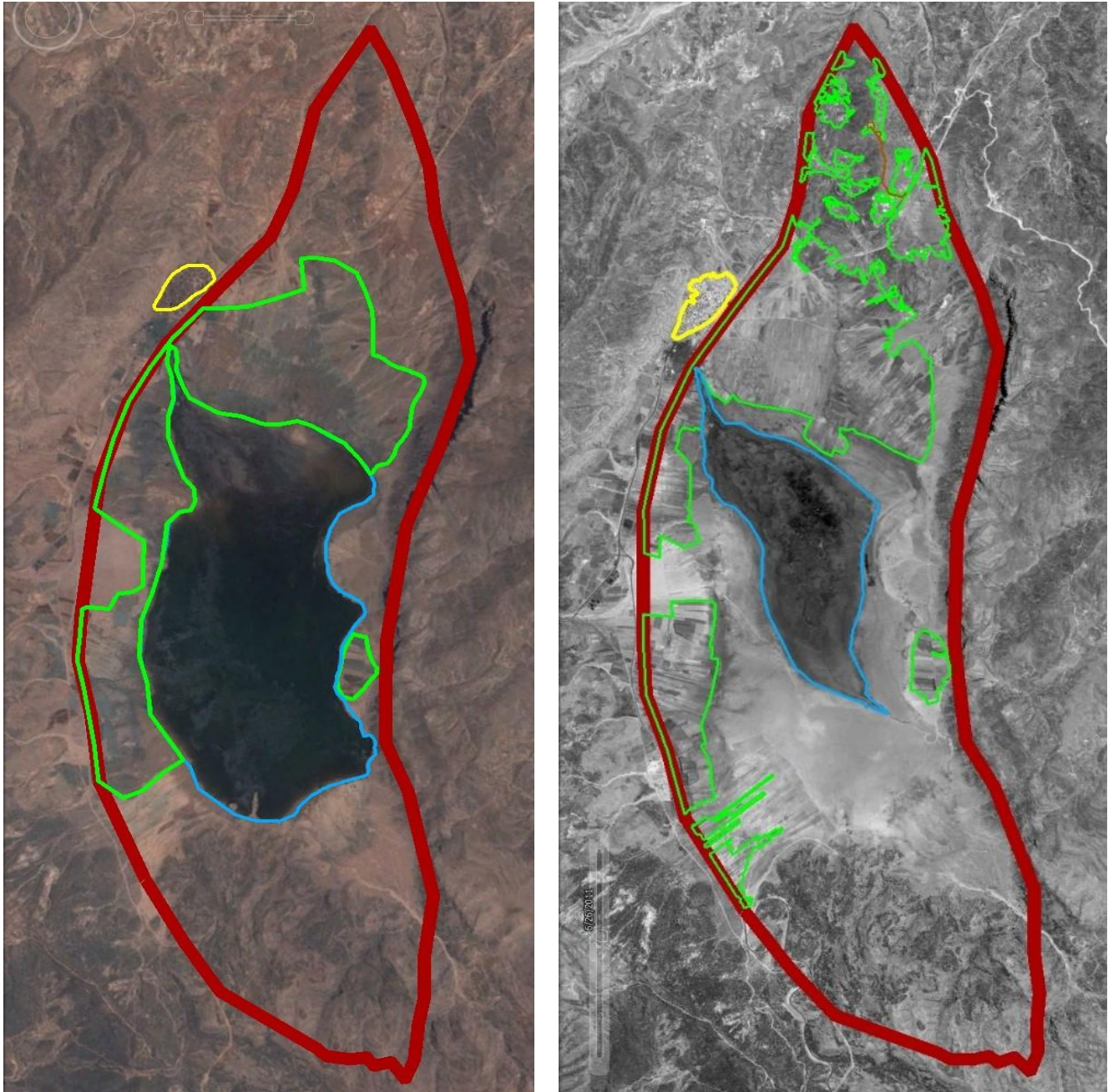
Figure 3- Space photogrammetry image in 1970





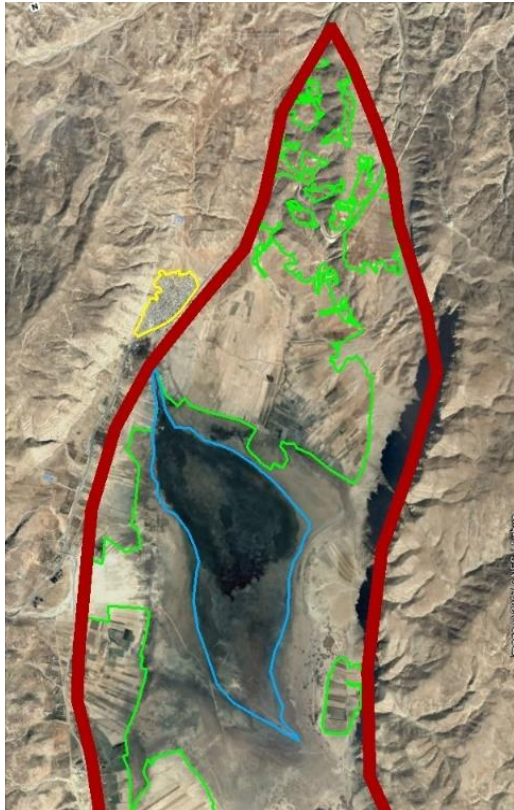
**Figure 4- Change detection with flourishing the tube wells in 1991**

In 2002, Landsat 7 satellite image illustrate expansion of agricultural lands about 7 folds in comparison with the base image (Figure 5). Besides, in Figure 6 the changes in rangeland and land use during 2010s is visible.





**Figure 5- Landsat 7 Satellite Image in 2002**



**Figure 6- Worldview 1 Satellite Image in 2011**

In the current situation with 2017 Sentinel image, current land use changes and expansion of agricultural area as well as village area

area

is



visible (Figures 7 and 8).



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**Figure 7- Total changes from 1955 to 2017**

**Figure 8- Expansion of agricultural lands from 2011 to 2017 with changing the land use from dense oak forests to wheat and barley farms and then orchards.**



**.Figure 9- Nomads' tents and corrals which now a days cover very small area of their territory**



## Discussion

To recap, this area witnesses the expansion of agricultural areas and shrink of wetland and rangeland areas. The village have reached to 48 ha from 7 ha (7fold) and 8fold increase in agricultural areas while the territory witnessed that the area of wetland decreased more than 2000 ha. With some enclosures enforced by Department of the environment (DOE) and other reductions in the grazing area, it is estimated that in total, the rangeland area that can be used by the indigenous nomadic sub-tribes (Gorjaee and Machanlou) is about 800 ha. Digging of 40 legal tube wells (writers couldn't find any information about illegal wells) showed a drastic decrease in wetland area.

The major limiting factor for the wider use of satellite imageries in rangeland assessment remains with the cost of the imagery. Unless data suppliers do not show their commitment to sustainable development in real terms, data costs will remain a limiting factor (Palmer & Fortescue, 2004). There have been abundant and exciting advances in the technology, but their acceptance by the user community has been slow (Palmer & Fortescue, 2004). So, we need to substitute the scientific way of range detection by using remote sensing data with the participatory way that community has to evaluate the trend in the rangelands.

We need field checks of areas showing trends, intensify geographic analysis, analyse weather data in conjunction with spectral trends data, and stakeholder analysis for socio-ecologic changes in the region.

It is widely said that overgrazing is one of the main factors of degradation, whereas this study reveals that other factors are more influential in rangeland degradation such as inappropriate acts and regulations, changes in landuse, and unwise development activities that should be taken into consideration if we believe that rangelands goods and services should be sustainable.





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## بررسی تغییرات مرتع توسط سنجش از دور

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### چکیده

ارزیابی آبخیزها و توسعه استراتژی‌های مدیریتی، نیازمند اندازه‌گیری دقیق پارامترهای کاربری زمین و پوشش زمین در گذشته و حال است. تغییرات مرتع، با تغییراتی در شرایط اکولوژیکی، اجتماعی و اقتصادی حوزه‌های آبخیز صورت می‌گیرد. در این مقاله، تغییراتی که طی حدود شش دهه در قلمرو بیلاقی دو تیره (گرجایی و ماچانلو) از طایفه فارسیمدان ایل قشقایی اتفاق افتاده، مورد بررسی قرار گرفته است. ارزیابی گرایش مرتع می‌تواند در دنبال کردن میزان تغییر در شرایط مرتع مفید باشد؛ ولی همیشه تمام شرایط حاکم بر مرتع را نشان نمی‌دهد. تغییرات نشان داده شده در این مقاله با کمک عکس‌های هوایی، فوتوگرامتری فضایی و تصاویر ماهواره‌ای (لندست ۴، ۵، ۷ و ۸، اسپات ۱، وردیو ۱ و سنتینل ۲)، تغییرات ایجاد شده طی شش دهه گذشته نشان داده شده است. اولین تصویر که به عنوان مبنا در نظر گرفته شده است؛ مربوط به سال ۱۹۵۵ (۱۳۳۴) سازمان جغرافیایی کشور است؛ که بسیاری از ریش‌سفیدان و گیس‌سفیدان جوامع بومی کشور معتقدند که همه منابع طبیعی و مراتع کشور در شرایط خوبی بوده است و آخرین تصاویر مربوط به سال ۲۰۱۷ (۱۳۹۶) است. در این مقاله سعی شده است که در هر دهه، یک یا دو تصویر ماهواره‌ای براساس اتفاقات، رویدادها و مصوبات مهم مورد بررسی قرار گیرد. نیازی به گفتن نیست که مدیریت مناسب مراتع مورد نیاز است؛ در غیر



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این صورت این منابع به زودی از دست خواهند رفت و دیگر قادر به انجام نقش کلیدی خود در توسعه اجتماعی و اقتصادی نخواهند بود.

کلمات کلیدی: تغییرات مرتع، سیر زمانی، قوانین، سنجش از دور، سیستم اطلاعات جغرافیایی (GIS)، رویدادهای تاریخی.