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Peculiarities of Introducing Geoinformation System in the Monitoring Procedure of Rangelands in the Republic of Armenia

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A R T I C L E   I N F O

A B S T R A C T

Animal husbandry is one of the leading agricultural branches in Armenia. Throughout recent years, almost 40 % of the agricultural gross product is resulted from the animal husbandry branch.

The rangelands play a crucial role in the forage base development. In the recent 30 years the pastures in Armenia have lost their qualitative properties due to overgrazing and degradation thereof, while the land types with the characteristic traits of grasslands are not often used for their intended purpose.

It is practically impossible to implement monitoring over the rangelands without clear and constantly updated information. Such kind of information can be retrieved via the use of geoinformation systems.

Introduction

Rangelands are all those plant-covered areas in the environment, that are most rich in perennial plants, shrub and semishrub vegetation and which are used as a forage base for the management of agricultural production.

Per their intended purpose and significance, the rangelands are divided into two main types: a) pastures and b) grasslands.

The possible and efficient ways of using the rangelands' vegetation cover are related to a number of peculiarities of a specific vegetation cover. Mostly the areas with short-stalked/low-stemmed vegetation cover are used as a pasture, where the main leaf mass of the developing plants is mostly concentrated at the base of the stalks. As grasslands, such rangelands are used, (meadows), where in the vegetation cover high-stemmed and for the most part uniformly foliated plants developing huge aboveground vegetation mass are dominating (Tovmasyan, 2019).

When using the pastures vegetation cover as a natural resource, at the same time it is necessary to take care of the mentioned resources in view of ensuring their self-restoration and diversity development. The pastures should be used in a way so that to maximally reduce or eliminate the harmful grazing effects. To this end, it is of utmost significance to observe to the grazing standards: times, duration, quantity and rules.

In 1991, after gaining independence the land privatization process launched in Armenia. The grasslands and pastures were also privatized. Physical and legal entities gained the right not only to privatize, but also rent the grasslands and pastures belonging to the state. As a result of overgrazing and degradation, the pastures have been deprived of their qualitative features in the last 30 years, while the land types intended for the use as grasslands are not used for the mentioned purpose.

In the RA, the rangelands are mainly located in piedmont and mountainous zones, where the farmers are mostly engaged in livestock management. There are residences in the piedmont and mountainous zones, where shepherd hiring is a serious problem, as a result of which the grazing of animals takes place without any control, hence upon free grazing; the animals are driven out from the cattle barn in the morning and return in the evening. Currently, there isn't any reliable and relevant information on the actual use, grazing times and directions of the rangelands. The mentioned issue is possible to resolve with the support of geoinformation systems. Geoinformation systems are such information systems, which enable to collect and process comprehensive information and to conduct different types of analyses. GPS receivers ensure the best results for baseline data collection (Calcante, et al., 2019, Sonneveld, et al., 2009, Bao-dong Yuan, et al., 2019, Knight, et al. 2018, Bailey, et al., 2018, David S.Pilliod, et al., 2021, Raizman, et al., 2013, Ungar, et al. 2005, Hyeon T.Kim, et al., 2013, Karl, et al., 2019, Turner, et al., 2000, Safaei, et al., 2018, Barbari, et al., 2006, Williams, et al., 2016, Millward, et al., 2020, Clark, et al., 2006, McCord, et al., 2021, Feldt, et al., 2016, Akasbi, et al., 2012).

Materials and methods

We have set a task to find and develop such technological solutions which would enable to collect and analyze information about the rangelands actually grazed by the community animals. To resolve the mentioned issue the model of RF-V26 for GPS receiver was applied (Figure 1). The technical description of the GPS receiver is introduced in Table 1. The mentioned model is waterproof and the solar panels ensure the duration of working time. The latter was fastened to the cow neck to provide the uninterrupted work of data collection. The investigations started from May, 2019 in the Arzakan community of the RA Kotayk region, the lands of which are located in piedmont zone at an altitude of 1450-1900 m high above sea level. Per the land balance, there are grasslands with 293.02 ha total land area, pastures with 2245.52 ha land area, as well as forest soils with 4236.03 ha land area, certain territories of which

are also used as pastures in September and October. In Arzakan and in the whole Republic of Armenia there isn't any clear information on the factual use of pastures and grasslands. RF-V26 GPS receiver enables to follow cows online, as well as to collect data on the total way the cow passes per day obtaining information on the factual grazing areas. Throughout 2019 and 2021 years we collected data on the factual areas grazed by the cows belonging to the residents of several districts in the Arzakan community.
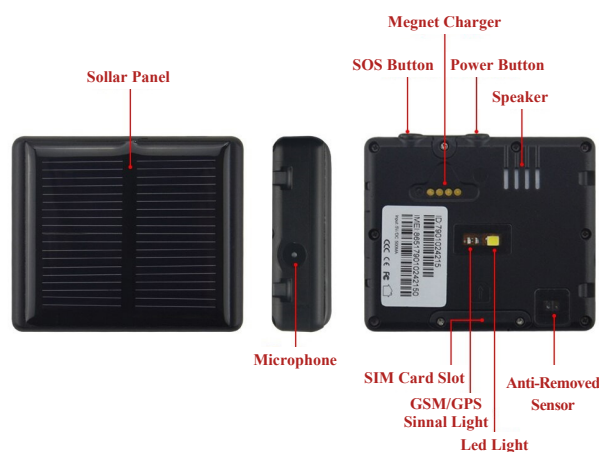

Figure 1. RF-V26 GPS receiver.

Table 1. Technical parameters of GPS receiver*

Model	RF-V26
Types	Tracker, GPS
Material	ABS
Network	GSM, GPRS
Bands	850/900/1800/1900Mhz
GPRS Standard	Class 12, TCP/IP
GPS Accuracy	10-15 m (under the open sky)
Start Time	30 s with cold boot (under the open sky) 29 s with warm boot(under the open sky) 5 s with hot boot (under the open sky)
Battery	1500 mAh
Standby Time	200 hours
Operation Temperature	-20 to +70 degree celsius
Humidity	5-95 percent non-condensing
Weight	64 g

*Composed by the authors.

Results and discussions

RF-V26 enables not only to collect information on the grazing areas of the cows, but also to detect them in the pasture online via phone application. The retrieved data are depicted in Table 2 (https://gps123.org/).

The obtained information is introduced on the digital maps in Figure 2.

Table 2. The data retrieved after the cows left the cattle barn*

V26-99399-Details				
From: 2020-08-16 06:40 to: 2020-08-16 20:12				
Position time	**Lat**	**Lon**	**Speed**	**Direction**
16.08.2020 06:40	40.44264	44.57323	0	124
16.08.2020 06:50	40.44295	44.57269	2.96	301
16.08.2020 07:02	40.44295	44.57269	0	233
16.08.2020 07:11	40.44295	44.57269	0	273
16.08.2020 07:38	40.44286	44.57285	1.28	257
16.08.2020 07:48	40.44286	44.57285	0	333
16.08.2020 07:58	40.4427	44.57341	3.31	255
16.08.2020 08:09	40.4427	44.57341	0	246
16.08.2020 08:19	40.4427	44.57341	0	77
16.08.2020 08:30	40.4427	44.57341	0	219
16.08.2020 08:40	40.44283	44.57309	3.05	264
16.08.2020 08:53	40.44283	44.57309	0	265
16.08.2020 09:09	40.44283	44.57296	2.07	283
16.08.2020 09:19	40.44329	44.57354	2.16	292
16.08.2020 09:30	40.44321	44.57334	2.37	277
16.08.2020 09:40	40.44321	44.57334	0	93

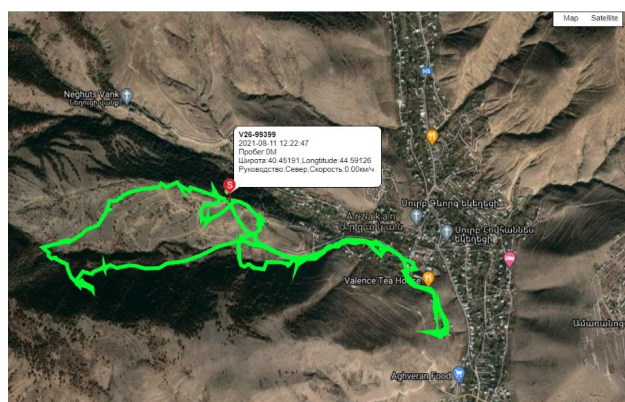*Composed by the authors.

Figure 2. The way a cow walked during a day.

In Figure 2 the movement pattern of a cow in free grazing conditions is clearly viewed. The main issue of free grazing is the absence of shepherd, thus, via the phone application the cow can be detected at any time, if it is required. The example of detection is introduced in Figure 3.
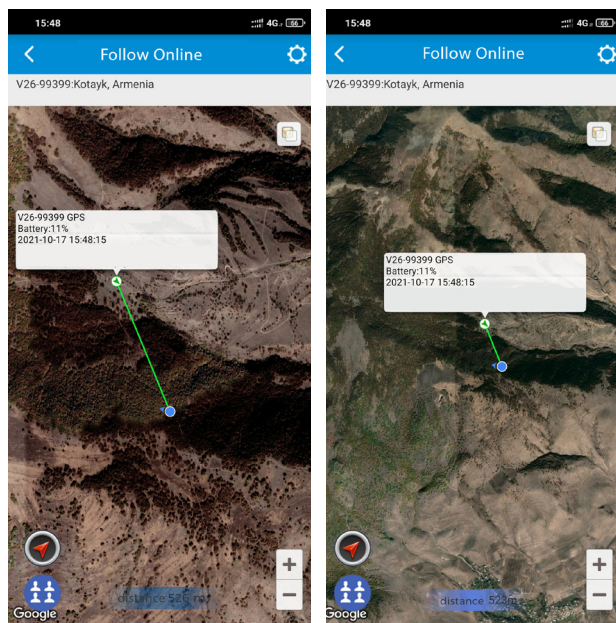

Figure 3. Detection of a cow via phone application.

Information collected throughout 3 years enabled to conduct different types of analyses. Particularly, there is an opportunity to calculate the average distances between the cattle barn and the area where the cow is grazing with straight line, whereby it is observed, that as soon as dry weather conditions are recorded, the cows walk up to 3.5 km away from the cattle barn in September-October (Figure 4) (https://gps123.org/).
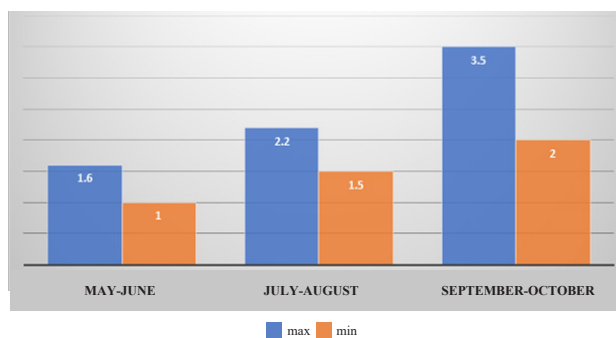

Figure 4. The average distance of the cow in the pasture from cattle barn with straight line in free grazing conditions (day/km) *(composed by the authors)*.
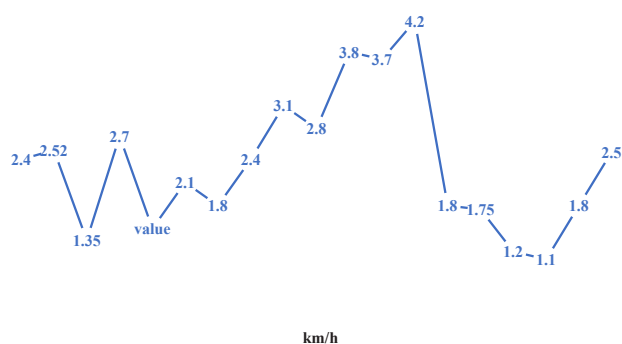
Figure 5. The average cow speed moving to the pasture during the day *(composed by the authors).*

In Figure 5 the average movement speed of the cow after leaving the barn is introduced. In the result of studying and analyzing the retrieved data we have identified the sites where the cows factually graze and their precise areas.

Collating the obtained spatial data with the cadastral map, we have recorded that for the recent 20 years about 45 ha land areas registered as grasslands in the land balance, have been factually used as pastures starting from May due to free grazing, as a result of which it is impossible to organize hay-mowing in the mentioned areas (Figure 6).
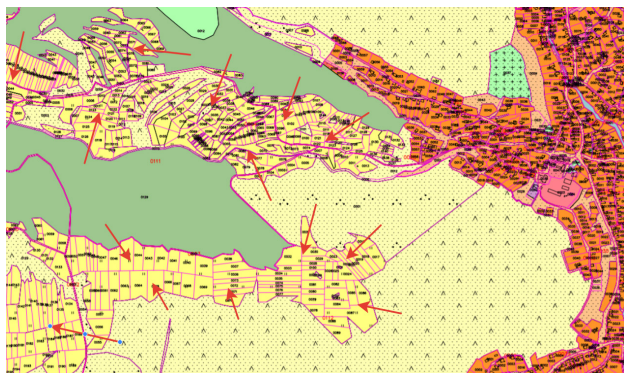

Figure 6. Fragment from the cadastral map of Arzakan, where the grasslands indicated with the arrows are factually used as pastures.

Conclusion

The role of Geoinformation systems in monitoring over the rangelands situated in the piedmont and mountainous zones of the Arzakan and other communities of the Republic of Armenia is indispensible to estimate the factual areas of pastures and grasslands and to combat the problems related to overgrazing. Should the farm households in the rural communities be equipped with such devices and facilities it will be possible to collect reliable and periodically updated information about the rangelands.

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