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Studying the distribution of population of Mountain Shirvan in the GIS environment

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Abstract

The paper deals with studying of resettlement of population of Mountain Shirvan region in the GIS environment. This mountain region for long has been known as one of lagging economic regions of Azerbaijan with its very low urbanization rate. Mountain Shirvan for decades experienced continuous out-migration. In this paper, upon conducting a comparative analysis of the two last population censuses we found that tens of settlements have experienced depopulation in the region. Moreover, through GIS mapping which included data collection (aerospace images and statistical information), mapping in ArcMap 10.8 program with using Overlay tool, and geostatistical analysis in ArcToolBox, we defined the features of spatial distribution of the population, and the geographical coverage of rural areas in the territory of Mountain Shirvan region.

1. Introduction

Sustainable demographic development of rural settlements is very crucial factor for mountain regions. These regions recently were less preferred by the population since they became less attractive in economic and social terms. Tens of villages experienced depopulation or faced depopulation in recent decades in various mountain areas of Azerbaijan. Out-migrations and the intensity of these processes are influenced by specific economic activities. The less profitable the jobs are, the more willingness of people to leave the place of residence in favor of regions with much higher economic opportunities.

We carried our study on the example of Mountain Shirvan region of Azerbaijan. Studying the distribution of population and the resettlement processes on the example of Mountain Shirvan is very topical issue, since demographically it is less competitive than other regions of the country.

The aim of this paper is to determine the distinguishing features of geographical distribution of population, and assess the demographic sustainability of rural areas and settlements of Mountain Shirvan through revealing the changes going in the population number.

2. Methods

To assess the demographic situation and favorability of demographic tendencies going in Mountain Shirvan in the last two decades, we reviewed relevant scientific literature. Based on available literature and fieldworks, we also considered the influencing role of geographical conditions and factors in resettlement. Analysis of the statistical data on the population number of rural settlements by region's 4 administrative districts – Shamakhi, Ismayilli, Aghsu, and Gobustan was carried out. We compared the results of the two censuses (of 1999 and 2009 years) on the region's villages to define where either population growth or depopulation has occurred.

Meantime, the territory of Mountain Shirvan was studied in the GIS environment which allowed make both the relief properties and the geographical distribution of the region's population more clearly visible. Studying in this context includes the compilation of three maps by us to demonstrate how the population is distributed in Mountain Shirvan, and at what degree in geographical terms, the studied territory is occupied by population. To examine the role of relief (altitude) factor in resettlement, we created a relief model in the ArcGIS 10,8 program which included the steps below:

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1. DEM model.
2. Heights are revealed by using the Extract_Point tool.
3. The obtained heights were used in the IDW tool.
4. Shapefile of settlements was integrated to the map. The outcome: Integrated maps of the relief model and the location of settlements done.



Figure 1. Interpolation analysis of the relief of Mountain Shirvan

Following this, Landslide model, for which DEM-model served as the primary data, was created. This was achieved in SAGA GIS program (Figure 3).

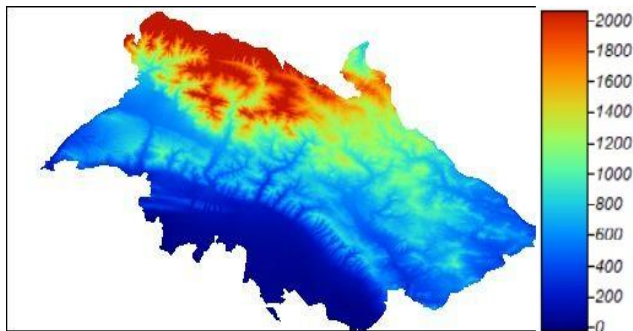


Figure 2. Digital Elevation Model (SAGA GIS) of Mountain Shirvan

To demonstrate the distribution of the settlements present in the studied region, a map of settlement was compiled in ArcGIS (Figure 3) that allows compare the density of existing settlements (rural areas) within the boundaries of Ismayilli, Aghsu, Shamakhi, and Gobustan districts of the region.

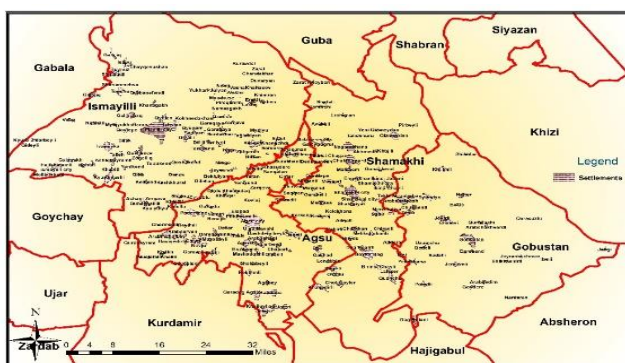


Figure 3. Distribution of settlements in the territory of Mountain Shirvan

3. Data analysis

In the Mountain Shirvan region, natural conditions are different, and natural resources, suitable (fertile land resources, fresh water resources, etc.) for economic activities are distributed unevenly in its territory (Tanriverdiyev and Safarov 1999). Fragmentation of the relief as well as the presence of inclined hills and descents and ascents may challenge the settlement process in some parts of the region (Budagov and Mikayilov 1996). From west to east in most part of the region, the altitude of relief increases. The foothills and low mountain areas of Shamakhi and Ismayilli districts are more populous, and the number of rural settlements in such areas is higher than others. Arid climatic conditions, scarce water resources, lack of irrigation canals, limited access to irrigation conditions, and low soil fertility are the adverse factors affecting the distribution of population in Gobustan and in part in Shamakhi districts (Abbasov et al. 2022). Upper parts of the region with more than 2000 m of altitude have cold climate and are relatively unsuitable for residence of population. The Mountain Shirvan is the most landslide-prone region of Azerbaijan. Here certain settlements are regularly affected and devastated by heavy landslides which are driven by both natural and human factors (Ismayilov and Mustafayev 2012). This factor challenges the sustainable development of many settlements in the region. The areas alongside the rivers of Aghsu, Pirsaat and Gozluchay, as well as the transport and infrastructure facilities have been devastated over and over by heavy landslides and long-term influence of active erosional processes [Budagov and Mikayilov 1996]. There are 69 settlements with totally about 44 thousand residents, which live under certain risk of landslide in the region (Pashayev and Karimov 2012). Beside with relatively flat plains and foothill areas, widely spread in the economic region, the medium and high mountain areas and high valleys altitude of which may reach up 1200-1300 m (Lahij, Mudri, Chukhuryurd etc.) are useful for settlement and agriculture (Tanriverdiyev and Safarov 1999).

There are significant differences in population number and density throughout the territory of the Mountain Shirvan. The villages in this region are of different sizes, thus, depending on relief, they are grouped in smaller areas constituting group of rural settlements, whereas in other places are evidently scattered and located far from each other, in particular in Gobustan district.

Population number of the Mountain Shirvan region is 326.8 thousand, consisting 3.2% of Azerbaijan's population. There are 272 villages in the region. 67.6% of all villages are in the territory of Shamakhi (38.6%) and Aghsu (29.0%) districts. Shamakhi with 105.1 thousand residents is the largest district, combining 33% of the region's total population, while Ismayilli is the second and Aghsu is the third (Table 1). The latter has the highest population density. The average size of rural settlements is very different by four districts: 970 persons in Shamakhi, 730 persons in Aghsu, 555 persons in Ismayilli, and 1190 persons in Gobustan, while the average figure by the region is about 770

persons, as calculated based on the 2009 census. 65.8% of the population of Mountain Shirvan is composed of rural population, and only 34.2% are urban residents [PoA, 2022].

Table 1. The main demographic data of the Mountain Shirvan region

Territory	Territ. area in thous. km ²	Popul. number. in thous. pers (2022)	Pop. density, thous. per/km ²	Urban popul. (thous. person)	Rural popul. (thous. person)
Shamakhi district	1.67	108.1	65	50.8	57.3
Ismayilli district	2.07	88.2	43	28.6	59.6
Aghsu district	1.02	80.5	79	22.4	59.7
Gobustan district	1.37	48.4	35	10.0	38.4
Mountain Shirvan region	6.13	326.8	53	111.8	215.0

Source: Population of Azerbaijan. Yearbook of the State Statistical Committee of the Azerbaijan Republic, 2022.

4. Results

Upon comparing the census data of 1999 and 2009 years we found that decline in population number has been common for 55 settlements present in the region.

In Shamakhi district, 1 urban type settlement (Sabir) and at least 11 villages (Talishnuru, Birinji Chayli, Ikinji Chabani, Avakhil, Adnali, Hajigadirli, Yenikand, Karkanj, Gurtepe, Nagharakhana, Pirbayli) have reduced in number of dwellers. Even larger villages (e.g., Birinji Chayli with 1603 residents) were among them. Highest decline at 181 persons has been fixed by Ikinji Chabani village. The small village of Ajidere almost disappeared by 2009. Growth in population number was lower in Sabir settlement, as well as in the villages of Hajili, Dedegunesh, Birinji Chaghan, Sefali, Chabani, Chiragli, Shirvan, Sabirli, Melhem, Angakharan, Kechmedin, Galaderesi, Sis, Chol Goyler etc.

In Aghsu, where tens of smaller villages with around 100-200 residents are present, 9 villages out of 79, experienced decline in population number. Decline equaled 102 persons in Shahbeyli village, 34 persons in Nuran, 22 persons in Muradli, etc. In at least 8 smaller villages, the risk of depopulation is relatively higher.

Among the four districts of the Mountain Shirvan region, highest concern over depopulation is in Ismayilli, where 27 settlements out of 105 one's experienced decline in population number. They are the urban settlement of Lahij, and the villages of Ivanovka, Gubakhalilli, Girk, Nanij, Guyum, Namazgah, Keyvandi, Mulukh, Qoydan, Zarat, Ustalgishlag, Shabiyani, Bahliyan, Kelbend, Shukurchu, Yenikend, Garagaya, Goshakend, Tubukend, Gezli, Mudri, Gersele, Zergeran, Machakhy, Keshkhurt, and Pireganim. Almost every fourth village in Ismayilli district has experienced depopulation.

In Ismayilli, the villages facing very high risk of disappearance are quite in number as well (such as Piraganim, Garcha, Dahar, Keshkhurt, Tubukend, Kenaa, Khimran, Mulukh, Zarat, Gersele, Dvoryan and many others). A few of them with around 10-20 residents or lesser, indeed, are either almost disappeared or will disappear in the next future.

In Gobustan district, population number of 9 villages has been decreased, including of Nardaran (as less as 63 persons), Gurbanchi (38 p.), Mudrise (36 p.), Julyan (30 p.), and others. Several rural settlements such as Dagh Kolani, Shikhlar and Damlamaja actually have disappeared long ago. More than a third part of all villages in Gobustan are currently have a risk of depopulation.

Our numerous visits to the region of Mountain Shirvan proved the presence of depopulation problem here. The actual population number of many villages in the region is lower than the figures shown in the official statistics. Typically, big portion of younger and medium generation (some also with their family members) currently lives and works actually not in their home villages but in other places, mostly in the city of Baku.

The map of settlement compiled (Figure 1) shows how unevenly the population is distributed across the region of Mountain Shirvan. In Shamakhi district, where 1 city, 5 urban settlements and 57 villages are present, the density of settlements and population is very different. Some settlements are in the areas close to Shamakhi city. To the south, as well as in the areas over 1500 m, the density is low. With 41.2 thous. Inhabitants, Shamakhi city accounts for 38% of the population of the same district (PoA, 2022). With more than 40 thousand residents, it is the biggest city in the region. We identified 6 small rural areals in Shamakhi.

The villages belonging to the first group are located south of the district center – in the Langebiz range district, mainly on the right bank of the Pirsaat river. It includes Kalakhana, Kerkanec, Adnali, Sabirli, Charhan, Nuydü, Dag Bagirli, Yenikend, Goyler Dag, Lalazar, Birinci Chayli, Gushchu, etc.

Another rural area covers the direction of Langebiz ridge with the highest demographic potential in Shamakhi district. There are Bagirli (2.1 thousand people), Ovchulu and other relatively villages here. All are located in relatively flat areas.

The third important rural area includes the villages located around the highway from the city of Shamakhi to the city of Ismayilli. This area is located in the northwestern end of the Langebiz range. Garavalli, Malcak, Gurdtape, Shirvan, Saghian, Sharadil, Mirikend, Munganli, and Biguk Khirisli villages are located within the area.

The fourth village area of Shamakhi district is a group of villages located geographically close to the district center, a little to the east and northeast of it. There are villages such as Chabani, Ikinji Chabani, Hamyali, and Gonagkend. This area, which belongs to the low and medium highlands, is also one of the landslide-prone areas.

The fifth village area of Shamakhi district is a group of villages located in the north-west of the district center, mainly in the middle highlands. Here,

Dedagunesh, First Jagan, Second Jagan, Kechmeddin, Galeybugurd, Galadaresi, Sis and other villages are more compactly located than others.

Angakharan, Chukhuryurd, Nagarakhana, etc. from Shamakhi in the direction of Yusif Mammadaliyev settlement. villages are found. They form the sixth rural area.

In Aghsu district, where, unlike Shamakhi, Ismayilli and Gobustan districts, the territory is composed mainly of plains, relatively high density of villages is present. The city of Aghsu, a center of the district, has 22.4 inhabitants [PoA, 2022]. Aghsu district is distinguished by the presence of numerous small villages. There are 6 villages only in Aghsu with population number at 3000-5500 persons. There are relatively large villages such as Gagali, Bijo, Kandoba, Kalva, Arabushagi, Padar, Arabmehdibay etc. in the region.

Based on the mapping, we identified 9 small village rural areas in Aghsu: Bozavand-Agharkh, Gagali-Arabushagi-Chaparli, Bijo-Langabiz, Garagoyunlu-Novju-Arabsarvan, Padar-Pirhasanli, Kandoba-Abbaskhanly, Gurjuvan, Nuyudlu-Girlar, and Kalva (Figure 1). Most of these rural areas involve smaller villages only.

In Ismayilli district, where the relief and biodiversity conditions are complex and various by areas, and where certain part of the territory is not only landslide-prone but is also vulnerable towards rockfall and talus processes, a few rural areas are evidently seen (Figure 1). Due to the relatively large area of Ismayilli district, and because of various relief features, and climatic conditions, the villages here are geographically scattered at higher degree.

Concentration of settlements in the territory of Ismayilli district can be grouped as follows:

1. Villages located to the right of Shamakhi-Aghsu-Ismayilli highway, either in the vicinity or relatively far to this main transport road of transitional importance.
2. Highland villages located higher than the Lahij area, those scattered towards the Burovdal village.
3. High Mountain villages on the right bank of the upper flow of Girdimanchay River.
4. Mountain villages occupying the northwest from Ismayilli city.
5. Villages located on the plateau of Gash, the western part of the district.
6. Villages spread to the southwest and south from Ismayilli city.
7. Villages located to the east from the Ismayilli-Kurdmashi highway.
8. Villages located to the southeast of Ismayilli city, the foothills of the Langabiz mountain ridge and adjacent areas.

The city of Ismayilli, located in the center of the district, and thus, having almost same proximity to most villages present, has 26.2 inhabitants (PoA, 2022).

Gobustan district is located in the eastern part of the Mountain Shirvan, and it is characterized by the high territorial capacity and the lower number of populations. Its center, the town of Gobustan has only 9.5 thousand residents (PoA, 2022). No big rural settlements are available around this town (Figure 2). Settlements are scarce. The demographic capacity of

both the administrative center and rural settlements is low.

5. Conclusion

As our studies show, the process of formation of rural agglomerations is weak in the region. This concerns particularly Ismayilli and Shamakhi districts, while in Gobustan district the villages are scattered at high extent and unfavorable to form rural agglomerations at all. Most of rural settlements present in mountain areas is typically lagging compared to foothill rural settlements for demographic development.

Though rural settlements have formed 6 rural agglomerations in Shamakhi, 9 villages in Aghsu and 8 villages in Ismayilli, most of these rural settlements are smaller in size, and of high concern in terms of depopulation and even disappearance driven by the continuing out-migration. The presence of villages of the disappearance risk is typical mostly for Ismayilli, and at lesser extent for Shamakhi and Gobustan districts.

Upon exploring the distribution of settlements in the territory of Mountain Shirvan region, we found out that totally 55 settlements in this region have already experienced depopulation. About 8-10 villages have been disappeared or almost disappeared in the first decade of the twenty first century, given the condition that the number of their residents is extremely small. As our study showed, around 30 villages in the region are under the high risk of disappearance, while, a few tens of others are also associated with presence of such risk at relatively lesser degree.

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