Assessment of Natural Disasters and Climate Change for Lower Alazani-lori Pilot Watershed Area, Plan of Mitigation & Adaptation Measures

Republic of Georgia

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Abbreviations and Acronyms

ACF International	Action Against Hunger
ADB	Asian Development Bank
AID	Agency for International Development
APA	Agency for Protected Areas
CARE	Care International
CDM	Clean Development Mechanism
CENN	Caucasus Environmental NGO Network
CO_2	Carbon dioxide
DRR	Disaster Risk Reduction
EBRD	European Bank for Reconstruction and Development
ECHAM	Atmospheric General Circulation Model Developed at the Max Planck Institute for Meteorology
EIA	Environmental Impact Assessment
EU	European Union
FIU	Florida International University
GHG	Green House Gases
GIS	Geographical Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit, GmbH (German Society for International Cooperation, Ltd.)
GLOWS	Global Waters for Sustainability
GoG	Government of Georgia
UNDP	United Nations Development Programme
UNESCO	United Nations special agency
USAID	United States Agency for International Development
Ha	Hectare
HADCM	Hadley Centre Coupled Climate Model
HPP	Hydropower Plant
IHE	International Hydrological Education

INRM	Integrated Natural Resource Management
INRMP	Integrated Natural Resources Management Plan
INRMW	Integrated Natural Resources management in Watersheds of Georgia
KfW	Kreditanstalt Für Wiederaufbau (German Development Bank)
Km	Kilometer
km^2	Square Kilometer
MoE	Ministry of Environment
m	Meter
m^2	Square Meter
m^3	Cubic Meter
mm	Millimeter
NGO	Non-governmental organization
PA	Protected Area
PRECIS	Providing REgional Climates for Impacts Studies
Riv.	River
ROFIU-GE	Representative Office of FIU in Georgia
SHPP	Small Hydropower Plant
Sida	Swedish International Development Cooperation Agency
WB	World Bank
WI	Winrock International
WMO	World Meteorological Organization, special UN agency

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Methodology of Reserch

In the presented report, the methodological approach for issues of expected climate change adaptation and natural disaster risk reduction implies the analysis of the risks of natural disaster processes (landslide-mudflow processes, floods, droughts, etc.) and their adaptation measures on the pre-selected areas. The analysis considers the current climate (1996-2006 baseline period) and the expected changes between 2020 and 2050.

For the assessment of hazards caused by climate change, high-precision, forecasting climate models and development of corresponding scenarios for climate change are required. This would make possible to forecast the probability of extreme phenomena (maximum temperature, droughts, abundant precipitation, floods, etc.).

Climate change scenario (which was used to analyze the expected changes in the meteorological elements on the target territories between 2020-2050 presented in this report) was processed using the PRECIS regional model. This model used ECHAM4 global model and the A2 and B2 scenarios of the worldwide socio-economic development. PRECIS regional model was calibrated on the territories of the municipalities presented in this report, using the results of actual meteorological observations during the baseline. This was the methodology for developing the scenarios of the modeled climate parameter (air temperature, atmospheric precipitation, wind, etc.) changes for the years 2020-2050 for the municipalities presented in this report.

Using the aforementioned scenarios, within the target areas, taking into account the changes in the climate between 2020-2050, the probability of occurrence of natural disaster processes has been estimated (mudflow, landslide, floods, droughts, uncomfortable temperatures), as well as their frequency and magnitude. In order to understand the probable future effect of climate change on target areas, it became necessary to prepare a short description of the components of the physical-geographic and socio-economic environment of these areas. Thus, the report briefly describes the geological composition, geo-morphological peculiarities, natural processes, soils, plant cover, and main fields of local economies for the target municipalities. Based on these components of expected climate change effect analysis, main problems and the adaptation measures have been identified.

Risk Assessment

Risk assessment is a process, which defines the qualities of the risk and its type and is based on the combination of technical characteristics of hazards, population vulnerability and their exposure to risks. Therefore, disaster risk can be conceptually presented in the following way:

Disaster risk = hazard * vulnerability * quantity of elements exposed to the risk

When analyzing risks, three main components are usually identified:

- Hazard;
- Vulnerability and Elements exposed to the risk, which have spatial, as well as non-spatial characteristics.

Hazards are characterized by their temporal probability and intensivity, which derives from the frequency/magnitude analysis. In the formula, the hazard component relates to the probability of occurrence of hazardous processes in the concrete time period (baseline). During analysis, different types of hazards will be taken into account: flood, mudflows, erosion caused by rivers, landslides, rockfalls. For hazards assessment, the historical information about the occurred/recorded disasters and the scale of different disasters was used, as well as the information gathered by the fieldwork team within the scope of program. During the field work, the natural hazards in the target areas were identified in detail using the participatory methods. Subsequently, the spatial probability was calculated. The eventually used hazard information was based on the data of the recorded natural disasters.

To calculate the social, physical, ecological and economic vulnerability, a qualitative-spatial multi-criteria assessment technology was used. The following characteristics of the target areas were assessed – the demographic situation of the population, infrastructure, communications, economic and social characteristics of the community, ecological conditions of the target areas, ability to respond to natural disasters. Finally, the vulnerability result was formalized and the extent of vulnerability was quantified on a scale from 0 to 100.

At the last stage of assessment, for all types of hazards (high, moderate, low) and taking into account the vulnerability of the elements exposed to risk, risk assessment was conducted based on the spatial analysis. Risks were defined on a scale from 0 to 1.

Additionally, we would like to mention that the field work conducted within the scope of the program, included every community of the target river basins. Besides the vulnerability assessment, the field visits entailed the first-hand inspection of territories containing the hazards, taking GPS coordinates and photo documentation.

Greenhouse Gas Emissions

This greenhouse gas (GHG) emissions study aims to identify the transport, agricultural, industrial, waste, and stationary GHG emissions emitted by target municipalities over two watersheds of Georgia, Roni and Alazani-Iori. These GHG emission estimations will be used to develop municipality-specific recommendations and actions plans to reduce GHG emissions. Although the study focuses on data that relates to factors that can be impacted on by local government, such as municipal and public buildings and transport means, a baseline study will also be completed for each municipality.

The methodology of the study was developed primarily using Intergovernmental Panel on Climate Change (IPCC) 2006 and 1996 Tier 1 methodologies for estimating national GHG emissions. Due to the unavailability of some data, the baseline results of this study entail some degree of uncertainty.

Introduction

The present report was developed within the framework of the program “Integrated management of natural resources in watersheds of Georgia” (INRMW), implemented by a group of the following partners:

- Florida International University (FIU)
- UNESCO Instituted of Hydrological Education (UNESCO-IHE)
- CARE International
- Winrock International
- Caucasus Environmental NGO Network (CENN)

The geography of the program covers watersheds of Georgia: the Rioni River basin in West Georgia, and the Lori River and Alazani River basins in East Georgia. The following pilot watershed areas were selected for the implementation of the pilot program:

- Upper Rioni pilot watershed area – Municipalities of Oni and Ambrolauri
- Lower Rioni Pilot Watershed areas - Municipalities of Khobi and Senaki.
- Upper Alazani pilot watershed area – Municipalities of Akhmeta and Telavi;
- Lower Alazani-Iori pilot watershed area - municipality of Dedoplistskaro.

Within the framework of the program, it’s envisaged to assess the pilot watershed areas/municipalities in respect of their vulnerability to climate change and natural disasters; also, to develop a plan of corresponding mitigation and adaptation measures.

This report provides the assessment of Dedoplistskaro municiaplity (Lower Alazani-Iori pilot watershed area) in terms of vulnerability and risks of natural disasters. The plan of activities that have to be implemented for climate change and natural disaster mitigation and adaptation is provided based on the performed assessment.

1. General Characterization

1.1 General Information

Location

Area – 2,532 km^2.

Dedoplistskaro municipality is located in the easternmost part of Georgia at the altitude of 90-1,000 mm. It is bordered by: Sighnaghi municipality from the west and north-west, while south, east and north-east border coincides with Georgia-Azerbaijan state border.

Relief

The Dedoplistskaro municipality boundaries comprise the southern-eastern part of Gombori ridge, southern-eastern part of Alazani accumulated plains and eastern part of Iori plateau (Gare Kakheti).

Southern-eastern part of the Gombori range is formed by conglomerates of Neogene period and molasse line formed with sandstones that is known as Tsivi (same as Alazani) line. At the southern-eastern end of this range, arround the territory of Dedoplistskaro town, there is a Nikoratsike mountain at the altitude of 1,000 m formed by the limestones and sandstones of Jurasic period. Alluvial and alluvial-proluvial loams and loamy road metals of Quaternary period participated in the formation of Alazani accumulated plains within the municipality borders. The plain lowlands of Iori plateau are filled by loams, road metals and partly lacustrine sediments (basically sandy clays) of mainly continental genesis of Quaternary period; while the anticline and monocline hills and hillocks located within the boundaries of the same plateau, are formed by clays, sandstones and conglomerates of continental and marine origin of Miocene and Pliocene age. The municipality territory is widely occupied by the formations of continental genesis of quaternary period represented by the alluvial, proluvial and partly diluvial sediments.

The main features of terrain of the Iori plateau eastern part are determined by smoth interchange of Monocline and Anticline hills, low mountains, and hillocks with Sincline (mainly flat bottomed) plain hollows. The slopes of the aforementioned hills, low mountains and hillocks are rather intensively segragated by dry valleys and ravines that have emerged as a result of occasional flows (formed during heavy rains). On the tops and steep slopes of the mountains and hills there is occasionaly developed badland relief – vertical precipices (so-called “Alesilebi”), clay hillocks of tower shape and others. Within the municipality borders, the Iori plateau is devided from Alazani River gorge by Kashi hill (747 m) and low ridge of Zilchi (845) at its south-eastern side. Along the latter the Alazani River has generated a narrow and deep gorge with tortuous course; its depth from the nearby mountain ridges reaches 400-600 m.

Within the municipality borders the most extensive plain hollows located on the Iori plateau is Shiraki Plains (lingth – 35 km, width – 15 km) that is bordered by Kushebis Tavi (832 m), Nazarlebi (685 m) and Kaladara (811 m) flat and smoothly topped hills from north and north-east. Didi Shiraki plains is continued by a Patara Shiraki plains (length - 15 km, width - 4 km) from south-east that is divided from it with Kaladara low hill. From east-south of Patara Shiraki plains there is located low hilled plains of Nagomrebi. Didi and Patara Shiraki, as well as

Nagomrebi plains are separated from Iori, Natbeuri, Taribana and Chachuna plains located to their west by KushebisTavi, Nazarlebi and Kaladara mountains and hills.

Souther-wasternmost part of Dedoplistskaro is occupied by Eldera plain with flat surface (length – 20 km, width – 6 km). The latter is located at the altitude of 90-200 mm. From north and north-east it is bordered by heavily fragmented hills and low mountains of Iori plateau.

Hazardous natural processes

The rocks participating in the formation of the terrain of the Dedoplistskaro municipality are distinguished by low engeneering-geological features. They are characterized by high sensitivity to erosive-denudational process, which creates favorable conditions supporting the development of hazardous natural processes. In addition, it also should be noted that the low energy of the relief (less absolute and relative heights, low quality of erosive fragmentation) significantly restricts the possibility of intensive development of the hazardous natural processes (first of all, geomorphological processes).

Because of the extremely arid nature of its climate, the municipality territory more easily gets influenced by the different types of droughts, which are accompanied by side effects of negative index of dampness coefficient, the soil drying process connected with it and wind erosion. It is well known that in the 80s of the XX century about 20,000 ha of arable land has been impacted by wind erosion intensively. From the beginning of the 90s of the same century, as a result of harsh deterioration of the energy conditions of the country, the big part of windbreaks and field protection wood zones were cut down that resulted in the increase of damage quality of the soil by the wind erosion. The increasing water erosion also should be mentioned. If in the 80s of XX century the 5.3 thousand ha of of the municipality agricultural lands were affected by water erosion, by the beginning of the XXI centruy this indicator increased twice. The erosion scale of north-western part of Alazani River gorge located within the municipality borders is also noteworthy. On the mentioned section of the gorge the river bed rather deeply cuts the easily dismantling sedminets (mainly silty clays) of Quaternary period. The river bed is highly curved with extensive meanders having high (sometimes 30-50 mm) precipice banks. Their steep edges are intensively collapsing and snowsliding. The mentioned process mainly marks the right bank of the Alazani River. As a result of erosions within the meanders borders the right bank of the river ebbs by 5-10m per year on avarage, therefore, tens of hectares of different types of land is lost (mostly riparian forest and pasture). The erosion of the river bank is particularly evident within Jumaskuri bay.

Among hazardous natural processes, particular attention should be paid to debris flows of relatively smaller scale and erosion associated with them. The development of the debris flows is connected with the erosive heavy rains and rocks with low engineering-geological characteristics that form the relief. Ravine erosion is widely developed in storehouses of the villages of Zemo Machkhaani, Kvemo Kedi, Samtatskaro, Arkhiloskalo, etc. Ravine erosion is more actively developed on the slopes of low mountains and hillocks (Kashi hillock, Zilcha, Kushebistavi, Kaladara, Nazarlebi, Kotsakhuri ridge, Burda mountain, etc.) of the Iori plateau eastern part located within the municipality borders. Because of strong exhaustion and erosion of the easily dismantling rocks, these places are marked with the relief heavily fragmented by statute and columnish forms, paralleled longitudinal ravines, etc. During the heavy rains sometimes debris flows are developed in the aforementioned ravines that produce the colluval fans formed on the last sections of the ravines by rough materials. Debris flows pass through the ravines one a year on average, while the one-time capacity of the material brought by them exceeds several thousand m3.

Landslide are less prevalent on the Dedoplistskaro municipality territory. Here, basically, a small area of shallow landslides occur on the slopes of Gombori range and hazard risk related to them is relatively insignificant.

As it was already mentioned, the municipality is characterized by sharply exposed arid climate which leads to the expression of intense droughts. The ratio of the terrestrial air temperature and total number of annual and seasonal atmospheric precipitation contributes to the creation of heavy deficit of humidity. The annual and seasonal indicator of the humidity coefficient of the municipality territory varies between 0.3-0.6. The thermal regime and the length of the vegetation period of the municipality territory create favorable conditions for the development of agriculture; however, because of the harsh deficit of humidity, the land needs to be irrigated.

On the eastern and southern peripheries of the municipality, the Alazani and Iori Rivers pass through their transitional sections. They are extensively used for irrigation pruposes before they enter the Dedoplostskaro municipality territory (for irrigation of the agricultural lands of Signaghi, Sagarejo, Gurjaani, Telavi, Akhmeta municipalities). Consequently, the full irrigation of the municipality agricultural lands is not possible with the water of the mentioned rivers.

It also should be pointed out that the Dedoplostskaro municipality is quite rich with the underground waters. In regards to the hydrodynamic conditions, the municipality territory is distinguished by two groups of underground waters – ground and artesian (with preasure) waters. Ground waters are mainly associated with the sediment horizons of Quarternary period, and the depth of their allocation varies between 5-60 meters. The sulfate-chloride and sulfate-gydrocarbonate-chloride waters are mainly dominating; the part of their supplies are spent on the evaporation and evapotranspiration. The mineralization quality of these waters are quite low and varies between 3-6 g/l on average.

It should be mentioned that in the 70-80s of the XX century the so-called "Small Reclamation" measures were successfully carries out on the Dedoplistskaro municipality territory. With the help of irrigation water coming from the newly constructed boreholes, the problem of irrigation of the agricultural lands was partially solved. Unfortunately, most of these boreholes are out of order nowadays; the water drifts out from them deliberately and is no more used for irrigation purposes. The deliberately drifting water transfers the surrounding area into swamps and ravines.

With the reconstruction of these boreholes and updating their technical equipment it would be possible to partly solve the problem of irrigation water deficit.

1.2 Climate

Ongoing Changes in Climate

Dedoplistskaro municipality is located in the area of moderately humid subtropical climate and is characterized by dry, subtropical climate – with moderately cold winder, hot summer and ample moisture deficiency (especially in July-August). According to the data of the Dedoplistskaro meteorological station (at the altitude of 800 m.) average annual terrestrial air temperature within the municipality borders varies between 10.1-10.3^{0}C, in July it is 21.7-22.6^{0}C, while in January it is -1.5-2.3^{0}C. The absolute maximum temperature is 35-38^{0}C and absolute minimum is -26-32^{0}C. The total annual precipitation is 540mm in the town of Dedoplistskaro, while in Shiraki plains lowland it is 650mm. The most arid climate is characteristic of Eldari plains lowland. The total annual precipitation does not exceed 250-300 mm here, the average temperature in July is 25^{0}C and its absolute maximum reaches 40^0C. The municipality territory is characterized by North-West and West wind, the average speed of which is 5-8 m/s. The strong winds are prevalent from February till April. In summer the South wind blows quite frequently with the speed of 1.5-2.5 m/s.

The vegetation period (with average daily temperature of more than 10^0C) in the municipality lasts about 6 months on average.

In order to reveal the ongoing changes of meteorological elements (air tempreature, atmospheric precipitation, wind) and other parameters, the average data of two 25 year periods (1956-1980 and 1981-2005) observed by the Dedoplistskaro meteorological station was used. The comparison of these data revealed that:

In the baseline period, the average multiannual air temperature has increased by 0.4^0C (mostly in summer- by 0.8^0C). Also, the absolute maximum temperature (excluding winter) has also increased – with the highest difference in summer ($+3^0$C). The absolute minimum has decreased in all seasons except summer. The average maximum temperature has increased (by $+5^0$C) during year and in all seasons, but mostly in summer ($+1.3^0$C). The average minimum temperature has relatively less decreased ($+0.1^0$C), mostly – in summer ($+0.5^0$C). The total annual atmospheric precipitation has increased by 6% in the second 25 year period. The increase of sediments was most observed in spring (+14%). The maximum value of the daily atmospheric precipitation has increased in the second 25 year span, particularly in spring – by 38% (26mm).

Maximum value of daily precipitation. In the second 25 year span the seasonal increase of this parameter was observed in the first half of the year – significantly in spring (26 mm, 38%). The increase of the average annual value of daily maximums is mostly caused by this parameter in spring (+4.4 mm). According to the linear trends, the daily maximum precipitation, as well as average and maximum values, according to the seasons in the baseline period was mostly increased also in spring. In summer the decrease of daily sediments was observed that significantly affected the development of agriculture because of the increased temperature and wind.

Average wind speed has decreased in all seasons, and particularly in spring and summer (-0.6 m/s). The annual decrease reached 0.4 m/s.

The increase of the strength of the **maximal wind speed** was observed in the cold season the most. The average annual increased value of the maximal wind speed is +1.6 m/s, while for the winter season it reached +2.9 m/s.

According to the last 25 year span data **winter** has become warmer compared to the first 25 year period (mostly on the expanse of the increased maximum temperature). The average daily amplitude of the temperature has increased ($+0.2^0$C). Compared to the first period, the number of cold days and frosty days has decreased by 13 and 18 days. The amount of daily precipitation has risen on this season, as well as the number of days with more than 10 mm sediments; however, the total amount of precipitation in the second period was less by 2%. The average wind velocity has decreased insignificantly, while the tendency of the maximum wind speed was positive. Thus, winter was warmer with more frequent extreme sediments, the possibility of the days with less sediments and the increase of the maximum wind velocity.

In **spring** the average temperature was slightly increases ($+0.1^0$C) in comparison with the other seasons. The average minimum temperature has decreased (-0.3^0C). The daily amplitude of temperature has increased (by $+0.5^0$C). During the last 25 year span the absolute values of the minimal temperature has also got warmer, nights got warmer in spring: between two observed period the number of nights when $T_{min}<0$ has decreased with 5 cases, while the number of frosty days when $T_{max}<0$ has increased by 16 days. At the same time, the relatively positive increase has been marked by the index of hot days (by 18 days). Total seasonal amount of precipitation in the second period has increased in very spring (+14%). The daily sediments have also increased by 26 mm. All the sediment indices have increased during this season. The number of days with 19 and 20 mm of sediments has significantly increased. In other words, spring was warmer and damper with less possibility of freezing.

In **summer** the air temperature has increased the most compared to the other seasons. Extremums (absolute maximum and minimum) have got warmer. During the whole period the number of hot days has increased by 227, while the number of tropic nights (Tmin>20^0C) – by 29 days in summer. During the whole discussed period the total seasonal amount of sediments decreases (by 4%), as well as the daily maximums. The only index that increased is the number of days with sediments (more than 50mm) that increased by 3 days between two periods. The wind speed has decreased the most, compared to the other seasons (-0.6 m/s), while there is no sustainable trend revealed in the change of maximum wind. Thus, taking into consideration the increased temperature and decreased precipitation, the risk for summer is the increase of droughts.

Autumn has become warmer on the expanse of the increased maximum temperatures. However, compared to summer, it has become less warmer (0.7^0C). The absolute maximum has increased by 1^0C, the number of hot days has increased by 124 days in the second period, there were observed two cases of tropic nights that have not occurred in the first period. The number of frosty days, when the maximum of a day is negative, has decresed by 3 days, while the number of frosty nights has increased also by 3 cases. The average minimum temperature has not changed that created the possibility of freezing in autumn. The total seasonal precipitation, different from summer, was increasing (+11%). In regards to the precipitation, the extreme climate indices (R10 mm, R20 mm, R50 mm and others) confirm the slight increase of sediments per day; the average wind speed was decreased by -0.4 m/s, while its intensivity was slightly increased. Thus, the autumn in Dedoplistskaro municipality was warmer and damper.

Extreme Phenomena

The precipitation indices show that the number of days with heavy sediments (when the total daily sediments are more than 10, 20 and 50 mm), as well as the consistent precipitation period has increased on the Dedoplistskaro municipality territory. This region is not characterized by redundant precipitation, the days with more than 50 mm of sediments has been observed 23 times during last 50 year span. From this, 9 cases were observed in the first and 14 cases in the second 25 year period, while the days with more than 90 mm sediments have been observed once per each period. Consequently, there was a low probability of landslides and debris flows. However, the extreme precipitation could create streams. Herewith, it should be noted that the case of total annual precipitation with 200 mm and more sediments was observed once in the first period and twice in the second one.

Table 1.1. The change in the amount of precipitation posing risks of mudflows and landslides

	Total daily precipitation > 50 mm	Total daily precipitation > 90 mm	The number of cases with total annual precipitation with 200 mm or more sediments
Change in the number of cases	+5	0	+1

Drought, as well as for the other regions, was assessed by the standardized index of precipitation. In the tables below the change of the recurring number of severe and extreme droughts between the two periods are displayed.

Expected Change of Climate in Years 2020-2050

For the Dedoplistskaro municipality the climate change scenarios for 2020-2050 years has been assessed by the PRECIS regional model developed according to ECHAM4 global model and using two (A2, B2) scenarios of the social-economic development of the world. The calibration of the model has been carried out by the real observed data of the Dedoplistskaro meteorological station. The average values of 30 years observation of the average air temperature and total precipitation for each month, as well as the values of the same parameters have been calculated ECHAM4 and HADCM3 models.

Modeled scenarios of climate change parameters for the Dedoplistskaro municipality are presented below.

Seasonal and annual values of the average air temperature, according to the both scenarios, have increasing character. B2 scenario shows the increase by more than 30^0C on average, except autumn (it should be noted that this tendency coincides with the increase in the baseline period on all seasons).

Average maximum of the air temperature, according to the both scenarios, increases in all seasons, and accordingly, annually (that continues the warming of the baseline period). According to the B2 scenario, it is possible that the average maximum temperature in summer and winter may increase by 3^0C, while in other seasons and annually by $2\text{-}2.5^0$C.

The average minimum temperature will also increase. The winter minimum will get warmer the most (according to B2 scenario by 3. 3^0C). According to A2 and B2 scenarios this increase will comprise $2\text{-}2.5^0$C in other seasons and annually.

Total amounts of **atmospheric precipitation** contradict all the change tendencies revealed in all seasons of the latter period. The amount of precipitation increases in winter (21%) and in summer (6-8%). In spring and autumn the decrease of precipitation is expected. The total annual precipitation will be almost the same as in the baseline period.

According to the scenario, the daily precipitation maximum, just as in the baseline period, is also expected in spring. In winter maximum value of the daily sediments decrease by approximately 1 mm. This climate parameter decreases in summer, while increases in autumn. The decreasing trend of the average value of maximum daily precipitation is revealed in all seasons and particularly in summer.

The average wind speed increases almost twice according to the future climate and goes back to the index of the first observed period on the municipality territory. It is noteworthy that the scenario shows the contradictory picture about the change of the wind average velocity of the last period in all seasons.

Analysis of the future scenarios is mostly based on the results of A2 scenario since the extreme indices are calculated for this scenario.

Winter in the Dedoplistskaro municipality will be warmer by 3^0C for 2020-2050 compared to the baseline period. The average maximum and minimum temperatures will also rise (presumably by $2\text{-}3^0$C). The number of frosty nights will decrease by approximately 15% compared to the first 25 year period of observation. The number of frosty days will decrease by 50% (136) compared to the baseline period. Total seasonal precipitation will increase by 17%. According to the climate scenarios there is a probability that the daily maximum precipitation, as well as its average value will double. The number of days with more than 10, 20 and 50 mm sediments will significantly increase. To summarize, it can be said that winter in the Dedoplistskaro municipality will get milder and more sedimental (on the expanse of the increase of days with more than 10, 20 and 50 mm).

In **spring** the rise of all three indices of the air temperature is expected by an average of 1.5-2^{0}C. The number of cold days will slightly decrease, as well as the number of frosty days. The number of hot days will significantly rise (with 70 days for 2020-2050 periods). There is a possibility of decrease of the total seasonal precipitation in future. The maximum and average values of daily precipitation will also decrease; however, the largest amount of daily sediments (78.8 mm) is expected to occur in spring. The number of days with more than 10 mm sediments will slightly increase (3 days), while the number of days with more than 20 mm sediments will decrease by 11%. The number of days with 50 mm sediments remains the same, while the number of days with more than 90 mm sediments will decrease. Despite the fact that spring is expected to be warmer, the big number of frosty days and nights still occur that is not favorable for early vegetation.

In **summer** the air temperature for 2020-2050 years may increase by 2.5-3^{0}C. The number of hot days is also expected to rise (by 450 days during 30 year period). There is a possibility for tropical nights to triple. According to A2 scenario the total seasonal precipitation will increase by 12%, while according to B2 scenario – by 9%. The extreme indices of precipitation shows the increase of days with more than 10 mm sediments in summer, and significant decrease of days with more than 20 and 50 mm sediments. The daily maximum precipitation and its average value will also decrease (by 33%).

In **autumn** the average, average maximum and minimum temperature are expected to increase. Compared to the first period, the average temperature will increase by 2.5-3^{0}C. The number of cold days with frosty nights may decrease by 90 days, while the number of frosty days will insignificantly decrease. The number of hot days will decrease by 5 days. According to the A2 scenario, the autumn will get warmer mainly on the expense of the increased night temperature. The total seasonal precipitation will decrease according to the both scenarios. The maximum amount of daily precipitation will increase, while its average value will decrease by 12%. The number of days with 10 and 20 mm sediments will not change, however, the number of days with 50 mm sediments and more will increase. According to all these data, the autumn in the Dedoplistskaro municipality will become warmer with the significantly decreased risk of freezing. The risk of extreme precipitation and landslides is not high here per se; however, the possibility of one-time occasions may increase.

Extreme Phenomena

Debris flow and landslide processes: The precipitation indices show that by 2020-2050 there is a possibility for daily maximum precipitation as well as the maximum amount of sediments during 5 days to rise on the Dedoplistskaro municipality territory. The number of days with daily precipitation of more than 10, 20 and 50 mm will decrease during a year. The duration of continued precipitation periods and continued dry periods will increase. The number of days with the risk of debris flows, with more than 50 mm sediments, will remains almost the same as in the second period of observation.

Table 1.2. The change in the amount of precipitation posing risks of debris flows and landslides in the period between 2020 and 2050

Debris flow and landslide processes	Total daily precipitation > 50 mm	Total daily precipitation > 90 mm	The number of cases with total annual precipitation with 200 mm or more sediments
Change of number of cases between the scenario and the first period of observation	+6	-1	-1

Thus, there is a possibility for the risk of debris flows to rise in the Dedoplistskaro municipality, while the risk of landslide processes is less possible.

Drought was assessed with a standardized precipitation index. The tables below show the change of the average number of recurring severe and extreme droughts between the three periods discussed.

Table 1.3. Total number of "severe droughts" of different length according to timeperiods discussed

Severe drought (SPI>-1.5)	1-month	3-month	6-month	9-month	12-month
1957-1981	17	23	23	27	30
1982-2006	20	18	17	10	11
2020-2050	23	28	30	28	27

According to the mentioned tables, the number of severe droughts of 1, 3 and 6 month length will increase by 2020-2050, while the risk of longer severe droughts and extreme droughts of almost all length decreases.

1.3 Hydrographic Network

Because of hot and dry climate, the territory of the Dedoplistskaro municipality lacks the constant rivers. The Alazani River (about on 90 km) goes along its north-east border only and the Iori River (about on 35 km) goes along its southern border. The mentioned rivers are Transit Rivers within the municipality borders. The municipality territory is fragmented by dry erosive valleys and ravines of small periodic rivers (Mlashetskala, Lekistskali, Pantisharatskali, Didi Ru, Kushiskhevi, Brotseuli Khevi, etc).

The Alazani River takes its source from the Caucasus Range. It is created by meeting of Samkuristskali and Tsiplovani Khevi Rivers at the village of Khadori at the altitude of 825 m (Alazani joins Mingechauri reservoir on Azerbaijan territory). The length of the river is 351 km, while the total drop equals 745 m, and the area of the watershed comprises 11,800 km.

The Iori River also takes its source from the Caucasus Range at the altitude of 2006 m (joins the Mingechauri reservoir). The length of the river is 320 km^2; the area of the watershed is 46-50 km, while the total drop is 3,520 m.

The rivers Alazani and Iori are fed by snow, rain and ground waters. In natural conditions they are characterized by spring floods, flash floods in summer-autumn and constant shallowness in winter. The runoffs of the mentioned rivers are featured by unequal distribution. Out of the annual runoff of the Alazani River, in spring it comprises 35-40%, in summer – 30-32%, in autumn – 20-23%, and in winter – 8-12%. From the annual runoff of the Iori River, 40-44% is in spring, 27-33% - in summer, 16-17% - in autumn, and 8-14% - in winter.

The resources of the Alazani and Iori rivers are of great importance for supplying the agricultural lands with irrigation water and generating hydroelectric energy. The upper and lower irrigation systems of Alazani are functioning based on the usage of the Alazani River runoff; they can supply about 220,000 ha of various agricultural lands with the irrigation water (in Kakheti and Gare Kakheti). The Sioni water regulatory reservoir is built on the Iori River that supplies the Tbilisi water storage ("Tbilisi Sea") with water. By the Iori River runoffs (with Samgori irrigation channels) it is possible to irrigate about 90,000 ha of agricultural lands (at this stage the Iori River is not used to irrigate Dedoplistskaro agricultural lands). Together with the aforementioned, the Alazani and Iori River runoffs are used to generate hydroelectric energy as well.

Observations on the Alazani and Iori rivers runoffs have been conducted since the beginning of the XX century (in respect to Alazani - at Shakriani, Chiaurim Zemokedi; in respect to Iori – at Lilovani). Hydrological observations finished by 1991; however, the materials of observation were published till 1986. According to the mentioned data, in order to calculate average monthly, average annual, maximum and minimum discharges of the Alazani and Iori rivers, the observation data of 1946-1965 and 1966-1986 were used. The tables below display the characteristics of the mentioned hydrological parameters in the multiannual dissection (see tables 1.4, 1.5, 1.6).

Table 1.4. Monthly and annual discharges of the Alazani and Iori rivers in the multiannual dissection

River	Hydrological checkpoint	F km^2	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	year
Alazani	Shakriani	2190	18.9	20.6	33.2	68.6	91.1	78.4	52.4	35.2	37.1	37.6	30.6	22.2	43.8
Iori	Lelovani	494	4.82	5.14	10.4	21.3	25.4	20.0	13.2	9.23	8.82	7.96	6.83	5.96	11.6

Table 1.5. Maximum discharge of different reccurency of the Alazani and Iori rivers

River	Hydrological checkpoint	F km^2	recurrence τ year					
			1000	100	50	20	10	5
Alazani	Shakriani	2,190	1,530	1,100	920	680	580	450
Iori	Lelovani	494	900	640	540	400	340	265

Table 1.6. Minimum water discharge of different maintenance of the Alazani and Iori rivers

River	Hydrological checkpoint	F km^2	Maintenance *P* %						
			75	80	85	90	95	97	99
Alazani	Shakriani	2,190	11.2	10.6	10.1	9.25	8.30	7.74	6.63
Iori	Lelovani	494	2.09	1.95	1.79	1.61	1.38	1.23	0.98

1.4 Soil

According to the FAO classification the following soil types are present on the Dedoplistskaro municipality territory:

- BLASK
- BLASK CALCAREOUS
- BLASK ALKALIZED AND NATRIC
- MEADOW BLASK
- SINNAMONIC CALCAREOUS
- MEADOW SINNAMONIC
- GREY CINNAMONIC
- SOLONCHAK
- RAW HUMUS CALCAREOUS
- RAW HUMUS SULFATE
- ALLUVIAL (CALCAREOUS AND NON- CALCAREOUS)

Synnamonic soils are mainly developed on calcareous rocks by the altitude of 800-1000 m and are characterized by positive physio-mechanical features with highl level of fertility. They are distinguished by heavy clay composition, well developed profiles, nuciform lumpy structure and good drainage conditions. The synnamonic soils contain about 6-7% of humus. The mentioned soild are easily susceptible to the influence of erosion processes.

Grey cinnamonic soils are widely spread on the municipality territory. This type of soils are on the next stage of the evolution of synnamonic soils. They rich with clay and calcareous, are featured by alkalized and natric characteristics. They have differentiated profile, positive physical and mechanical features, average content of nitrogen, phosphorus and potassium.

Meadow sinnamonic soils occupy a significant area in the Dedoplistskaro municipality, particularly on the forest-steppe transitional zone located on the slopes of the Gonbori range. In the genesis of the meadow sinnamonic soils the following development stages are outlined at the first stage: from the alluval soils of groves and meadows towards the meadow synnamonic soils.

Blask soils. This type of soil is rather widely speard on the municipality territory. They are distinguished by positive agronomic features and, therefore, are mainly used under the graining cultures. Blask soils have a well-developed profile, with clay-mechanical contents. They contain 5-6% of humus and, therefore, are rich with plant nutrition elements (nitrogen, phosphorus and potassium).

Blask alkalized and natric soils. Blask alkalized and natric soils occupy a big area on the Taribana, Natbeuri, Eldari and their border desert fields. The upper layers of the mentioned territory are natric, while the lower layers are strongly alkalized. That is why alkalized and nitric soils are created here. Alkalized and nitric soils are of heavy mechanical composition; the lower layers of the alkalized soils of Taribana, and particularly Natbeuri fields contain almost 65-70% of silt and colloidal particles (<0.001 mm), while the sum of <0.01 mm particles reaches 98-99%. The heavy mechanical composition of Taribana-Natbeuri alkalized soil determines their high absorbtion capacity, particularly in alkalized layers. The low absorbtion capacity of Chatma-Chachuna and Nazarlebi soils is expained by light mechanical composition of the soil.

Because of the basic characteristic of soil, climate and poor vegetation, the territory is mainly used for pasturing purposes. The territory is characterized of average and strong erosion (wind and anthropogenic erosion).

Raw humus calcareous soils belong to intrazone soils and are mainly speard between sinnamonic and brown soils. Compared to the Western Georgia, the raw humus calcareous soils occupy much less space in the eastern part of the country. The raw humus calcareous soils developed on the limestones are more frequent. On the steep slopes and lowlands the raw humus calcareous soils are characterized by big and average thikness, alkaling from carbonic lime and the heavier clay mechanical composition. The upper layers of the raw humus calcareous soils contain high percentage of humus (8-9%). In the lower layers of the soil the carbonic lime content reaches 70-80%. On the steep slopes the raw humus calcareous soils are easily affected by erosive processes. In the area of the raw humus calcareous soils there are open cast mines of various minerals, the explotation of which changes the visual esthetic appearance of the landscape.

Alluval soils. This type of soil is mainly developed along the floodplains of the Alazani and Iori rivers. Their biggest part is used to cultivate the gourd culture, while the other part is covered with floodplain forest. The alluval soils are characterized by high agronomic features, light mechanical composition, good structure and favourable conditions of drainage. The alluval soils are calcareous and quite rich with the plant nutritional elements. Sometimes, the alluval soils are natric on the municipality territory. Sometimes they have swampy parts as well.

1.5 Natural Vegetation

The natural vegetation on the Dedoplistksaro municipality territory is represented by: semiarid desert, arid light (sparse) forests, steppes and Mtistsineti deciduous forest formations. Here also are represented intrazone types of vegetation: phryganoid vegetation, Mtistsinebi semiarid deserts, hemixerophilic scrubs of shibliak type, riparian forests, secondary meadow steppes and natric meadows.

The semiarid desert vegetation is mainly distributed on the Eldari lowlands, Taribana valley, plains and hillock lines located on the middle and lower part of Lekistskali gorge. The main eddificators of the formation of this vegetations are: Artemisia (Artemisia fragrans), Salsola ericodes, Salsola dendroides, Salsola nodulosa, Nitraria choberi.

Arid light forests are spread on the Iori plateau and Eldari plain lowland (in the area of Chachuni, Kotsakhuri, Burdo mountain, Vashlovani, Kaladari, Kumroi, Bugha-moedani and others), from time to time they are also distributed in the riparian forests as well. The arid forests are created by Pistacia mutica, Juniperus polycarpos, also Georgian maple (Hacer Ibericum), nut tree (Celtis Caucasica) and Pyrus salicifalia.

Phryganoid vegetation is distributed on the south-eastern part of the Iori plateau (on the slopes of Chachuna, Kotsakhuri, Eldari mountain, territory of Vashlovani National Park, etc). This type of vegetation is basically created by Reamuria alternifolia, Caragana grandiflora Astracantha microcephala and others.

As a rule, the steppe vegetation is of secondary origin on the municipality territory. Its area consists of: Didi Shiraki, Patara Shiraki, Naomari, Oles and Jeirani gorges, Nagomrebi, Black Mountain, Kashebi, Serebi slopes, Iori, Chachuna, natbeuri steppes, etc. The steppe vegetation is represented by Botriochloeto and Stipa steppes.

Shibliak type vegetation is distributed on the north-western, central, eastern and southern parts of the Dedoplistskaro municipality. This type of vegetation is mainly represented by Paliurus (its big part is created on the expense of cutting down the arid sparse forests), Carpinus orientalis mills and groups of polydominant shrubwoods.

The boradleaf forests are not widely spread on the territory of the Dedoplistskaro municipality. The fragments of these trees can be seen in the west-norther, central and easter parts of the municipality at the altitude of 400-800m. Georgian oak, ash-tree participate in their formation. The undergrowth is formed by carpinus orientalis mill, hawthorn, jasmine, etc.

Riparian forests are spread along the riverbeds of the Alazani and Iori rivers. In particular, in the Alazani gorge – around Mijniskuri, around the village of Sabatlo; also, in the Iori River gorge – around Chachuni. The riparian forests are represented by aspen woods (Populus canescens) and oak woods (Quercus pedunculiflora).

Meadow steppes of the secondary origin are distributed in the north-western, central and eastern parts of the municipality. They are represented by polydominant graining-herby (Gramineto-varioherbetum) types.

Natric meadows are developed on the Alazani plains, along the banks of the Iori River and Southern part of the Eldari plain lowland. Vegetation of the natric meadows are mainly represented by Elytrigia repenus and Limonium meiery vegetational groups. Along the Alazani plains and partly the Iori River, natric meadows are replaced by cultural landscapes and pasturing fields on quite a wide area.

An important area of the Dedoplistskaro municipality territory is occupied by protected areas. At the first place Vashlovani National Park should be mentioned among them with 25,115 ha, Vashlovani preserved forest – 8,480 ha, Chachuna Aghkvetili – 5,200 ha and Eagle Gorge national heritage site. The existence of the protected areas prove the high level of the biodiversity of the municipality territory in respect to ecosystems, as well as the multiplicity of the standard and rear taxons of plants and animals.

1.6 Agricultural Activities

According to 2002 census the population of the Dedoplistskaro municipality comprised 30,910. Out of this number 7,430 people live in the town of Dedoplistsakro. The rest of the population lives in the rural area.

The leading field of the municipality economical sectoral structure is agriculture.

The leading branches of the economy are production of grain crops (mainly autumn wheat), livestock (mostly cattle breeding), viticulture, producing fruits and vegetables. The major part of the population is employed in agriculture.

The total land area of the municipality is 165,680 ha. The rural-agricultural lands occupy – 113,841 ha, agricultural land – 47,040 ha, the multiyear plantations – 2,718 ha (vineyards - 1,400 ha, orchards – 1,318 ha), pastures occupy 64,083 ha, forests – 20,941 ha. According to the data of 1988 the windbreakers occupied 1,770 ha of the municipality territory. Currently, 99% of them are cut down.

Agriculture

According to data of 2009, in the Dedoplistskaro municipality the agricultural land of 38,000 ha (wheat on 21,000 ha, barley – 11,000 ha, sunflower – 6,000 ha) was cultivated and planted, out of existing 47,040 ha. 9,000 ha of the agricultural land has remained uncultivated. The average productivity per 1 ha was: in case of wheat – 17 centner, barley – 12 centner, corn – 22 centner, bean – 7 centner, sunflower – 8 centner. It should be noted that according to the 1981 data, on the municipality territory there was planted 21,771 ha of grain (wheat – 15,330 ha, barley – 5,047 ha; oats – 215 ha; corn – 1,057 ha); 122 ha of bean; 7,000 ha of sunflower; eatable brassicas – 954 ha; silage – 5,211 ha. These data show that compared to 1991, in 2009 the area of the cultivated land was reduced by 5,318 ha. Productivity has also reduced. It should be mentioned that on the lands of the municipality territory that are cultivated annualy do not give the amount of productivity that can be received in absence of the irrigation systems. The main reason of this is the reduction of fertility of the land, not enough amount of organic and mineral fertilizers, ignorance of seed recycling consistency, low quality of seeds, not conducting the agrotechnical facilities on time, cutting down the field protection wood zones, etc.

It should be particularly underlined that the irrigation system that existed before is out of order, therefore, supplying the irrigation lands with water is a very important problem. To solve this problem it is vital to repair the water collectors, clean them up, build irrigation systems and implement state-of-the-art irrigation systems on the municipality territory. It should be noted that in number of villages (village of Pirosmani and others) the tradition is being implemented to irrigate the agricultural lands with the system of drop by drop irrigation that uses the water taken from artesian wells.

Livestock

According to the data of 2009, in the Dedoplistskaro municipality there were: 18,260 cattle (out of this – 8,000 cows; average capacity of 1 cow is 1,200 kg), 60,700 sheep and goats, 2,670 swine, 890 horses, 3,523 bee families, 64,700 poultry. For the record, it should be noted that in 1981 the number of cattle exceed 28,00, sheep – 147,900, swine – 31,700, bee families – 3,580, poultry – 176,000.

The total area of the transitional type of lands, as well as pasturing lands equal to 112,000 ha on the municipality territory. From this territory the municipality uses 64,000 ha of pasturing land (the rest of the territory is rented to the neighbouring municipalities). The municipality pasturing land is used by about 19,000 cattle and 61,000 sheep and goats. The pasturing lands are intensively exploited – they are reexploited twice and even sometime three times. Because of the intensivity of the exploitation the grass cover grows sparser, cord is being removed, the soil surface gets bare. As a result the soil is easily affected by water and wind erosion that in the end determines the reduction of their productivity. One of the main reasons of the harsh degradation of the pasturing (and mowing) lands is the disarrangment of the traditional systems of their exploitation and maintenance, complete ignorance of necessary agro-technical measures. It should be mentioned that in past the pasturing lands were undergoing chemical amelioration with the use of gyps in every 7-10 years. In order to raise their productivity, the different sort of mineral fertilizers were introduced to the pasturing lands. This practice is completely ignored due to the financial crisis or the negligence of the land owners. It also should be mentioned that because of the damage of the irrigation systems, these lands practically are not irrigated at all. In some places the constant strengthening of the process of becoming natric is evident because of more erosion and the accumulation of the natric materials brought to the lowlands of the pasturing lands as a result of erosive-denudation process of the steep slopes located nearby.

The increased droughts, that are connected with the expected climate warming by years of 2020-2050, may cause the reduction of the debit of the drinkable water for the livestock, and in the worst-case scenario – its complete disappearance. The serious problems with the washing of the livestock are also expected that in turn will contribute to the spread of diseases. The susceptibility of the municipality territory towards the increase of the summer temperature regimes and wind spead is by all means contributing to the degradation of the soil and the reduction of its productivity. In order to avoid these negative processes, it is assential to undertake the following steps in the first place: arrange and maintain the pasturing infrastracture of the municipality (wahing places, drinking water sources, shady posts, places to rest, etc.); set an order to use lands for the mowing and pasturing purposes; improve the surface of the mowing-pasturing lands; sow leguminous and drought resistent grass between them; also, it would be necessary to start mowing, pasturing and nomading 10-15 days earlier than usual, and, therefore, develop and new plans and schedules for the agricultural activities.

In case of irrigation of the agricultural lands, as well as considering the abovementioned recommendations, the global warming would not significantly affect the development of agricuture in the Dedoplistskaro municipality.

1.7 Assessment of health condition of the population

It is proved that the global change of climate significantly affects the human health.

In recent decades number of studies has been conducted by various countries, important international organizations and regional programs in order to determine the vulnarability of a human organism and health to the climate changes.

The climate change does not innovatively affect human health, however, it can worsen the sensitivity of deseases towards the climate change. That is why it is important to undertake ontime and effective intervention on global, as well as regional and state level.

In order to realistically assess the results of the climate change it is necessary to imagine what is the sensitivity of the population towards new conditions and whether they posess skills to adequately react to them. The relationship between sensitivity, adaptation skills and potential results is determined according to standardized schemes. The human health vulnerability towards the climate changes is determined by:

- perceptibility, which includes the level of sensibility of health, natural and social systems (on which the results of the population health depends in terms of influence) towards the changes in weather and climate; as well as the characteristics of the population, such as the level of development and demographic structure;
- dependence on the influence of weather and hazardous climate factors (including the character, level and frequency of climate variations);
- for the measures and activities taken for adaptation purposes that are directed at reduction of the concrete load negatively affecting human health (first level of adaptation); based on its effectiveness the approach of “exposition-reaction” is measured partially.

Those groups and subgroups of population and systems that cannot or do not want to adapt, represent the particularly sensitive ones, as well as highly vulnarable to weather and climate changes. In overall, the senitivity of population towards any threats to health depends on the local environment, material resources, effective management (high and local level), quality of infrastacture of public healthcare and access to the information.

For the report the indices of morbidity (incidents) and desease (prevalence) of the population of the Dedoplistskaro municipality has been studied in respect to communicable and non-communicable diseases, as well as addressing the medical institutions.

In order to study the morbidity tendency and structure of the population of the Dedoplistskaro municipality, the official statistical data of 2000-2010 has been research for the spread of disease in the Dedoplistskaro municipality, Kakheti region and the whole Georgia.

General morbidity and the increase of cases. According to the data analysis, the total number of ambulance calls and applied patients, as well as the number of 1 person applying to the ambulatories and polyclinic hospitals of the Dedoplistskaro municipality, in 2000-2010 has equaled to 2.5 that exceeds the country average index (1.83) by 1.3 times (the highest rate of addressing a doctor was observed in 2006 – 3.36, and in 2008 – 3.39). Therefore, the indicators of morbidity and number of prevalence is very high in the municipality. This is also proved by the fact that the official statistical data display only those cases of illness that were marked in the medical facilities.

Communicable diseases. The trend of increase or decrease of communicable diseases among the population of the Dedoplistskaro municipality is not significant. The figures of the spread of communicable diseases is quite low in the municipality if compared to the average country index. The peak of prevalence of such diseases has been observed in 2009 that exceeded the indicator of the previous year by 1.6 times. The mentioned situation is also consistent with the sharp increase of the index of communicable diseases in Kakheti region and in Georgia.

The increasing tendency of communicable diseases that is clearly observant in the country, and therefore, is also evident in the Kakheti region, can be caused by poor sanitary-hygienic conditions, as well as the increase of the upper respiratory tract infections and diarrheal diseases, the increased number of cases when patients applied to the medical institution, and therefore, improvement of the registration.

Cancers. The 2000-2010 data analysis of the index of cancer patients at the medical facilities in the Dedoplistskaro municipality has revealed that in 2007-2010 there is a significantly high level of cancer rate. This figure is close to the common indicators of Georgia and Kakheti region.

Diseases of blood and blood-forming organs. The data analysis of diseases of blood and blood-forimg organs among the population of the Dedoplistskaro municipality has revealed that in 2000-2010 the index of the pathologies of this group was very high that significantly exceeds the analogical indicators of Georgia and Kakheti region.

Endocrine, nutrition and metabolic diseases. The 2000-2010 data analysis of the endocrine system diseases in the Dedoplistskaro municipality shows that this index is significantly lower than that of Kakheti region, though frequently equals the average index of the country. Herewith, there is no important tendency of increased or decreased rate of the diseases of this group.

The diabetes occupies an important position in this group. The trend of its distribution in 2000-2010 shows that the indicators of diabetes in the Dedoplistskaro municipality significantly exceeds the overall index of the region. However, in respect to the region, the increasing tendency was also revealed in the Dedoplistskaro municipality in 2000-2010. The peak of prevalence of this disease has been observed in 2009 when the indicator exceeded that of the region by 2.1 times.

Nervous System Diseases. The analysis of 2000-2010 trend shows that in regards to the spread of nervous system diaseses, Dedoplistskaro municipality indicator is slightly lower than the overall country, as well as Kakheti regional indicators, that indicates a comperably low level of the patological diaseses of this group.

Cardiovascular diseases. The cardivascular diaseases has been increased throughout Georgia; the same trend was observed in Kakheti region, however, there was a decreasing tendency in the Dedoplistskaro municipality.

The increasing tendency of ischemic diaseases and hypertension is evident in Dedoplistskari municipality, as well as in Kakheti region; however, the indicators of the Dedoplistskaro municipality is much lower than the regional index. At the same time, in 2010 there was a sharp increase of ischemic diseases as in Dedoplistskaro municipality, as well as in Kakheti region. This should be caused by the increased number of cases when patients addressed the medical facilities; in 2009 the program of “village doctor” has started actively which means that every village has its doctor receiving salary from the state, and visit to doctor is free of charge for the population. The management and registration of chronical diseases (including cardiovascular diseases) is under the competence of the village doctor. Therefore, all patients that were not included in the official statistics are now registered by the doctor despite whether or not they have received treatment in the regional or other medical facilities.

Respiratory System Diseases. Ten year dynamic analysis of this group of diseases show that in 2000-2010 there is an increased tendency of respiratory diseases as thorughout Georgia and region, as well as in the

Dedoplistskaro municipality; the index of the latter for 2009-2010 in respect to the respiratiry diseases is almost similar to regional and coutry indicators, though still lower. However, in 2006-2008 Dedoplistskaro indicator was higher than that of the region and the country. The level of asthma is also high that in some cases exceeds the regional index. The abovementioned shows a high level of respiratory diseases in Dedoplistskaro including that of asthma.

Digestive system diseases. The analysis of 2000-2010 statistical data revealed that the level of digestive system diseases in Dedoplistskaro municipality is significantly low compared to the Kakheti regional and country overall level. The abovementioned shows a low level of pathological diseases of this group.

Urinary and reproductive system diseases. The trend of 2000-2010 of urinary and reproductive system diseases shows that in the Dedoplistskaro municipality the level of the mentioned pathological diseases significantly exceeds the overall regional and coutry levels. At the same time, since 2000 this index of regional and country level constantly rises. However, in case of the Dedoplistskaro municipality, the increasing tendency is more evident that indicates the high level of pathological diseases of this group.

Bone, muscle and connective tissue diseases. The analysis of the 2000-2010 data of bone, muscle and connective tissue diseases show that in the Dedoplistskaro municipality there is a sharp increasing tendency of the pathological diseases of this group. In 2006-2007 this index significantly exceeded overall country index, while according to the 2006-2010 data this region shows higher level of the diseases than that of Kakheti region. Therefore, it can be concluded that there is a high level of prevalence and increased tendency of these diseases.

Accidents and injuries. Dedoplistskaro municipality is distinguished with very high level of accidents and injuries. It should be noted that this index significantly exceeds the regional and overall country levels. This is mainly caused by big number of patients addressing ambulatories for minor wounds and superficial injuries.

Congenital malformations and developmental defects. In respect to this group of diseases the index of Dedoplistskaro municipality is much lower than the overall country level, though it exceeds the Kakheti regional index.

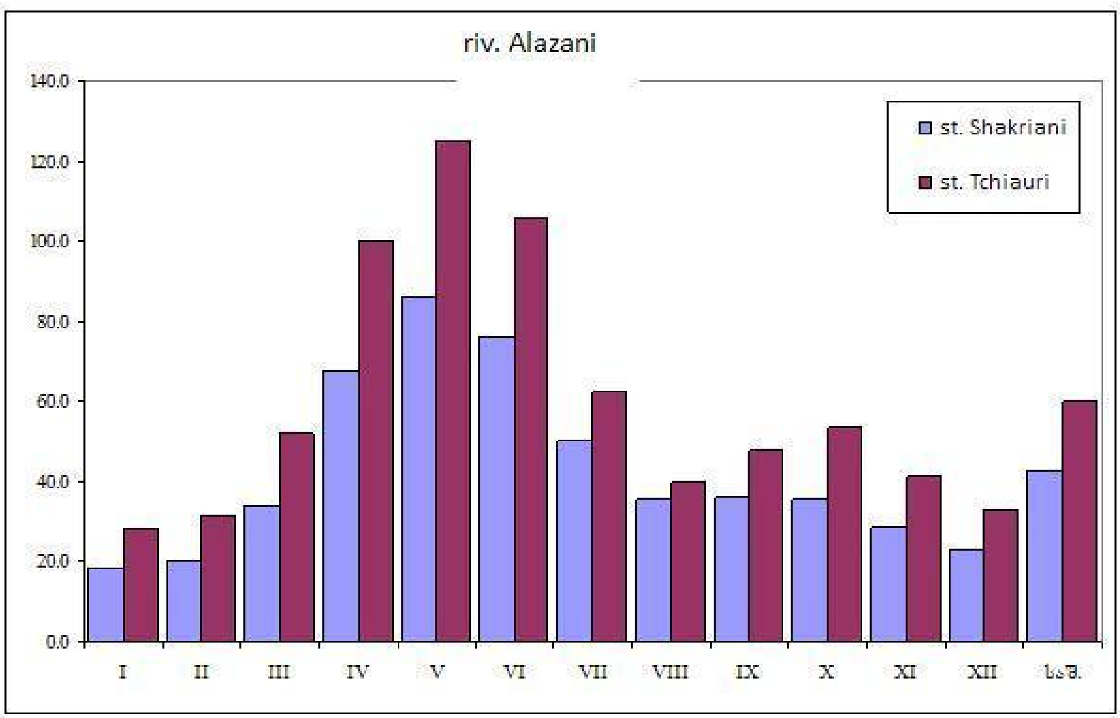
2. Vulnerability to Climate Change and Natural Disasters in Lower Alazani-Iori Pilot Watershed Area

2.1 River runoff and its inter-annual distribution taking in to account expected climate changes

The climate change scenario for the Dedoplistskaro municipality was used to study annual runoff and distribution for the municipality rivers (Alazani, Iori). Estimated changes in meteorological parameters are expected in this scenario in 2020-2050. Georgia's second national notification for climate change framework convention was also used. It is known that the annual liquid flow in rivers is distributed unevenly. Inter-annual runoff distribution is mainly determined by climatic factors. Thus, in regards to climate change, inter-annual distribution changes are more expected than annual runoff change on the Alazani and Iori rivers. Inter-annual distribution is expected to become more intense in future (runoff amount is expected to reduce during less-liquid period and vice versa, increased runoff during high-liquid period).

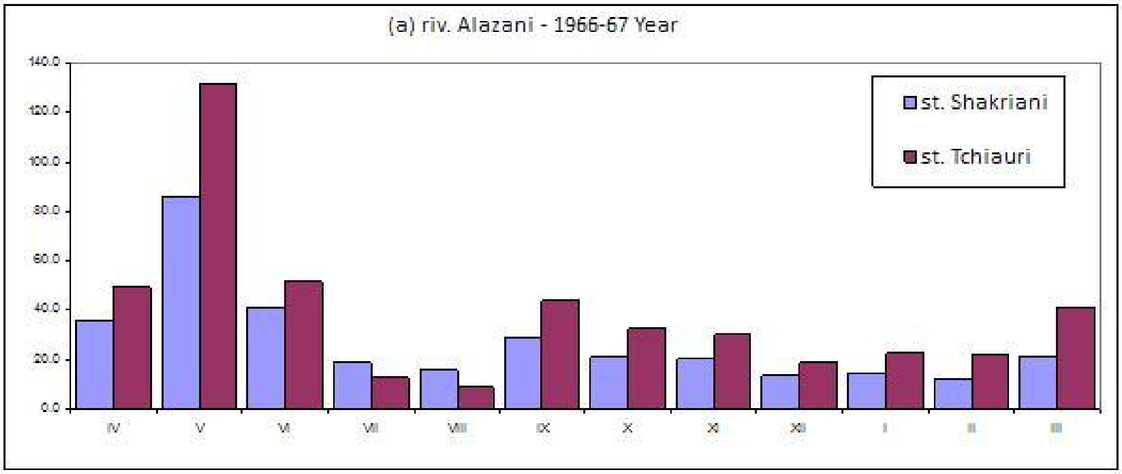
It is known that the inter-annual river runoff is distributed by months or seasons, which is expressed in terms of annual runoff values or to use a percentage of their parts. The joint analysis of these data gives a more informative and reliable results. Inter-annual distribution of water runoff is calculated by year, which starts from forth month (April) (see diagram 2.1)

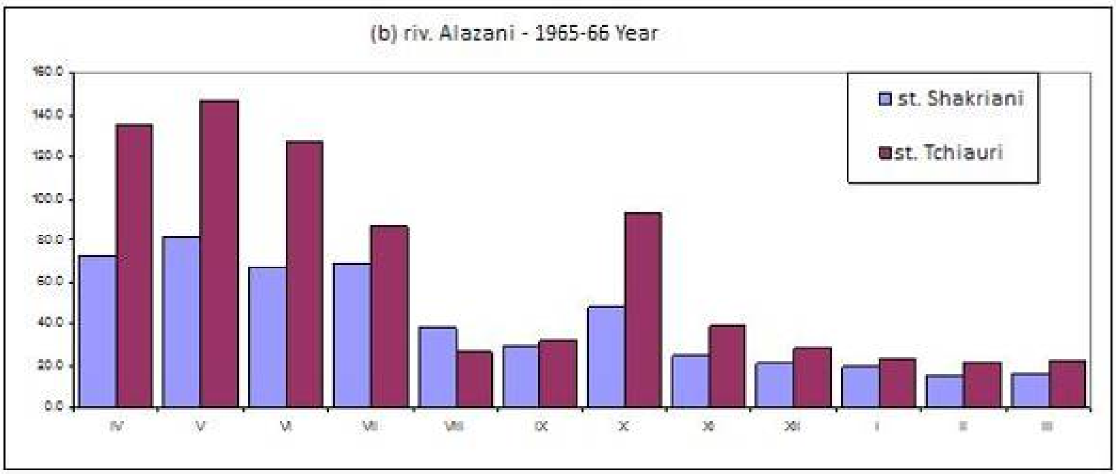
Diagram 2.1. Alazani River average multiannual discharge: 1. Village of Shaqriani; 2. Village of Chiauri

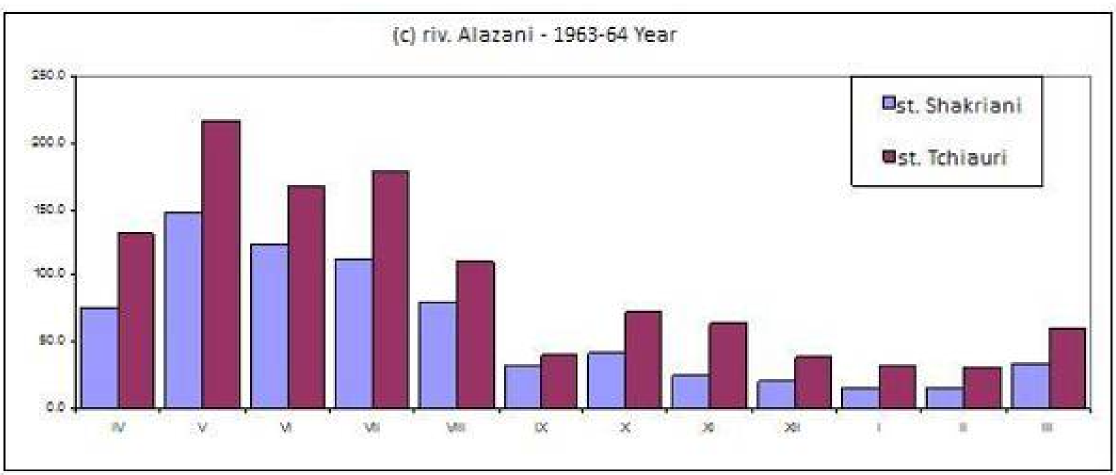


According to the diagram, inter-annual distribution of the Alazani River has the same trends at both stations.

Diagram 2.2.-2.4. Hydrographs of the Alazani River at villages of Shakriani and Chiauri: a) low-liquid (1966-67 years); b) average-liquid (1965-66 years); c) high-liquid (1963-64 years)







According to the diagrams, inter-annual distribution is same for all years, except average-liquid year, where there is a significantly higher cost in the village of Chiauri, which is typical of this station expenses for the month of October.

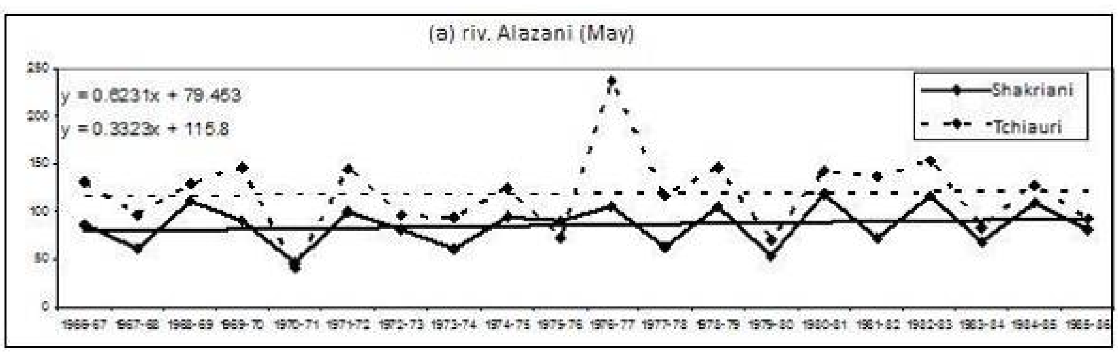
Because the Alazani River water is used for irrigation, the basic calculations were conducted for the irrigation period (V-IX months). The table given below shows the Alazani River average monthly and annual consumption in descending order.

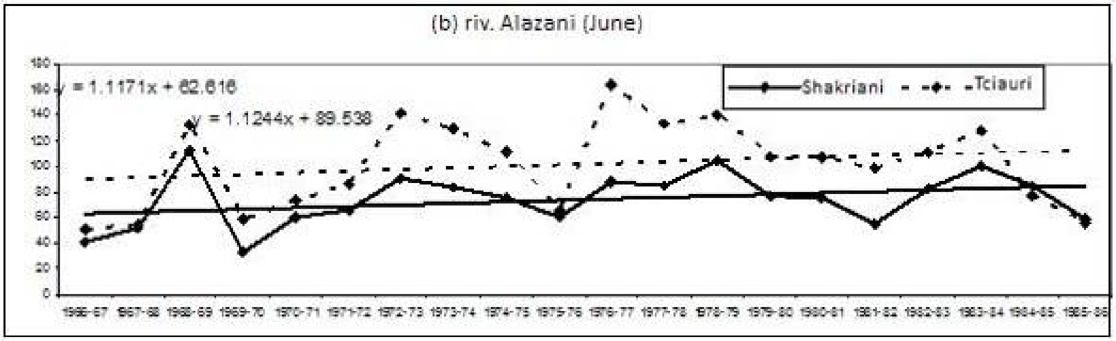
Table 2.1. The Alazani River average monthly and annual consumption in descending order

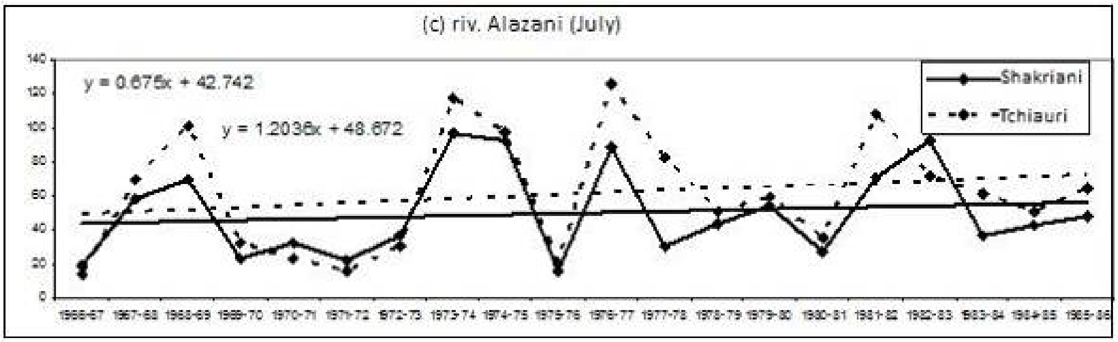
	V		VI		VII		VIII		IX		Annual	
	Village Shakriani	Village Chiauri	Village Shakriani	Village Chiauri	Village Shakriani	Village Chiauri	Village Shakriani	Village Chiauri	Village Shakriani	Village Chiauri	Village Shakriani	Village Chiauri
1	148	262	123	217	112	179	109	114	91	120	61.2	105
2	119	237	112	193	96.2	126	79.4	113	70	119	59.4	92.7
3	116	217	111	168	92.6	119	74.3	110	67.9	113	56.2	80.8
4	116	209	109	163	92	117	68.7	81.7	66.8	97.4	53.8	76.8
5	114	176	107	161	88.4	108	67.3	71.4	66.6	90.8	53.7	75.4
6	113	173	104	141	70.9	102	62.1	70.6	65.8	89.7	49.5	74.5
7	111	170	100	140	69.7	101	53.1	65.9	60.7	85.2	49.5	74.5
8	110	154	99.4	133	68.4	97.3	48.2	64.4	57.3	76.8	49.3	73.1
9	106	147	90.3	132	66.5	93.7	43.7	61.7	53	71.5	47.1	71.7
10	106	147	87.9	129	61.7	86	43.6	52	44.7	62.7	47.1	70.7
11	105	146	85.6	128	61.2	82.3	40.2	51.6	44.3	61.4	46.9	70.4
12	105	145	85.6	127	58.3	71.8	38	51.1	42	55.6	46.8	68.7
13	104	142	84.5	126	57.8	69.8	37.2	50.1	40.6	52.1	45.8	68.2
14	100	142	84.1	125	55.9	64.5	36.8	49.4	39.7	51.2	45.5	65.4
15	97.2	137	82.7	116	54	64.5	36.5	45.6	37.3	50.9	44.7	64.9
16	96.2	132	82.3	116	53.4	64	36.3	43.8	37.2	49.8	44	64.2
17	95.9	130	81.8	111	51.1	62.8	35.9	40	34.8	46.4	43.9	63.8
18	95.3	129	81.4	111	50.1	60.7	33.7	38.2	34.3	44.2	43.8	62.8
19	91.2	129	79.4	110	47.9	58.7	32.4	29.5	33.5	43	43.6	62.5
20	91.2	128	77.3	108	45.8	56.8	30.9	28.5	32.8	42.4	42.8	61
21	86.5	126	76.2	108	45.2	51.2	30.2	27.7	31	40	42.7	60.1
22	82.4	125	76.1	107	45.2	50.9	28.5	27	29.4	39.8	42.7	58.2
23	82.4	123	74.8	107	44.6	50.8	28.4	26.1	29	39.5	42.4	57.7

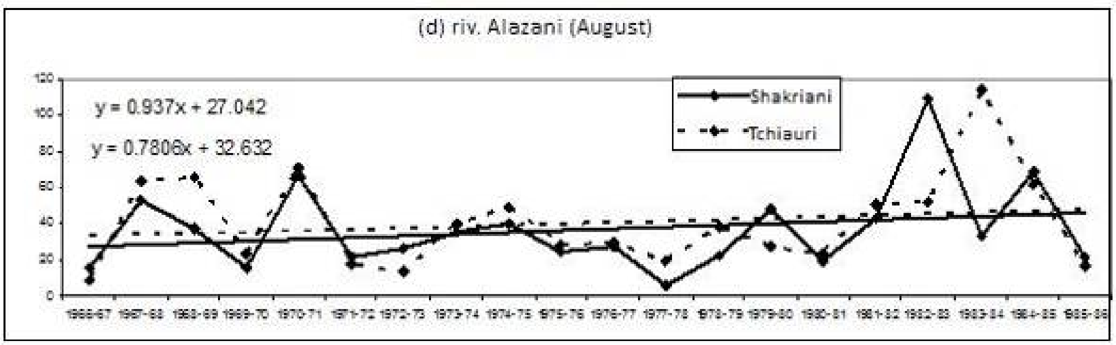
24	81.4	116	73.8	101	43.9	50.3	27.1	24.5	29	33.5	41.3	55.3
25	81.3	116	69.5	98.8	43.2	50.2	27.1	24	26.5	31.6	39.6	54.3
26	80.8	110	69.1	89.2	42.1	49.2	26.1	23.9	25.9	31.2	39.1	53.6
27	72.6	100	68.9	88.9	40.8	49	25.9	23.9	23.8	31	38.5	52.5
28	71.9	97	67.7	86	36.8	47	25	23.3	22.2	30.3	38	51.8
29	69.6	96.9	66.7	83.5	35.8	45.1	23.1	21.6	21.2	29.4	37.9	50.1
30	68.8	93.8	65.7	80.3	35.7	37.3	22.6	19.3	20.6	28.6	37.7	49.5
31	65.3	93.5	61	77.2	33.6	35	21.8	19.2	20.6	24.8	37	48.8
32	62.3	86.3	60.3	75	32.2	32	21.6	17.5	19.4	24.6	36.6	48.4
33	61.3	83.9	60.1	74.8	31.3	31.8	20.6	16.9	19.3	23.6	36.5	47.1
34	60.7	77.9	59.1	66.1	30.9	30.6	20.5	16.5	18.9	21.1	36.3	46.9
35	57.4	72.6	55.4	59.6	30.4	30	19.3	15.6	18.7	20.4	35.7	46.4
36	57	71.8	51.9	58.6	26.7	28.9	16	14.6	17.9	19.6	35.3	44.7
37	56.2	69.6	51.3	55.7	22.7	22.8	15.9	14	17.9	18.8	34.8	44.5
38	53.4	59.4	40.9	55.5	21.4	20.7	15.9	13.4	16.3	16.4	33.7	37.3
39	48.3	59.2	32.6	51.2	19.6	19.4	15.6	10.3	16	15.2	29.8	37.2
40	48.3	47.3	32.2	37.4	18.8	15.5	14.3	9.91	15.6	13.3	27.7	35.5

Diagram 2.5.-2.9. Schedules of runoff changes of the Alazani River for V-IX months (villages of Shakriani and Chiauri)




(b) riv. Alazani (June)
y = 1.1171x + 62.616
y = 1.1244x + 89.538
Shakriani
Tciauri


(c) riv. Alazani (July)
y = 0.675x + 42.742
y = 1.2036x + 48.672
Shakriani
Tchiauri


(d) riv. Alazani (August)
y = 0.937x + 27.042
y = 0.7806x + 32.632
Shakriani
Tchiauri

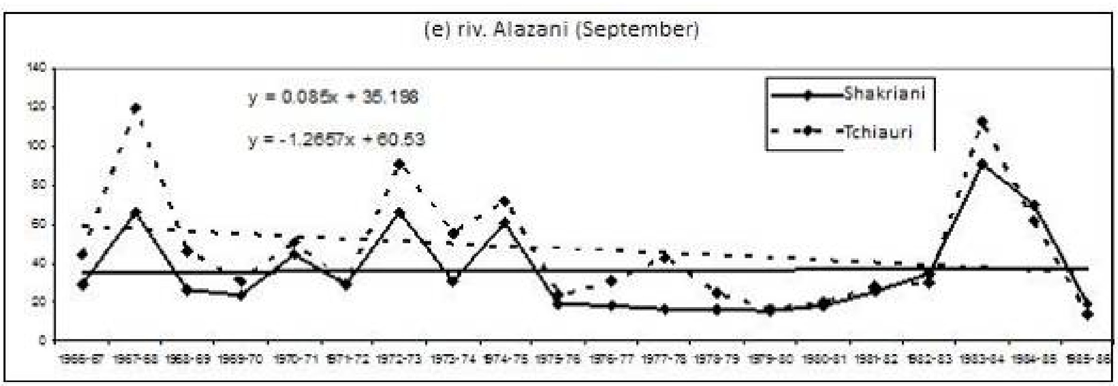
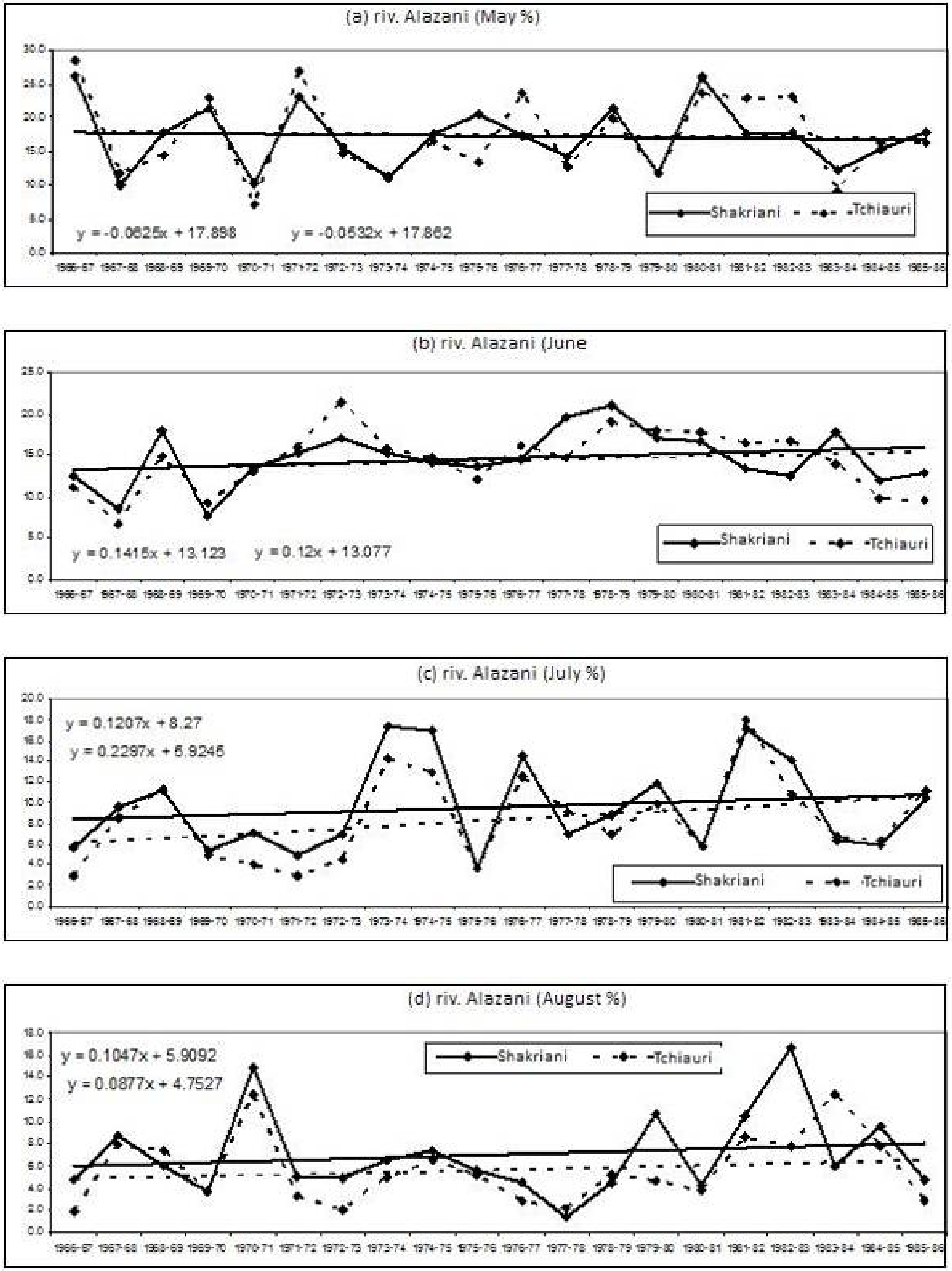
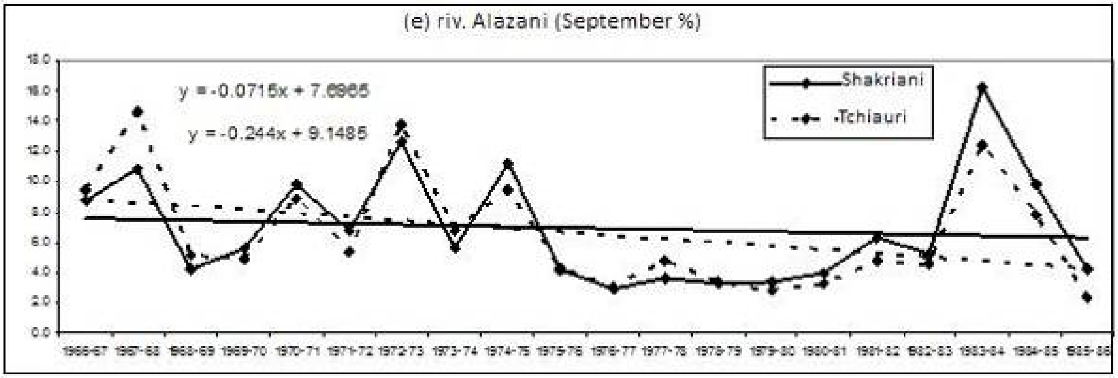

(e) riv. Alazani (September)
y = 0.085x + 35.198
y = -1.2657x + 60.53
Shakriani
Tchiauri

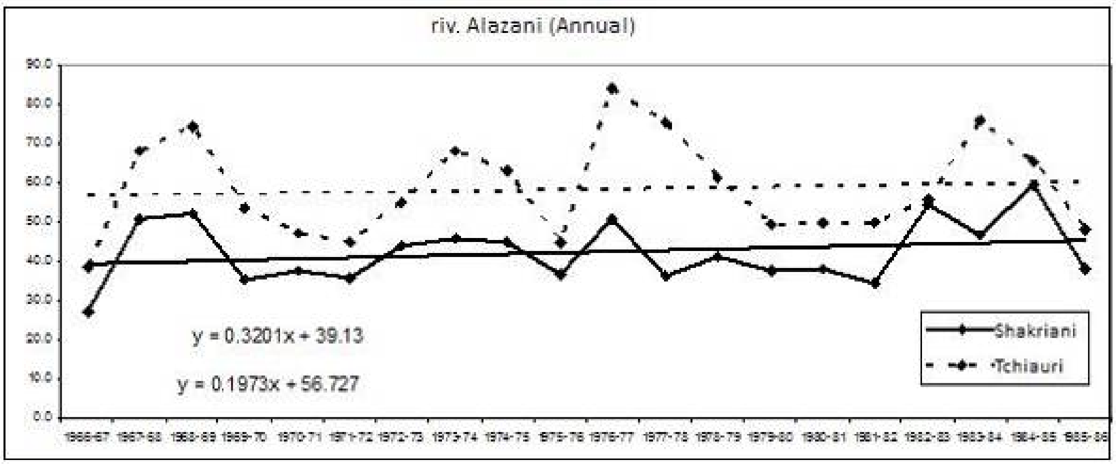
Diagram 2.10.-2.14. The schedule of the contribution (percentage) of the annual runoff of the Alazani River for V-IX months (villages of Shakriani and Chiauri)





The diagrams given above show the increasing trend in runoffs near both stations, the reducing tendency is observed only in the IX month.

Diagram 2.15. Schedule of change of the Alazani River annual runoff (Villages of Shakriani and Chiauri)



This chart also shows the increasing trend in runoffs near the both stations.

In order to determine the tendency of the annual and monthly runoffs of the Alazani River the correlation coefficient of their trends was assessed between the water consumption and its sequential number.

Table 2.2. The correlation coefficients of the Alazani River discharge: 1. Village of Shakriani; 2. Village of Chiauri

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	annual
1. 1946-86	-0.12	-0.09	-0.03	0.05	0.03	-0.03	0.03	0.12	-0.06	-0.16	-0.06	0.02	**-0.01**
1. 1946-86 (%)	-0.17	-0.12	0	0.04	0.07	-0.05	0.08	0.15	-0.04	-0.16	-0.13	0.03	
1. 1946-65	-0.14	-0.13	-0.21	0.19	0.05	-0.21	0.46	0.33	0.08	-0.15	-0.4	-0.19	**0.04**
1. 1946-65 (%)	-0.17	-0.29	-0.33	0.24	0.08	-0.38	0.5	0.34	0.08	-0.17	-0.44	-0.2	
1. 1966-86	-0.21	-0.05	-0.07	0.06	0.14	0.31	0.04	0.13	-0.08	0.06	0.09	0.19	**0.15**

1. 1966-86 (%)	-0.3	-0.17	-0.27	-0.09	-0.08	0.25	0.16	0.16	-0.11	-0.02	-0.02	0.18	
2. 1946-86	0.02	0.04	-0.03	-0.03	-0.14	-0.15	0.01	0.06	-0.23	-0.32	-0.21	0.01	**-0.17**
2. 1946-86 (%)	0.1	0.12	0.08	0.04	-0.01	-0.08	0.15	0.19	-0.15	-0.24	-0.13	0.09	
2. 1946-65	-0.23	-0.29	-0.38	0.09	-0.22	-0.36	0.25	0.19	-0.3	-0.36	-0.4	-0.15	**-0.25**
2. 1946-65 (%)	0.11	-0.06	-0.15	0.23	-0.06	-0.36	0.52	0.26	-0.15	-0.23	-0.21	0.09	
2. 1966-86	0.17	0.14	0.02	0.07	0.06	0.2	0.09	0.08	-0.32	-0.15	-0.16	0.11	**0.05**
2. 1966-86 (%)	**0**	**0.06**	**-0.2**	**0.07**	**-0.05**	**0.19**	**0.32**	**0.17**	**-0.39**	**-0.19**	**-0.23**	**0.11**	

As the table shows, the correlation coefficients of the Alazani River for different periods are not much different from each other, and its size is relatively unimportant, except for the years 1946-65, when correlation coefficient values increased.

The correlation ties between the average monthly runoff consumption (the Alazani River - villages of Shakriani and Chiauri) and accumulation of precipitations were also evaluated (village of Dedoplistskaro), which are given in table 3. This clearly shows that the connections are sufficiently large, r >0.3.

Table 2.3. The correlation coefficients for the average monthly discharge (the Alazani River – village of Shakriani [1] and Chiauri [2]) and for total precipitation (village of Dedoplistskaro)

	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**	**XII**	**annual**
1	0.31	0.34	0.37	0.33	0.32	0.44	0.4	0.41	0.31	0.38	0.36	0.31	**0.52**
2	**0.33**	**0.49**	**0.34**	**0.55**	**0.4**	**0.59**	**0.5**	**0.73**	**0.48**	**0.34**	**0.32**	**0.4**	**0.71**

For the years of 2020-2050, based on the forecasted climate models, sediment indices in the Dedoplistskaro municipality area shows that the greatest numbers of basic daily sediment (1956-2005) came during spring. Sediment indices also show that the daily amount of sediment is expected to rise in the years of 2020-2050, as well as maximum sediment during 5 day period.

The number of days per year when total daily precipitation is greater than 10 and 20 mm will reduce. Rainy periods will continuously grow, as well as the length of continuously dry period.

WEAP hydrological model was used to evaluate the Dedoplisrskaro municipality main water supply – the Alazani River water regime sensitivity, for Georgia's second national notification for climate change framework convention. Three different hypothetical scenarios were used for the evaluation. Scenarios were built on the assumptions that the river sediments near the village of Shakriani, from which the lower Alazani irrigation system begins, will be reduced by 10, 20 and 50% - at the same time, water consumption will rise with same magnitude. According to the report, the water shortage problem may arise only in the case of the third scenario development, and only in August. In other two scenarios the Alazani River waters would be enough to satisfy needs. Given that the third scenario is unrealistic (by forecast, the reduction of runoff is not expected), it can be concluded that the Alazani River water resources are enough to satisfy needs of irrigation in current region.

The studies have shown that runoffs in halfway of river are approximately 13% lower than the runoff at lower part of the Alazani River. So, the results obtained near the village of Shakriani could be applied for the Alazani River lower part, on right side of which is located the Dedoplistskaro municipality.

2.2 Possible activation of Hazardous natural and debris processes

By the years of 2020-2050 on the big part of the Dedoplistskaro municipality, on the expense of the increase of the maximum amount of the number of daily precipitation during 5 days and the probable slight increase of the number of days with 50 mm of sediments, it is expected that the debris flows revealed during the baseline period will be slightly increased in the ravines formed by the temporary streams of the Iori plateau (Pantishara ravine, Lekistskali ravine, Brotseuli ravine, Alandara ravine, Kumri ravine, etc).

2.3 Drought

It is estimated that the negative impacts of droughts most often manifested in the active vegetation period (VI-VIII months), when the air has a high temperature, and the lack of moisture damages agriculture (not very often destroys entire harvest). Droughts are characterized by a long periods (an average of 30 days, or sometimes even more), when the average daily temperature reaches 24-25^{0}C and relative humidity is less than 30%. Average wind speed is more than 4-5 m/sec. The Dedoplistskaro municipality territory was in sufficiently humid conditions for the baseline period. The average of 440mm annual sediments in the vegetation period and low hydrothermal coefficient rates (0.5-0.5) caused continuity of disastrous droughts an average of 46 days every year, average intensity droughts for 12 days and intense droughts 2 days. Despite the amount of such continuity of droughts when land was irrigated twice, there was no hindrance to the growth of the agriculture or crop development.

By future climate scenario, average air temperature will rise by 2^{0}C during the vegetation period, maximum air temperature rises with 3-4^{0}C, active temperature totals rise by 570^{0}C, the numbers of hot days increases, there is very minor changes (including maintenance of 440 mm of rainfall during the vegetation period) to atmospheric precipitation in each index (compared with the baseline period), therefore taking into account the decrease of annual and seasonal humidity coefficient, droughts of different types and duration will be more frequent, accompanied by the strengthening of wind erosion.

2.4 Assesment of soil quality vulnerability to climate change

As it was already mentioned, the climate has one of the decisive roles in the formation of soil. The main characteristics of the soil vary with the climate change. Soil types degrade and lose their main characteristics (productivity, physio-chemical or physio-mechanical). Due to climatic and anthropogenic factors, processes of **desertification and transformation into steppes** were activated in the Dedoplistskaro municipality. Erosion and soil degradation processes are enhanced in Chatmi and Chachuna lowlands, Eldari and Shiraki valleys and surrounding hills.

Due to the expected climate aridization processes, the degradation of soil of the Dedoplistkaro municipality will be further strengthened.

2.5 Pastures

In light of climate aridization, strengthening desertification and overuse of pastures in the Dedoplistskaro municipality, the increase of pauperization of pasture grass cover, turf destruction, enhance of surface soil wind and water erosion are expected. Ignoring of the agro-technical measures, rules and norms of using pastures, will therefore result in developing the irreversible process of pasture degradation.

2.6 Desertification

As a result of the increase of all indices for the air temperature, very minor changes for atmospheric precipitations compared with the baseline period, the reduction of the humidity supply in soil, and therefore, because of the significant reduction of annual and seasonal hydrothermal coefficient, the strengthening of the process of desertification is expected on large part of municipality territory (Eldari, Didi and Patara Shiraki valleys, Taribana, Patara Taribana, Jeirani, Kotsakhuri, Kasristskali, Natbeuri, Nagomrebi and Chachuna valleys and hills and strips nearby). This process is accompanied by a depletion of soil, the sharp increase of the humidity deficit due to erosion, especially the wind erosion. Soil degradation process is most active in the winter pastures. As a result of this negative process, pasture area decreased by approximately 60,000 ha in the years 2003-2009. Degraded pastures were covered with weeds and bushes, and the majority of them are now abandoned. The further degradation of the ecosystems of beard grass, the secondary steppes with beard grass, bright forests and floodplain forest is expected; based on the reduction of their area the widening of the partly-desert landscape areas is also expected. The endemic and relict flora and fauna of Vashlovani protected area are also in danger in terms of their degradation and their replacement by those types typical for deserts.

2.7 The impact of the future expected climate changes on the health condition of the population

The data analysis of the observed main meteorological elements (air temperature, atmospheric precipitation, wind, etc) during the baseline period (1956-2005) showed that the Dedoplistskaro municipality territory is characterized by distinguished arid climate.

As it is known from the information of the respective section (section 1.8 - Assessment of health condition of the population), in 2000-2010 among the municipality population the prevalence level of the various diseases and its increasing tendency (excluding rare exceptions) was significantly higher than that of the Kakheti regional, as well as overall index of Georgia.

Based on the analysis of the assessment, the risk groups can be identified that are more easily vulnurable to changes of the meteorological elements in terms of health condition. From this perspective, judging from the climate condition of the Dedoplistskaro municipality, at the first place, the particular attention should be paid to the increasing tendency of the high air temperature (daily, monthly, seasonal), as well as the probability of developing heat illnesses related to it (the most vulnarable group to this latter are old people). According to the climate forecasts, by 2020-2050 the average annual air temperature is expected to rise by 3^0C on the Dedoplistskaro municipality territory. The maximum air temperature is expected to increase with the similar rate. Therefore, as in the baseline period, in the nearest future decades, the most notable possibility on the municipality territory is the change of the discomfort temperatures. Under the discomfort temperatures are meant those indicators of the air temperature that may have adverse effects on human health (as well as the functioning of the economy in different sectors). In particular, it has been established that when the air temperature is within the limits of the human body temperature, the meteorological conditions have a negative impact on human health. Especially, if the continuity of this type of temperature is constant. The low air temperature also has a negative impact on human health. According to the climate forecasts, the absolute minimum temperature and the decrease of its average index (warming) is expected to be between 2-3^0C in the next few decades. However, it also should be noted that the meteorological index value was already high in the baseline period (between -20-30^0C). It is known that low air temperatures hinder the normal development of the variety of physiological processes in the human body. Even in 5-10^0C a person experiences discomfort and even the open-air presence is somewhat limited, especially if these high temperatures are accompanied by strong wind. In such cases, there may happen the circulatory disturbances of the human body tissues, and the lower temperature may cause Hypothermia. The continous high discomfort temperatures should be particularly noted. In particular, the continuity of high temperature of more than 33^0C which hinders the normal development of the physiological processes in the human body, has been observed with the continuity of 6-10 hours on the municipality territory. This figure may increase in the coming decades, as the surrounding natural environment will make it even more aggressive towards people.

2.8 Assessment of Vulnerability and Disaster Risks by Communities

The chapter below represents an analysis of field research covered within the scope of the program "Integrated Natural Resources Management in Watersheds of Georgia" - INRMW; based on this data the vulnarability of the communities within Dedoplistskaro municipality to climate change and natural disasters was determined. The volume of risk within the communities with respect to natural disasters was also evaluated. Based on this information maps concerning municipality disasters, vulnarability and risks were prepared.

Detailed characteristics of the communities within the municipality of Dedoplistskaro are presented below, these are based on data analysis of field research conducted by CENN within the scope of the program. Annual newsletters, prepared by National Environmental Agency (materials of 2006, 2007, 2008, 2009 and 2010 are used[1]), are also widely used for this report.

2.8.1 Zemo Machkhaani Community

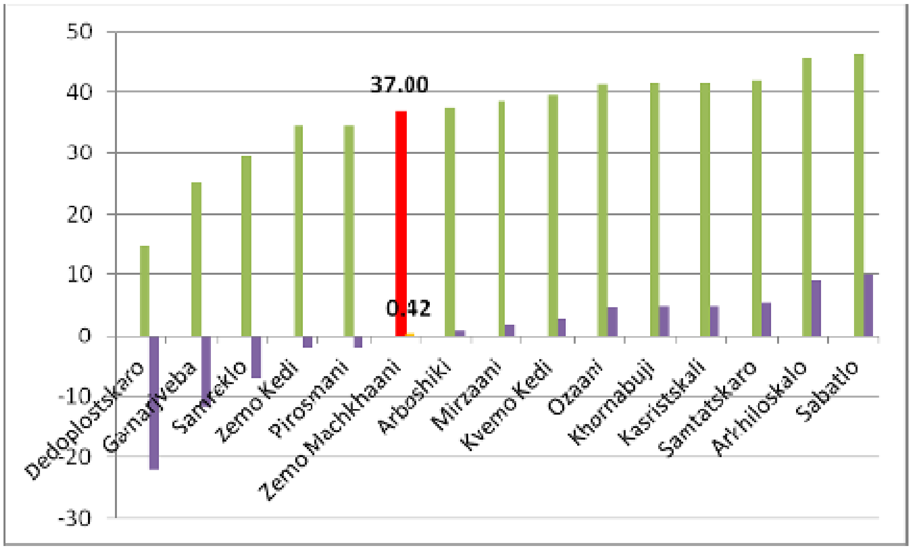
The Zemo Machkhaani community is located in the westernmost part of Dedoplistskaro municipality, bordering Sighnaghi Municipality. The easternmost border of the community coincides with the left bank of the Iori River. The community's territory is crossed by the Ole River, the source of which is in Sighnaghi municipality. The majority of the mentioned river basin is located in the territory of Zemo Machkhaani and joins the Iori River from the left side.

The Zemo Machkhaani community consists only of the village of Zemo Machkhaani. The distance of the village from the municipal center is 28 km.

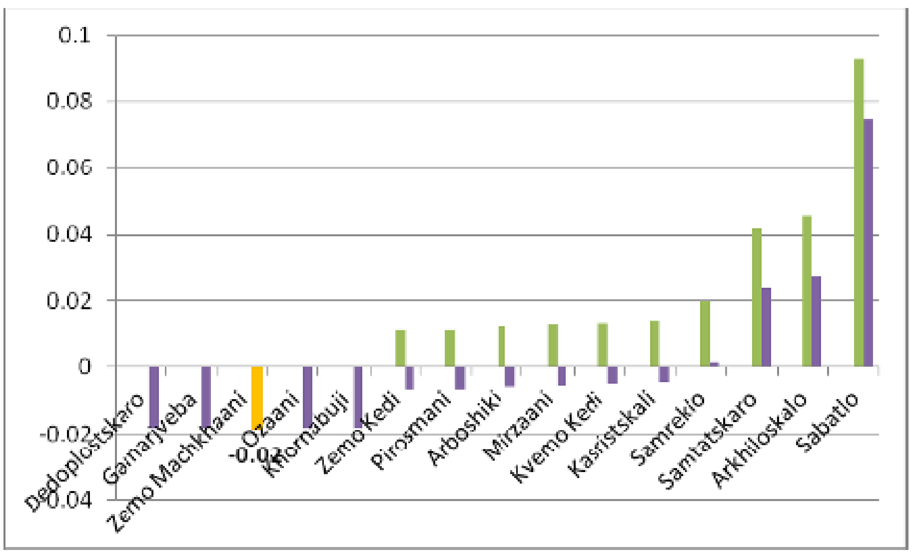
The research team did not reveal any hazardous natural events in the community's territory during the field research. In addition, no hazardous natural processes in the municipality territory have been documented by either the National Environmental Agency or any other sources.

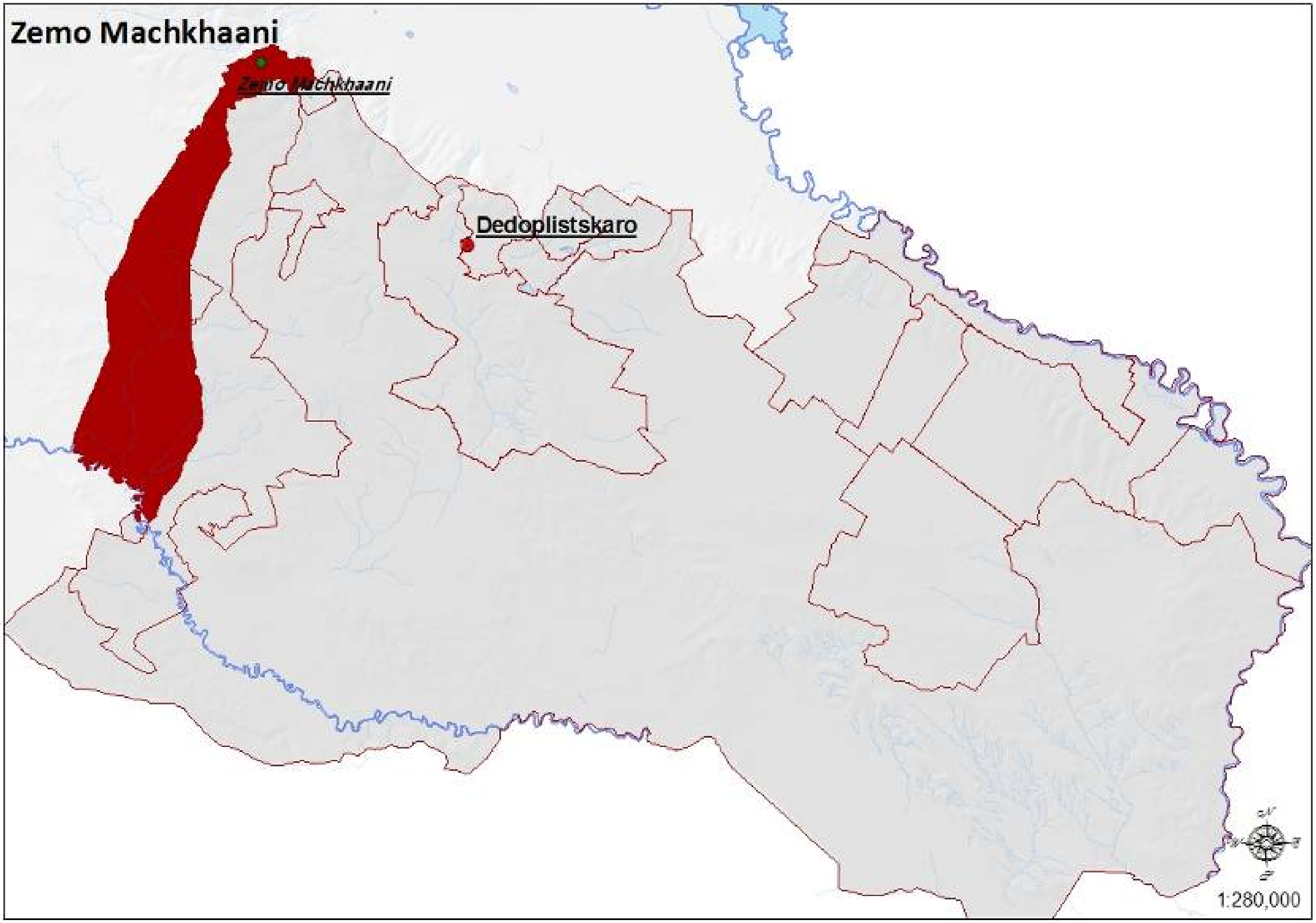
As a result of the research conducted within the framework of the program, the vulnerability of the Zemo Machkhaani community was assessed to be 37.00 points. This score almost equals the average index of the municipality. The difference (of 0.42 points) is insignificant (the average index of the municipality is 36.58. See the diagram). On the scale of the target program area (target river basins of the program), the vulnerability of the community was assessed to be average (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).

[1] Ministry of Environmental Protection of Georgia. National Environmental Agency. Department for Geological Hazards and Geological Environment Management. Bureau of Natural Disasters, Engineering Geology and Geo-ecology. Information Bulletin – Results and Prognoses of the Development of Hazardous Geological Processes in Georgia.



The level of risk in the community of Zemo Machkhaani is considered to be 0. Such a low indicator is determined by the complete absence of hazardous natural events in its territory. Therefore, on scale of the program, the risk level of the community was assessed to be very low (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).




Zemo Machkhaani
Zemo Machkhaani
Dedoplistskaro
1:280,000

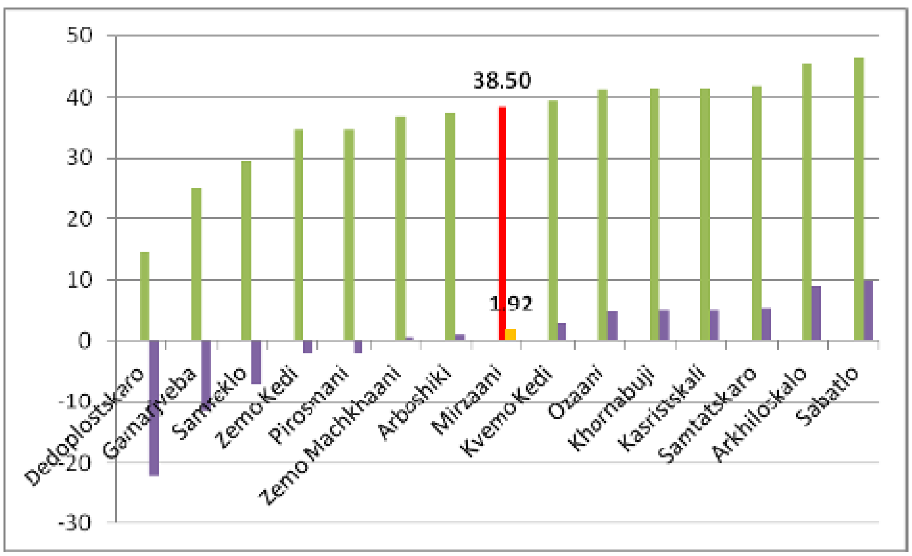
2.8.2 Mirzaani Community

The Mirzaani community is located in the western part of Dedoplistskaro, bordering Zemo Machkhaani. There are no large surface waters in the territory of the community.

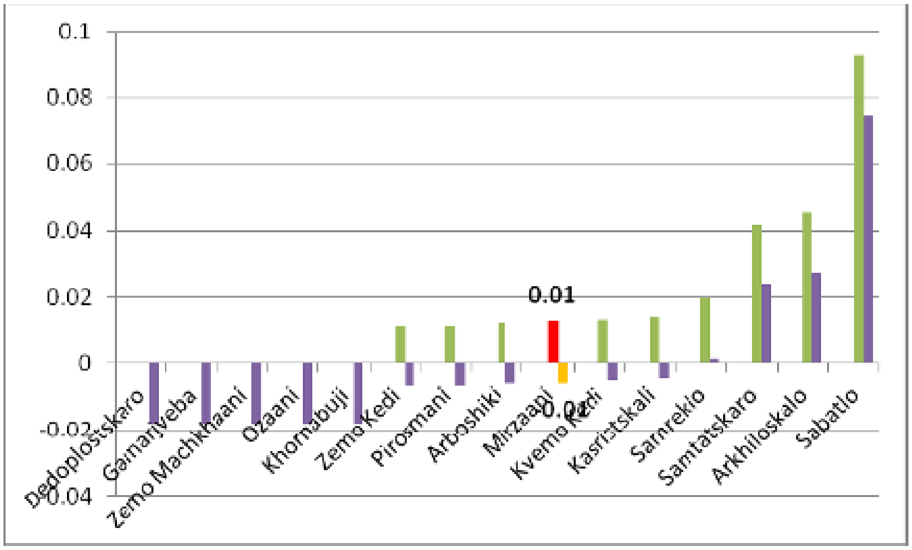
The community consists only of one village – Mirzaani, the distance of which is 22 km from the municipal center.

The field research has revealed that, of hazardous natural events, the population has named the debris flows formed by precipitation within the ravines of the territory. It should also be noted that, in the Mirzaani community, no hazardous natural processes of any kind have been described in the reports of the National Environmental Agency.

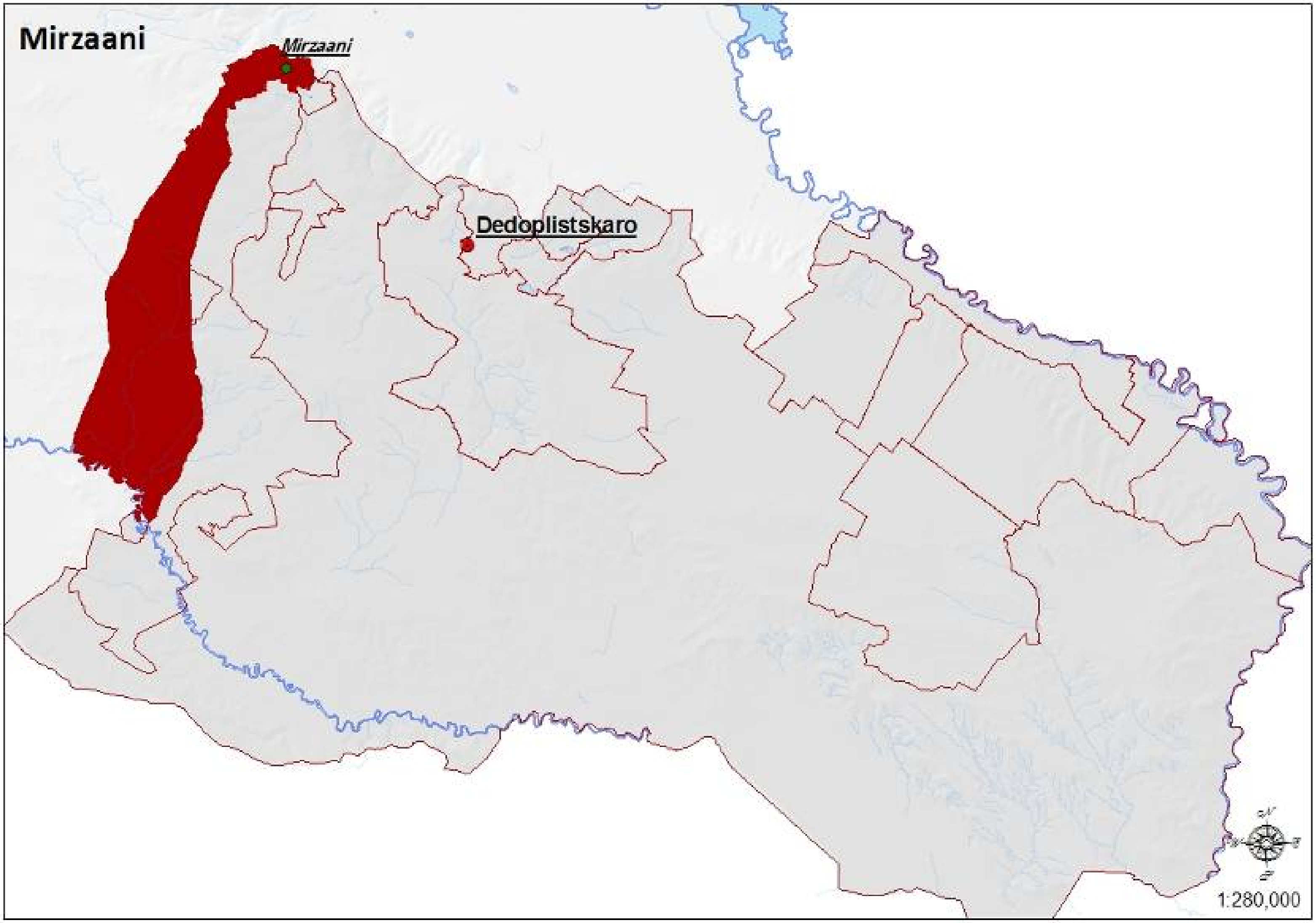
As a result of the research conducted within the framework of the program, the vulnerability of the Mirzaani community was assessed to be 38.50 points, which slightly exceeds the average index of the Dedoplistskaro municipality (36.58). The difference is 1.92 points (see the diagram). On the scale of the target area of the program (target river basins of the program) the vulnerability of the community was assessed to be average (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).



According to the assessment, conducted within the scope of the program, the level of risk for the community is 0.01 points. This indicator is below the average for the municipality, which is 0.02 points. The difference from the average indicator is 0.01 points (see the diagram). With regards to the scope of the program the risk level of the community was very low (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).



As was mentioned earlier, during the field research the population identified ***debris flows***, formed in the ravines of the village, as the main problem of the community. In spring and autumn, times of heavy precipitation, strong streams are created in the dry ravines of the village that destroy the roads to the agricultural lands. As a result of this process, approximately 1 km of the main road is significantly demaged. It should be noted that besides the population of Mirzaani village, this road is also used by the population of the Arboshiki and Ozani villages to get to their agricultural lands. In total, the road connects the local population with 2,000 ha of agricultural lands and 6 farms.


Mirzaani
Mirzaani
Dedoplistskaro
1:280,000

2.8.3 Arboshiki Community

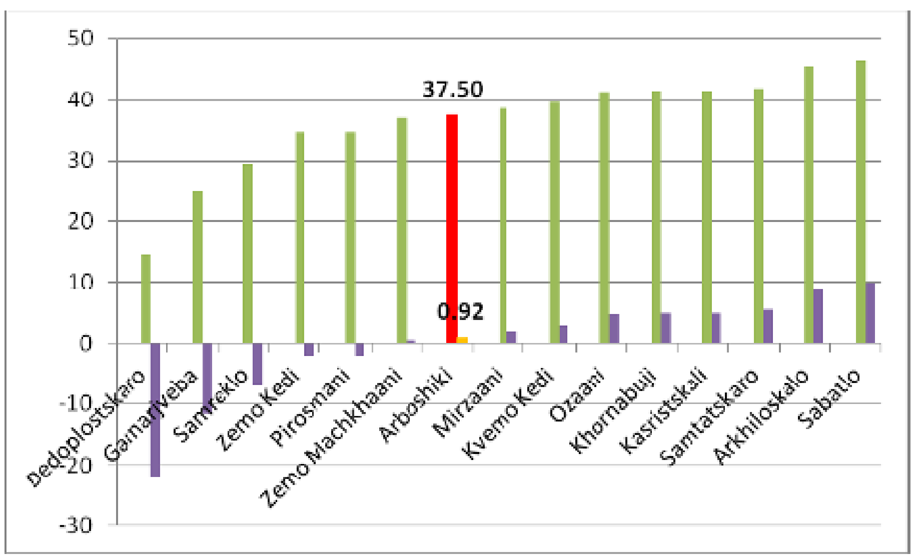
The Arboshiki community is located in the western and southern-western part of Dedoplistskaro. The community territory is stretched from north to south. The populated areas are located in the northern part of the territory. The southern part consists mostly of agricultural lands.

The territory of the community is crossed by the Iori River in the southern part. The territory is also intersected by the beds of seasonal streams. Among them are Mtsaretskali, Sakatme gorge and others.

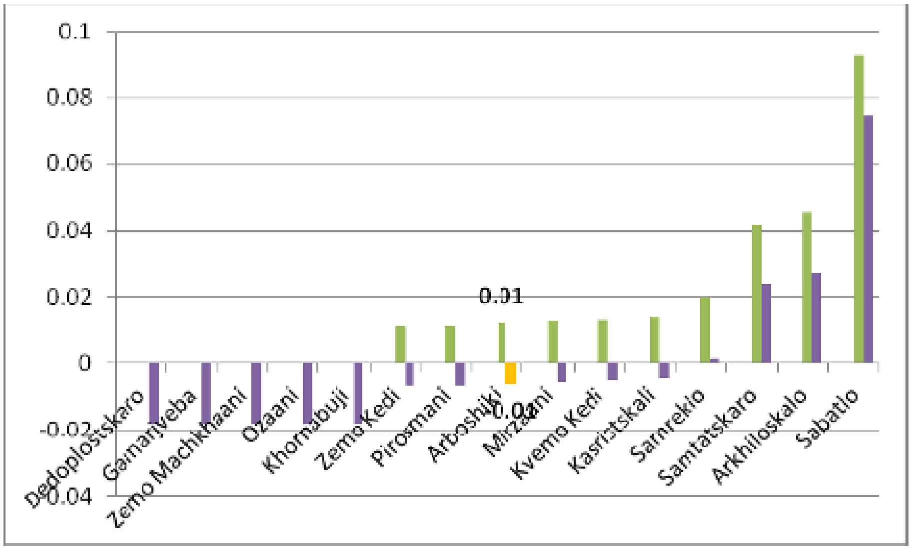
The Arboshiki community only consists of the village of Arboshiki. The distance of the village from the municipal center is 18 km.

Field research has revealed that, of hazardous natural events, the population named the debris flows formed by precipitation in the local ravines. It should be noted that, in Arboshiki community, no hazardous natural processes of any kind have been described in the reports of National Environmental Agency.

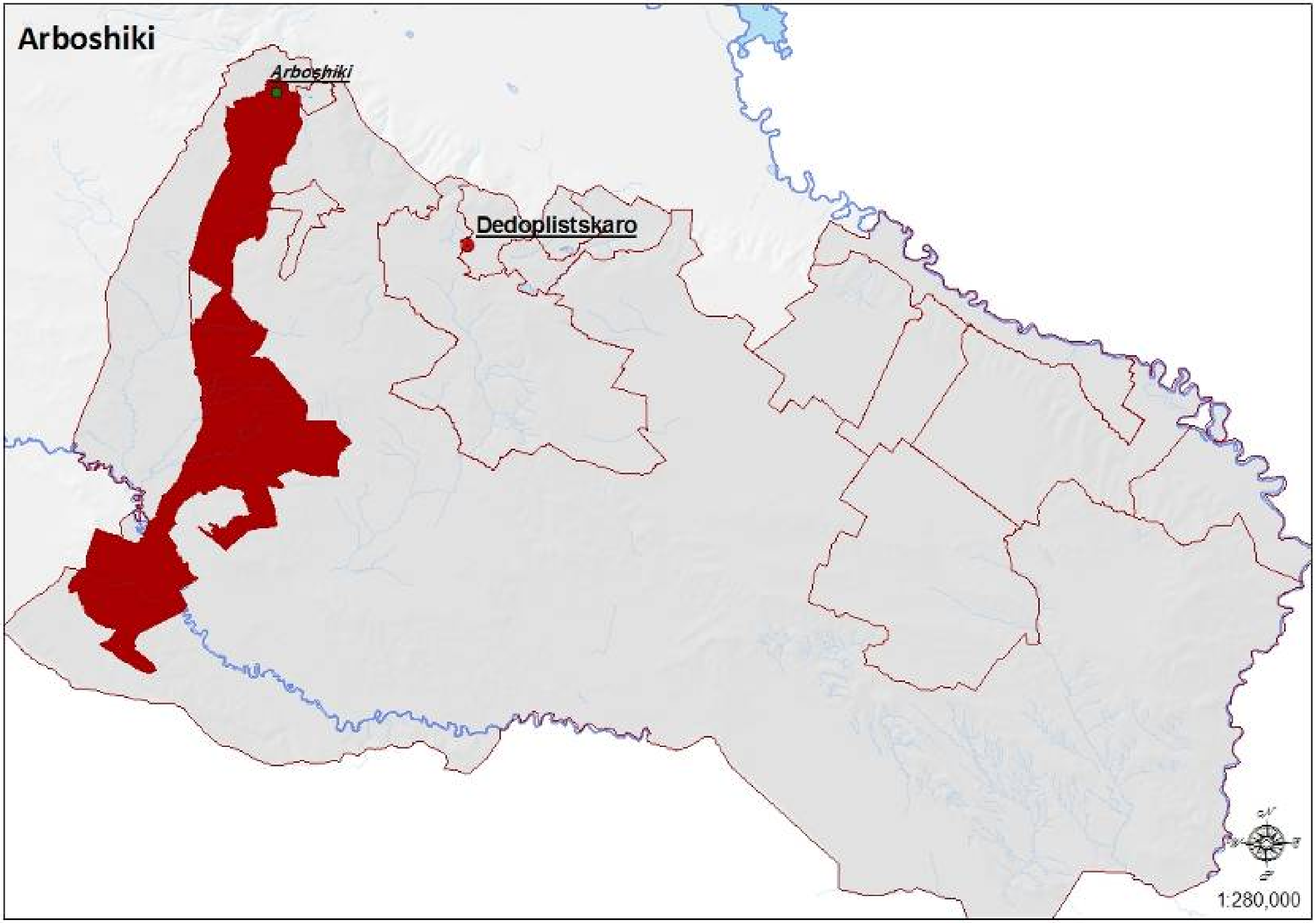
As a result of the research conducted within the framework of the program, the vulnerability of Arboshiki community was assessed to be 37.50 points, which slightly exceeds the average index of the municipality. The difference is 0.92 points (see the diagram). On the scale of the target area of the program (the target river basins of the program) the vulnerability of the community was assessed to be average (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).



According to the research conducted, the level of risk for the community is considered to be 0.01 points. This indicator is lower than the average for the municipality. The difference from the average indicator is 0.01 points (see the diagram). On the scale of the program, the risk level of the community is considered to be very low (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).



As was mentioned earlier, the main problem of the village is ***debris flows*** formed in the ravines of the village. In spring and autumn, seasons of precipitation, strong streams are created in the dry ravines of the village and destroy the precinct roads of the village. As a result, the majority of the precinct roads are demaged. The population has reported that about 6 km of road is demaged as a result of this process.


Arboshiki
Arboshiki
Dedoplistskaro
1:280,000

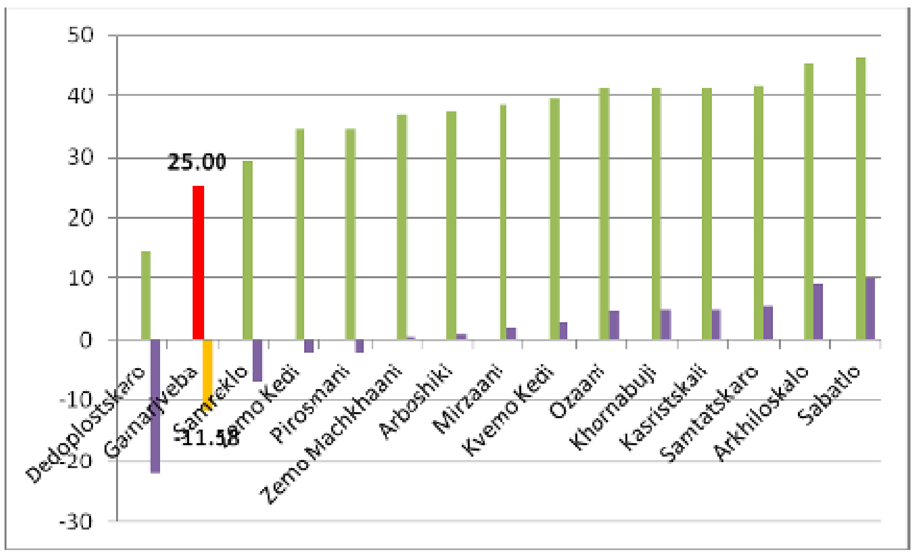
2.8.4 Gamarjveba Community

The Gamarjveba community occupies the western part of Dedoplistskaro municipality. The community territory is stretched from north to south. There are no large surface waters in the community's territory.

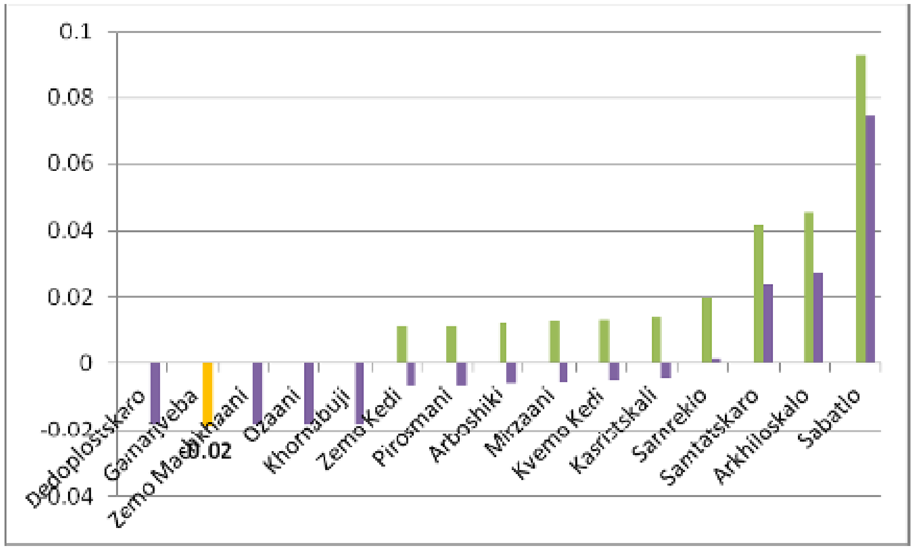
The Gamarjveba community only consists of the village of Gamarjveba, the distance of which is not more than 12 km from the municipal center.

Field research has not revealed any hazardous natural events in the territory of the community. No hazardous natural processes have been described by either by National Environmental Agency or any sources in the community.

As a result of the research conducted within the framework of the program, the vulnerability of the Gamarjveba community was assessed to be 25.00 points. This index is one of the lowest in Dedoplistskaro municipality. The difference from the average municipality index is significant (11.58 points, see the diagram). Due to this low indicator the community was considered to have a very low risk level (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).



The complete absence of hazardous natural events in the territory of the community determined the fact that the level of risk for the community was 0. Therefore, the community was assessed as a very low risk category (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).


0.1
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-0.02
Dedoplosskaro
Gamarjveba
Zemo Machkhaani
Ozaani
Khornabuji
Zemo Kedi
Pirosmani
Arboshiki
Mirzaani
Kvemo Kedi
Kasristskali
Samreklo
Samtatskaro
Arkhiloskalo
Sabatlo


Gamarjveba
Gamarjveba
Dedoplistskaro
1:280,000

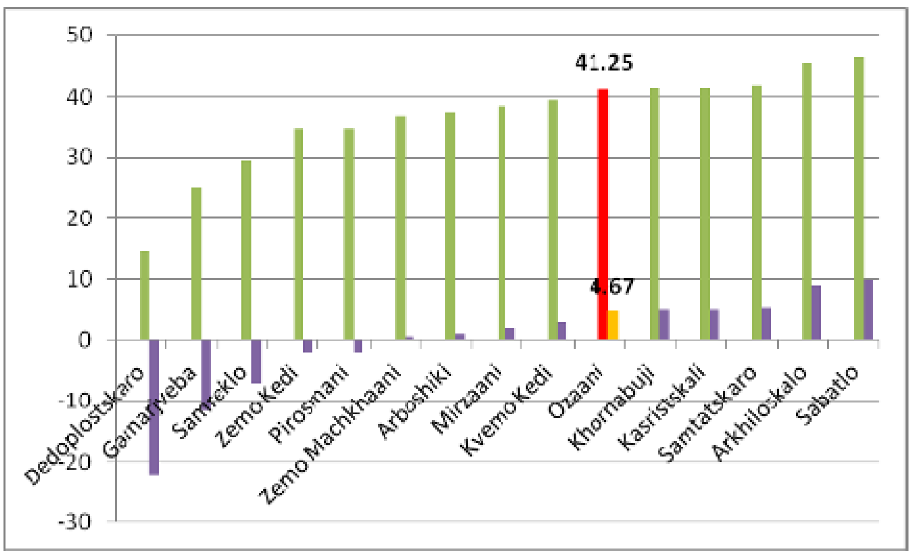
2.8.5 Ozaani Community

The Ozaani community is located in the northern-westernmost part of the Dedoplistskaro municipality and borders the territory of Sighnaghi Municipality. The western border of the community with the Mirzaani community is formed by the ravine channel of the Uzundari River. An artificial reservoir, the Ozaani Lake, is in the territory of the community.

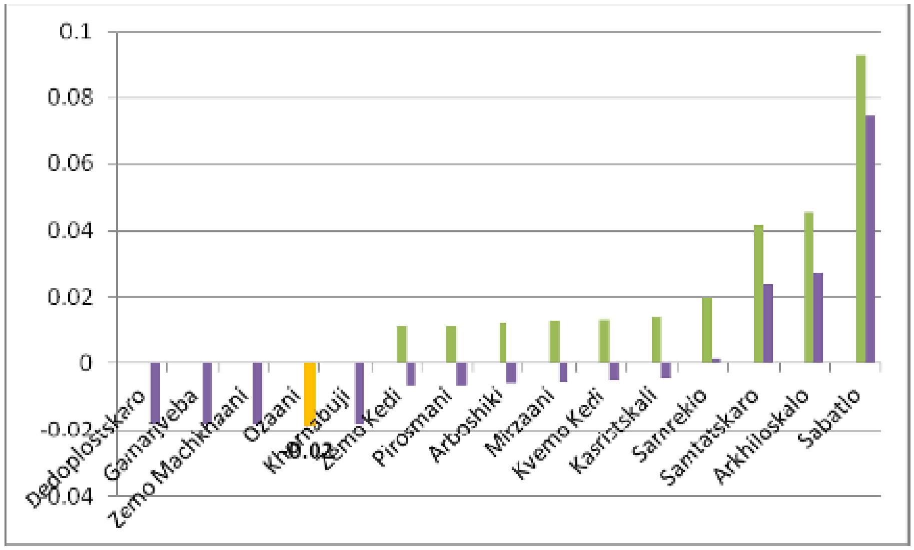
The Ozaani community consists of two villages – Ozaani and Tavtskaro. The average distance of the villages from the municipal center is 11 km.

It should be mentioned that neither the field research nor any other sources (e.g. National Environmental Agency) have revealed any hazardous natural events in the Ozaani community's territory.

As a result of the research conducted within the framework of the program, the vulnerability of the community was assessed to be 41.25 points. This indicator significantly exceeds the average index of the municipality. The difference is of 4.67 points. with regards to the target area, the vulnerability of the Ozaani community was considered to be average (see the map – Assessment of the Vulnerability of the Dedoplistskaro Municipality).



The complete absence of hazardous natural events in the community's territory determined the fact that the level of risk for the community was 0. Therefore, the risk level of the community was assessed as very low (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).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Dedoplistskaro
Gamarjveba
Zemo Machkhaani
Ozaani
Khornabuji
-0.02
Zemo Kedi
Pirosmani
Arboshiki
Mirzaani
Kvemo Kedi
Kasristskali
Samreklo
Samtatskaro
Arkhiloskalo
Sabatlo


Ozaani
Ozaani
Dedoplistskaro
1:280,000

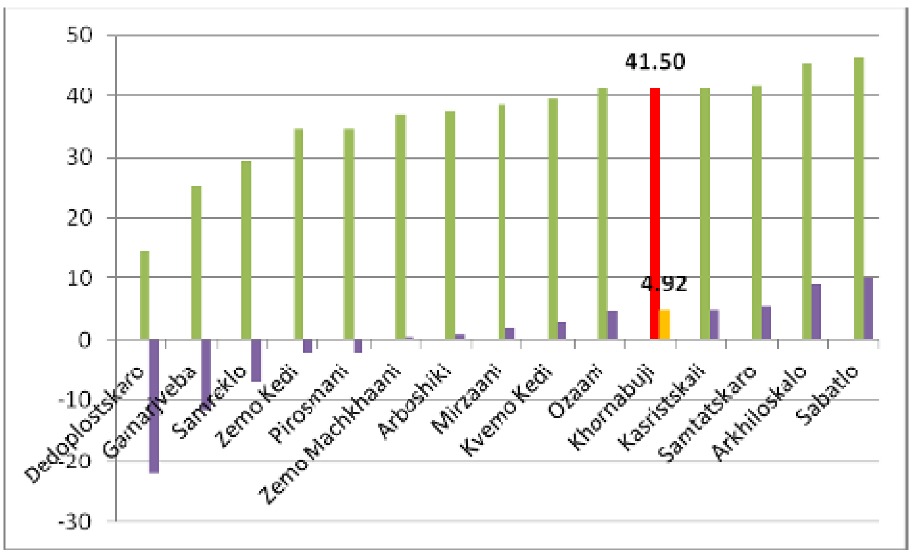
2.8.6 Khornabuji Community

Khornabuji community is located in the central part of Dedoplistskaro municipality, bordering the town of Dedoplistskaro. The community's territory is crossed by ravines of permanent and seasonal streams. Among them the tributaries of the Kushishkhevi River – Mkralakhevi and Koghotoskhevi are noteworthy.

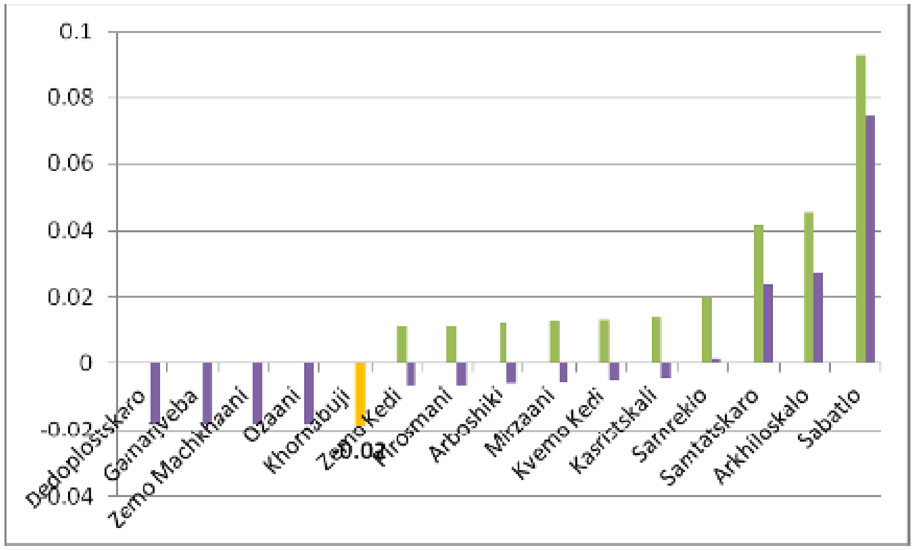
The Khornabuji community consists of two villages – Khornabuji and Choeti. The average distance of these villages from the municipal center is around 5 km.

The field research did not reveal any hazardous natural events. Neither the National Environmental Agency nor any other sources identified hazardous natural processes in the territory of the community.

As a result of the research conducted within the framework of the program, the vulnerability of Khornabuji community was assessed to be 41.50 points. This indicator exceeds the average index of the municipality. The difference is 4.92 points (see the diagram). With regards to the target area of the program (target river basins) the vulnerability of Khornabuji community was considered to be average (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).



The level of risk of the Khornabuji community was assesed –as 0 points. This indicator is explained by the fact that not a single source (field research, National Environmental Agency, etc.) has identified any hazardous natural processes in the territory of the community. Based on this, the risk level of the community was considered to be very low (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).


0.1
0.08
0.06
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0.02
0
-0.02
-0.04
Dedoplistskaro
Gamarjveba
Zemo Machkhaani
Ozaani
Khornabuji
Zemo Kedi
Pirosmani
Arboshiki
Mirzaani
Kvemo Kedi
Kasristskali
Samreklo
Samtatskaro
Arkhiloskalo
Sabatlo
-0.02


Khornabuji
Dedoplistskaro
Khornabuji
1:280,000

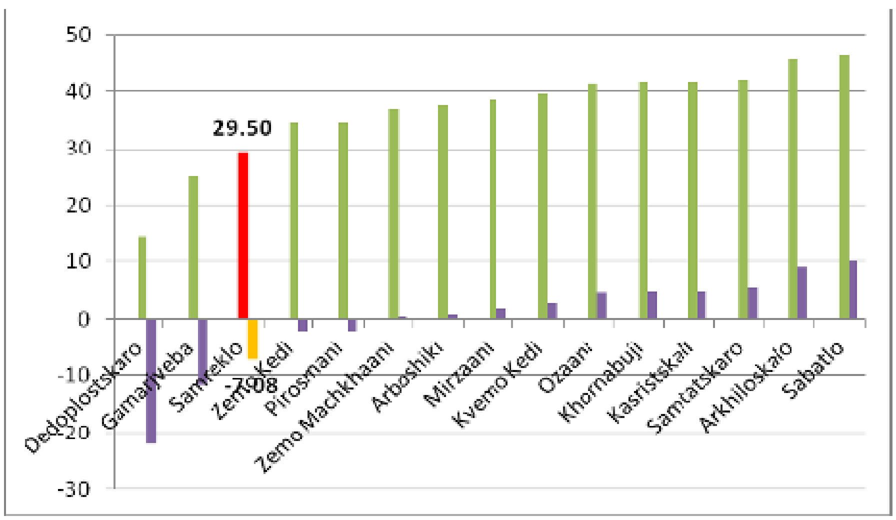
2.8.7 Samreklo Community

Samreklo community is located in the central part of Dedoplistskaro municipality, to the east of Dedoplistskaro town. The community territory is represented by relatively small rivers – the Mghvrietskali and Chilari Khevi, that have their sources in the territory, cross it and join the irrigation system of the Alazani River beyond Dedoplistskaro's municipality territory, in Sighnaghi. The salt Kochebi Lake is also located in the territory.

The Samreklo community consists of only one village – Samreklo (Japaridze before 2011[2]). The distance of the village from the municipal center does not exceed 3 km.

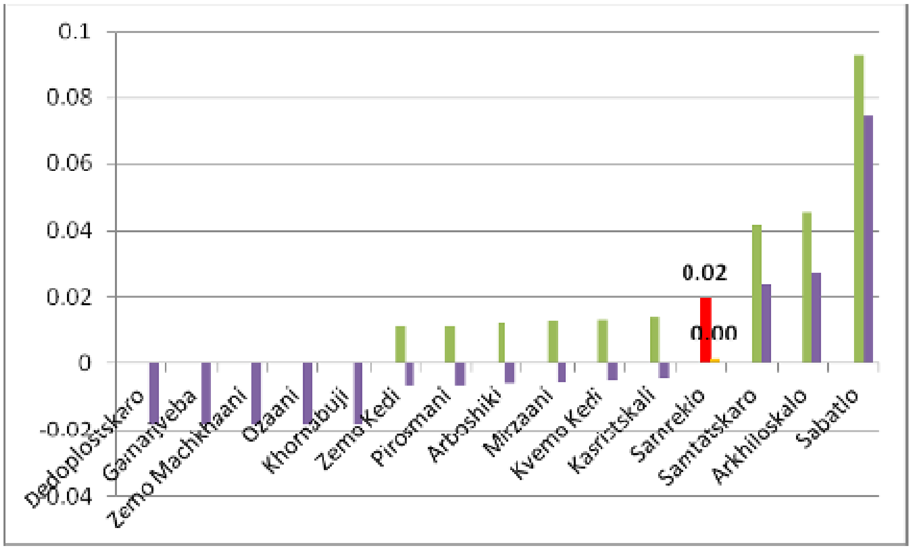
During the field research conducted within the scope of the program, the population of Samreklo identified strong winds as the main hazard.

As a result of the research the vulnerability of the community was assessed to be 29.50 points. This is one of the lowest indicators for the municipality. The difference from the average index of the municipality is a significant -7.08 points. Such a low indicator is determined by the fact that the Samreklo community index is lower than that of the municipality in almost all of the vulnerability criteria. In general, on the scale of the target area of the program the vulnerability of the community was assessed to be less than average (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).

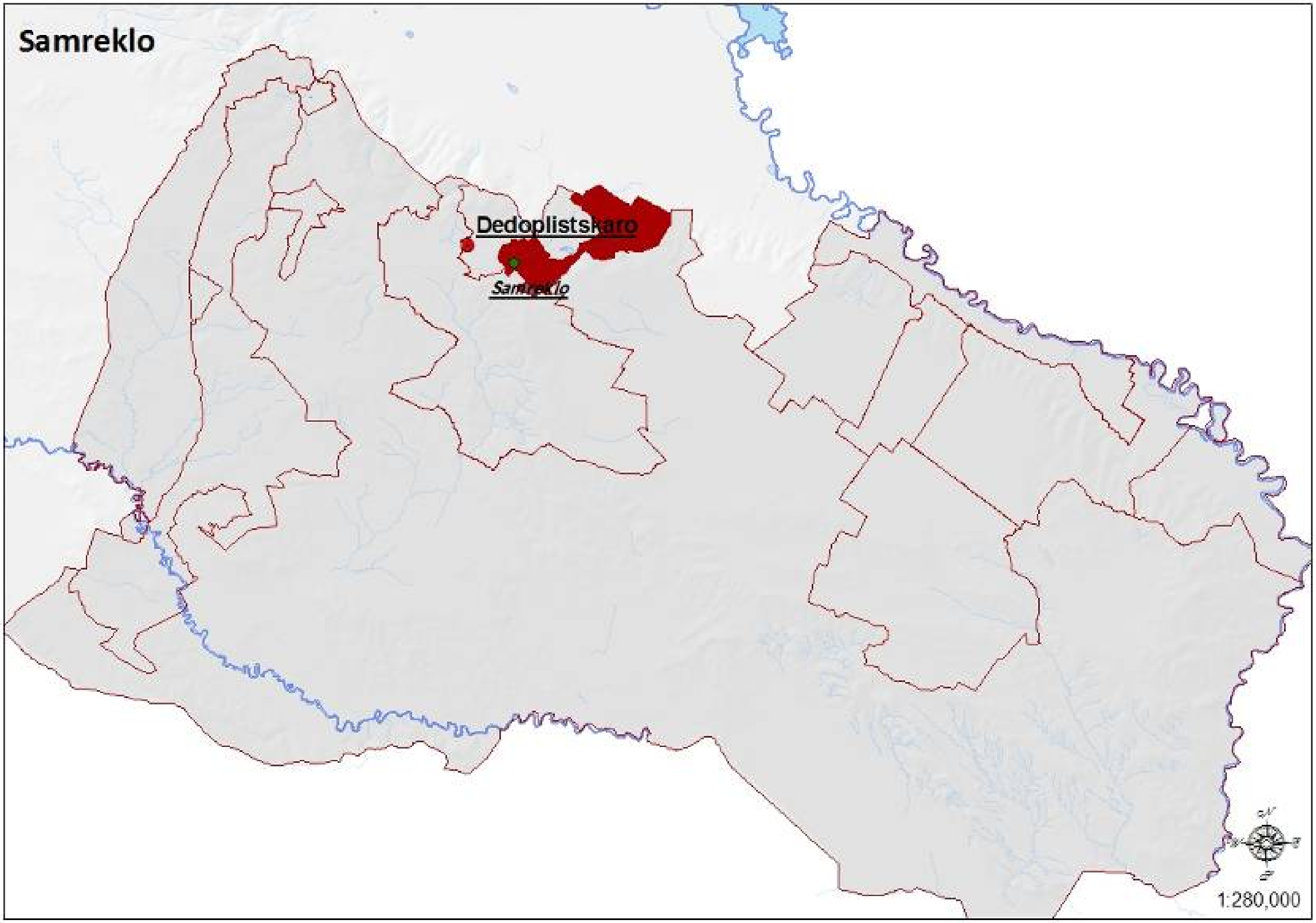


As a result of the research, the level of risk for Samreklo community was considered to be 0.02 points. This indicator coincides with the average indicator of the municipality (see the diagram). The risk level of the community was assessed to be lower than average (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).

[2] The name of the village was changed by the decree of the President of Georgia "About the change of the names of several geographical objects", decree N478, dated 30 August, 2011.



As was mentioned above, during the field research the local population identified ***strong winds*** to be the most hazardous natural events that occur in the community. According to the population, in the 1990s windbreaks created during the Soviet period were completely destroyed. As a result, wind demages the agriculture of the village, and particularly grain crops (autumn cultures – barley, wheat). According to the population, wind affects almost 1,000 ha of agricultural lands, comprising almost quarter of the total area of the community. As a result of these processes the economic wellbeing of the community population is being seriously affected.



Samreklo
Dedoplistskaro
Samreklo
1:280,000

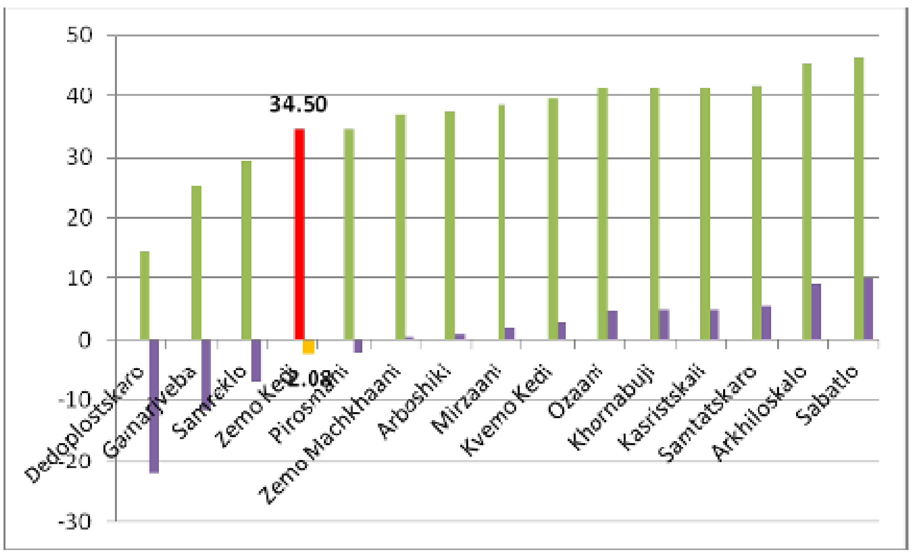
2.8.8 Zemo Kedi Community

Zemo Kedi community is located in the eastern part of Dedoplistskaro municipality, to the east of Dedoplistskaro town. There are no large surface waters in the territory of the community.

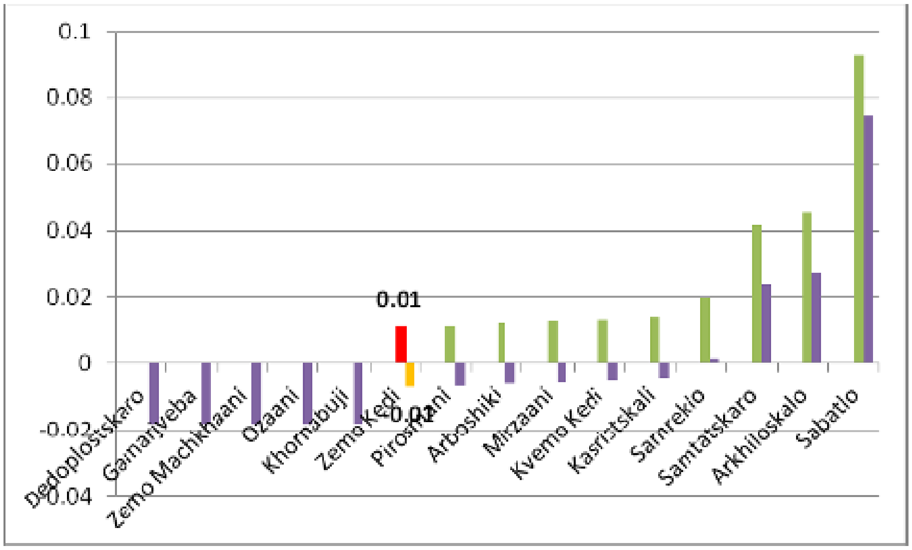
Zemo Kedi community consists of only one village – Zemo Kedi. The distance of the village from the municipal center is 26 km.

During the field research conducted within the scope of the program, the population of the community identified strong winds as the primary natural hazard. It should be mentioned that neither the field research nor the reports of National Environmental Agency have revealed any other type of hazardous natural events.

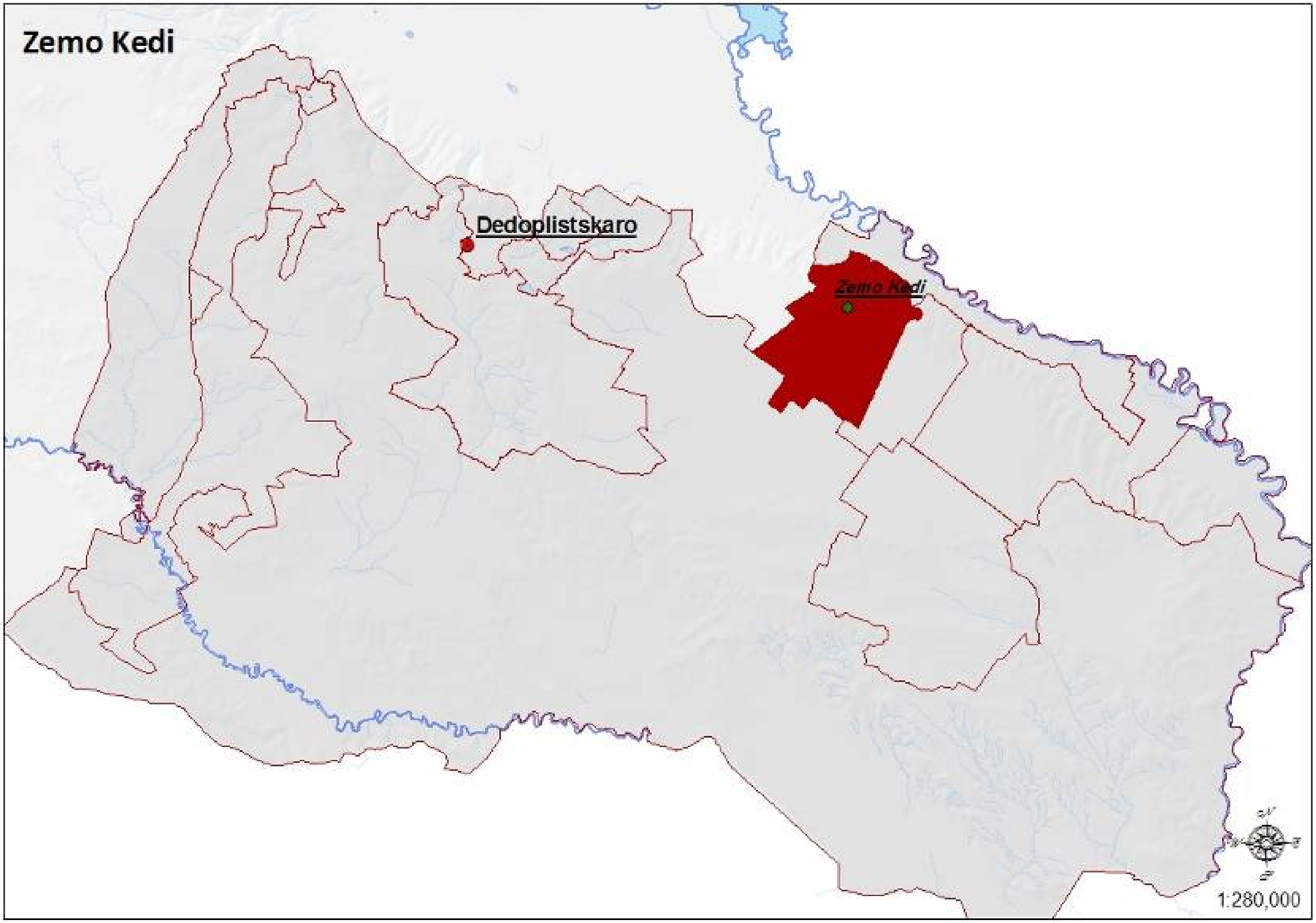
As a result of the research conducted within the scope of the program, the vulnerability of Zemo Kedi community was assessed to be 34.50 points. This is lower than the average indicator of the municipality. The difference from the average is not large (2.08 points, see the diagram). In general, on the scale of the target area of the program the vulnerability of the community was assessed as the average (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).



As a result of the research, the level of risk for Zemo Kedi community was assesed to be 0.01 points. This indicator is slightly less than the average indicator of the municipality, which is 0.02 points (see the diagram). The risk level of the community was considered to be very low (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).



Of hazardous natural events, the local population identified ***strong winds*** as the main problem for community of Zemo Kedi. According to the locals, strong winds demage almost 400 ha of agricultural lands. The main reason for this is the fact that in the 1990s windbreaks created during the Soviet period have been completely demolished. As a result of the process the economic wellbeing of the community population has been seriously affected.


Zemo Kedi
Dedoplistskaro
Zemo Kedi
1:280,000

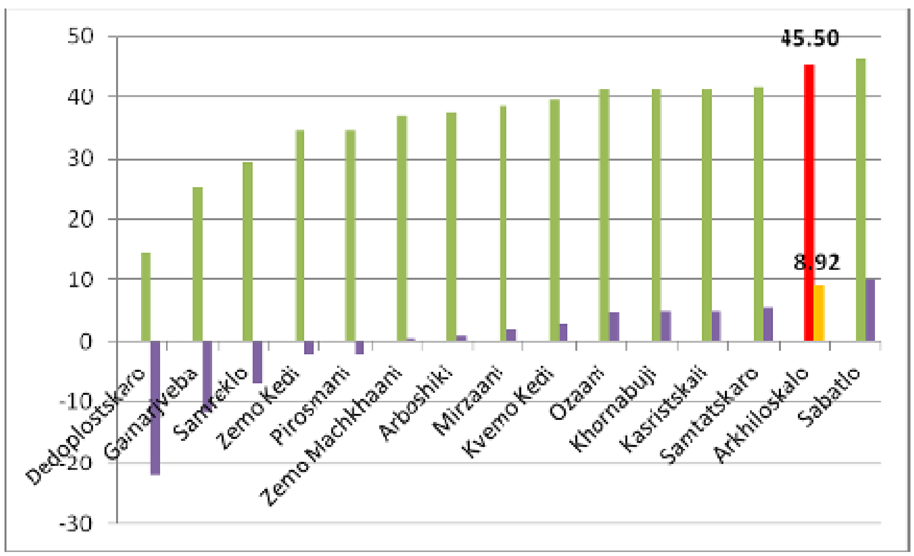
2.8.9 Arkhiloskalo Community

Arkhiloskalo community is located in the eastern part of Dedoplistskaro municipality, between the territories of Zemo Kedi and Kvemo Kedi. It should be noted that there are no large surface waters in the territory.

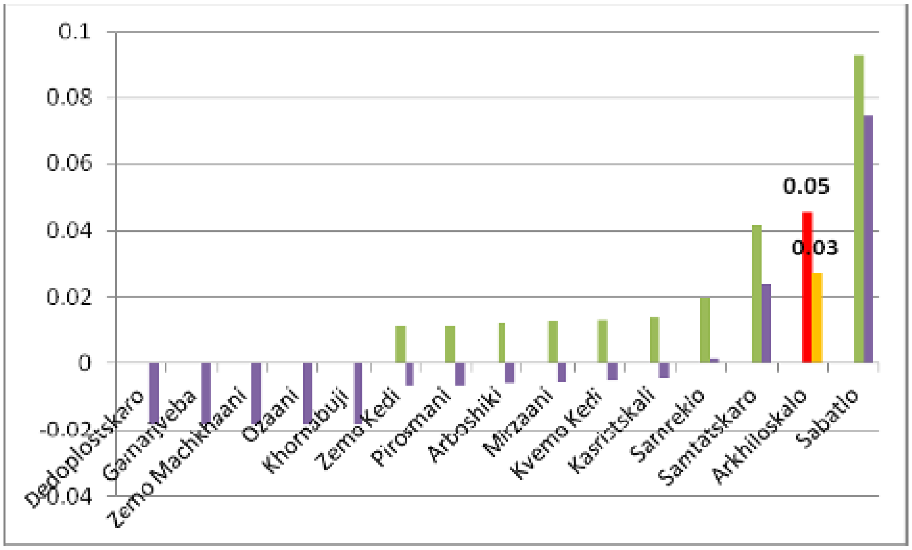
Arkhiloskalo community consists of only one village – Arkhikalo. The distance of the village from the municipal center is 35 km.

During field research, the population identified strong winds as the primary natural hazard in the community.

As a result of the research, the vulnerability of Arkhiskalo community to natural disasters and climate change was assessed to be 44.50 points. This indicator significantly exceeds the average indicator of the municipality (of 36.58 points). A deviation of 8.92 points (see the diagram). Therefore, Arkhiskalo community is one of the most vulnerable communities within the Dedoplistskaro municipality. Such a high level of vulnerability is determined by the fact that the community indicator exceeds that of municipality average in almost all the criteria of the vulnerability index. As for the general vulnerability index, it was assessed to be above average (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).



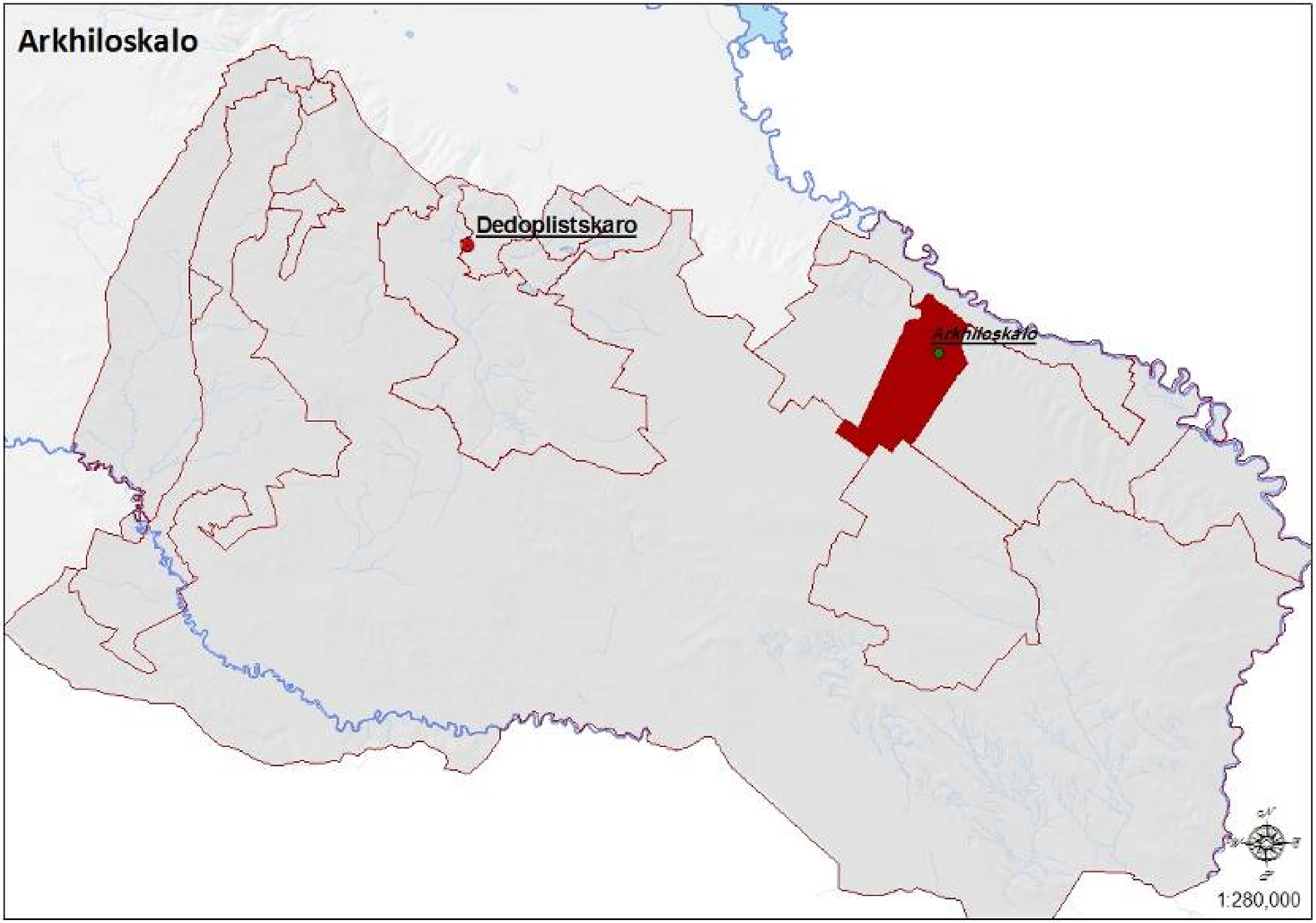
The level of risk for Arkhiloskalo community was assesed to be 0.05 points. From this perspective, the indicator for Arkhiloskalo community exceeds the average indicator of the municipality (it is the second highest in the municipality). The deviation from the average is 0.03 points (see the diagram). The high level of risk is, first of all, determined by the high level of vulnerability. In addition, hazardous natural events characteristic of the community have an impact on the majority of the community's agricultural lands. As for the general risk level, it was assessed to be average (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).



In conclusion, Arkhiloskalo community is one of the most vulnerable communities on the municipality scale. Therefore, Arkhiskalo community should be assessed as one of the so-called “hot spots” in Dedoplistskaro municipality.

As mentioned above, the field research revealed that ***strong wind*** is the main problem faced by Arkhiskalo community. According to the population, strong winds affect almost 600 ha of the agricultural lands, which coprise 55% of the total agricultural lands in the community. Therefore, wind is seriously affecting the economic wellbeing of the community.

The main reason for this problem is that the windbreaks that were demaged during the energy crisis in the 1990s.


Arkhiloskalo
Dedoplistskaro
Arkhiloskalo
1:280,000

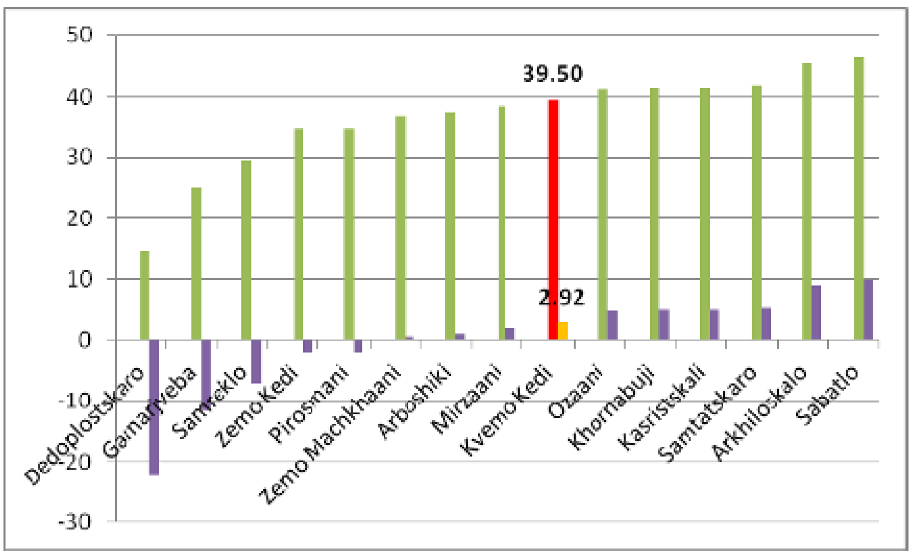
2.8.10 Kvemo Kedi Community

Kvemo Kedi community is located in the eastern part of Dedoplistskaro municipality. The community territory is crossed by irrigation channels. The easternmost part of the community borders the Alazani River. The eastern border of the community coincides with the Georgia-Azerbaijan state border.

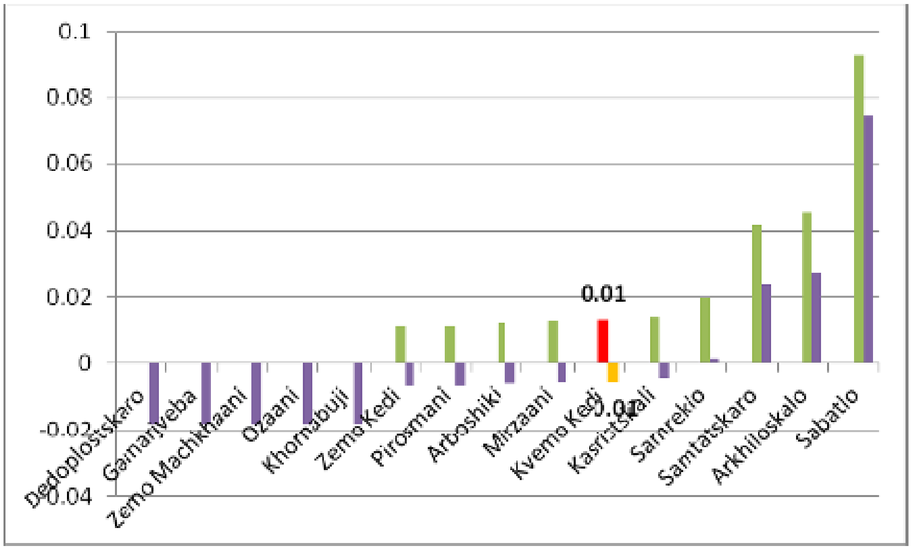
Kvemo Kedi community consists of only one village – Kvemo Kedi. The distance of the village from the municipal center is 45 km.

Similar to the other communities located in the eastern part of Dedoplistskaro municipality, the population of Kvemo Kedi identified strong winds as the main problem facing community with respect to hazardous natural events.

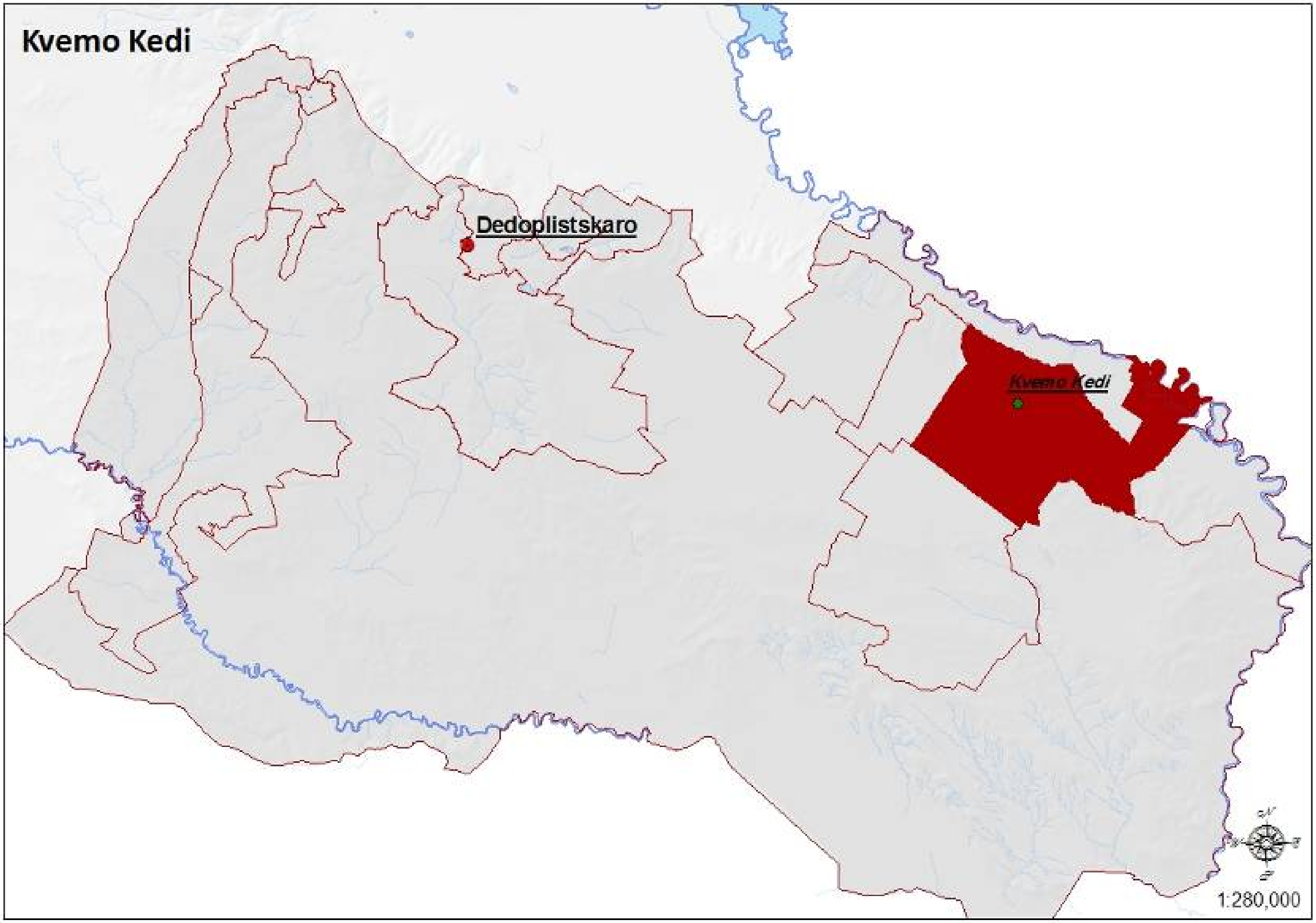
As a result of the research conducted within the scope of the program, the vulnerability of the Kvemo Kedi community was assessed to be 39.50 points. This indicator slightly exceeds the average indicator for the municipality. The difference from the municipal average is 2.92 points (see the diagram). The community's vulnerability was assessed as average (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).



Based on the results of the research conducted in the Kvemo Kedi community, the level of risk for the community was assesed to be 0.01 points. This indicator is slightly lower than the average indicator of the municipality. The difference is 0.01 points (see the diagram). Therefore, the community is not distinguished by a high risk level within the municipal borders. The risk level of the community was assessed to be very low (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).



As was already mentioned, similar to the other communities located in the eastern part of Dedoplistskaro muicipality, the population identified ***strong winds*** as the main natural hazard facing the community, which cause significant degradation of the community's agricultural lands.This process affects about 120 ha of land. Similar to other communities, the problem here is also caused by the destruction of windbreaks during th 1990s.


Kvemo Kedi
Dedoplistskaro
Kvemo Kedi
1:280,000

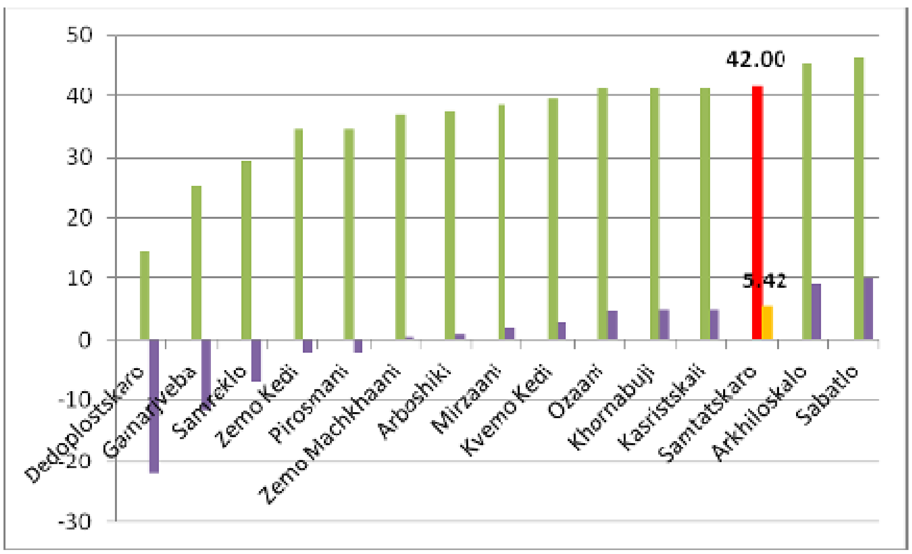
2.8.11 Samtatskaro Community

Samtatskaro community is located in the northen-easternmost part of Dedoplistskaro municipality. The eastern part of community borders the Alazani River, which at the same time coincides with the Georgia-Azerbaijan state border. Also, the community's territory is intersected by the right tributary of the Alazani River, as well as by irrigation channels and small river gorges.

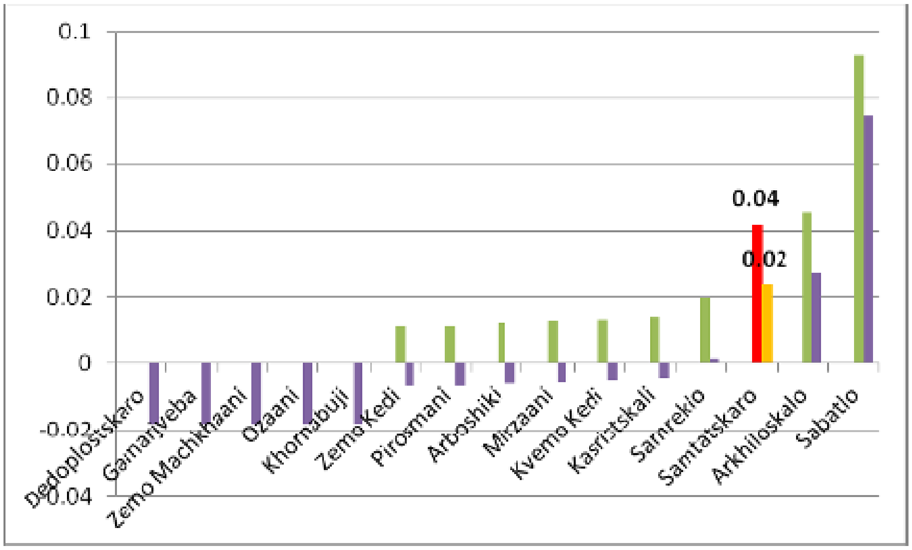
Samtatskaro community consists of only one village – Samtatskaro. The distance of the village from the municipal center is 45 km.

During the field research conducted within the scope of the program, the population of the community identified degradation of banks by the river as the primary problem.

As a result of the research conducted within the scope of the program, the vulnerability of Samtatskaro community was assessed to be 42.00 points. This indicator exceeds the average indicator for the municipality. The difference from the average is 5.42 points (see the diagram). The community's vulnerability was assessed to be average (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).



The level of risk for Samtatskaro community was assessed to be 0.04 points. From this perspective the indicator of Samtatkaro community exceeds the average indicator of the municipality, which is 0.02. The deviation from the average is 0.02 points (see the diagram). The general risk level of the community was assessed to be lower than average (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).



From the perspective of hazardous natural phenomena the situation in the Samtatskaro community is as follows:

Rural areas and agricultural lands of village, the so called Fifth Brigade territory, are washed by the Alazani River. Approximately 40 ha of agricultural lands are waterlogged.

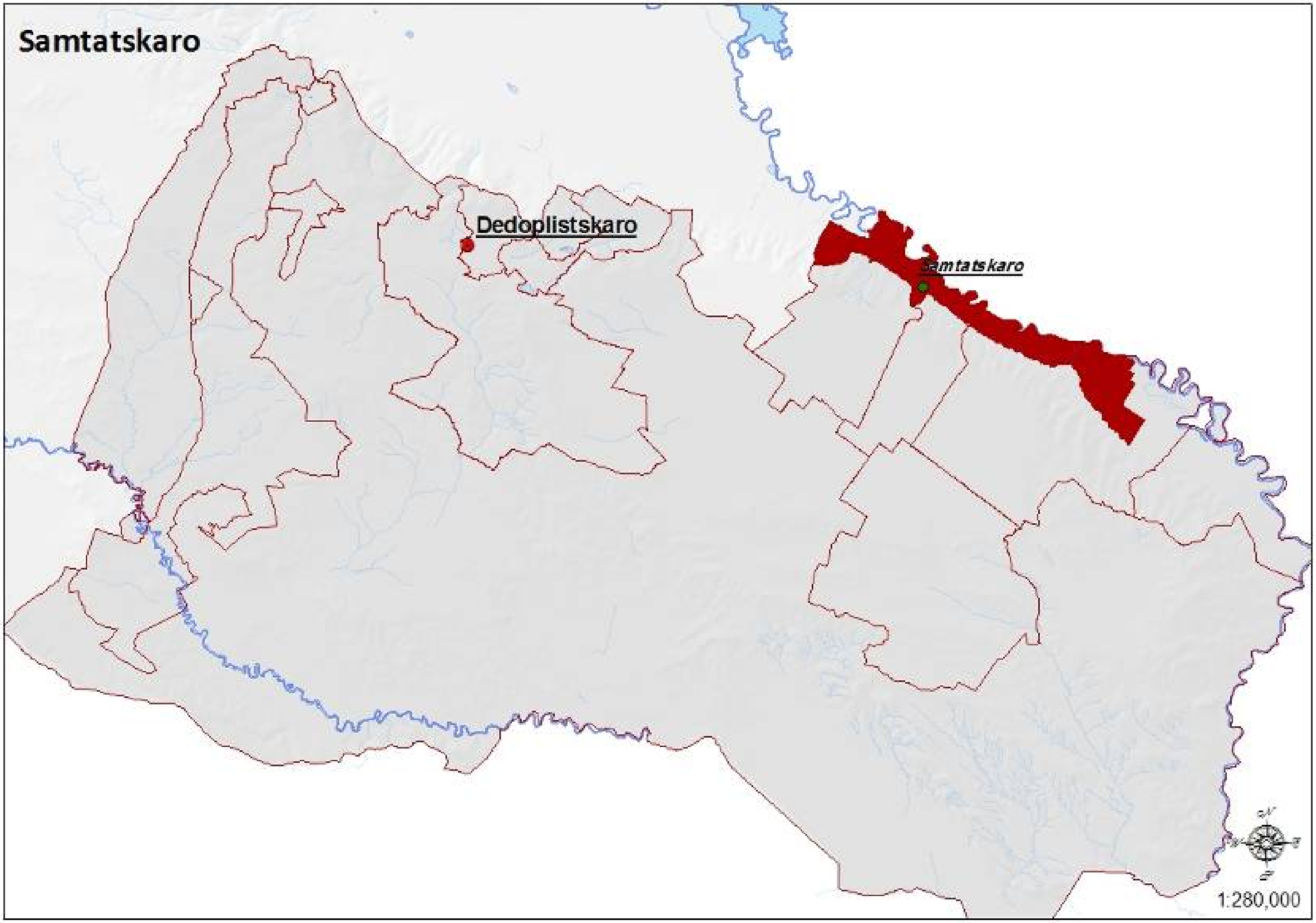
The following should be noted – as described above, the state border of Azerbaijan and Georgia lays on the river Alazani channel[3]. This section of river is described as meandering. In some places, as a result of intensive erosion, river is trying to cut a straight line. As a result of changes in the riverbed, some Georgian territories may transform with regards to the boundaries of Azerbaijan. According to the local population, the same processes are continuing on Azerbaijan side too, but unlike Georgia, the Azerbaijani side is doing reinforcement work to prevent the loss of territory. Accordingly, in the absence of similar work on the Georgian side, the river moves deeper and deeper into the municipality territory, moving the state border. A similar situation is present along several districts of the Alazani River as well.

We can see this situation in satellite image analysis. In this satellite image, the red line indicates the erosion trend of the river channel and the establishment of a possible vector.

[3]Meander - curved line of the river channel

In addition, during the field research the Samtatskaro population noted the problem of agricultural lands becoming ravines (near Sighnaghi municipality). According to the population, a few years ago a private person made an irrigation channel by himself, to better use irrigation water (which changed the water direction). Since the new channel was made by makeshift methods, over time, and as a result soil erosion, quite large gaps have formed. Observation of the area confirmed the significance of the problem; the parameters of the newly made ravine are impressive. Its depth in some sections is up to 30 meters (see pictures). A 10 meter section of Sabatalo-Tsnori road is damaged. If the problem is allowed to continue it will get worse rapidly, which will negatively affect the surrounding agricultural lands and new sections of Sabatalo–Tsnori road.





Samtatskaro
Dedoplistskaro
Samtatskaro
1:280,000

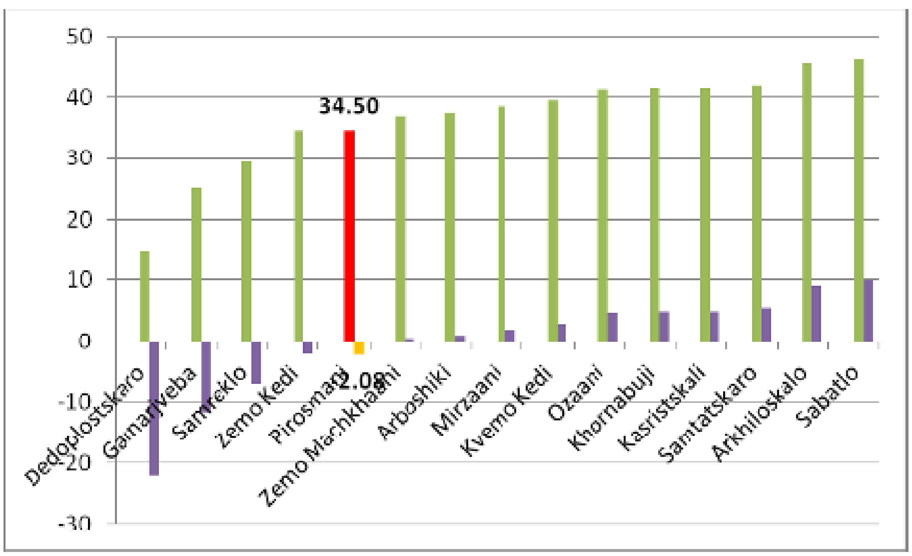
2.8.12 Pirosmani Community

Pirosmani community is located in the eastern part of Dedoplistskaro municipality, near Samtatskaro community. Like Samtatskaro community, the eastern part of the Pirosmani community borders the Alazani River. Here, the eastern border of the community coincides with the Georgia-Azerbaijan state border. The community territory is intersected by irrigation channel beds.

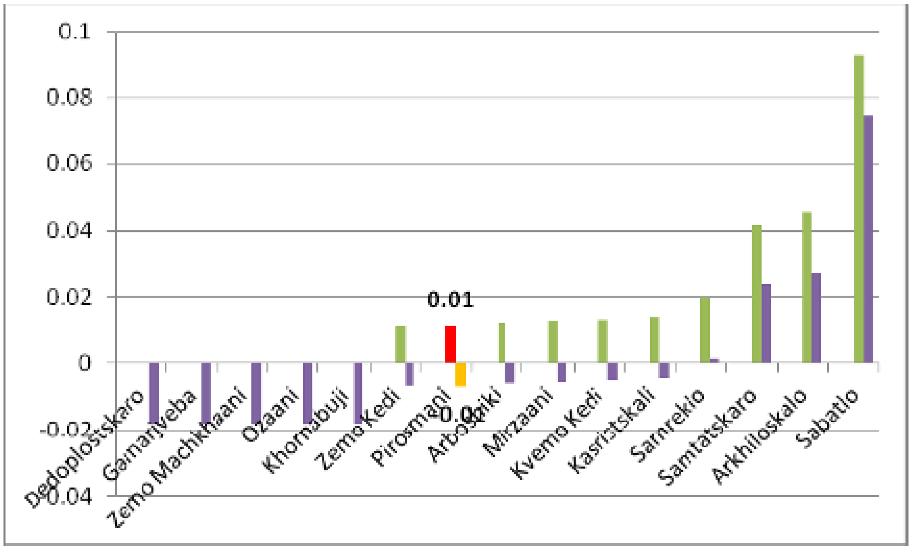
Pirosmani community consists of only one village – Pirosmani. The distance of the village from the municipal center is 60 km.

During the field research conducted within the scope of the program, the population of the community identified floods, associated with the Alazani River, as the main problem. It should be mentioned that reports of the National Environmental Agency have not revealed any type of hazardous natural events.

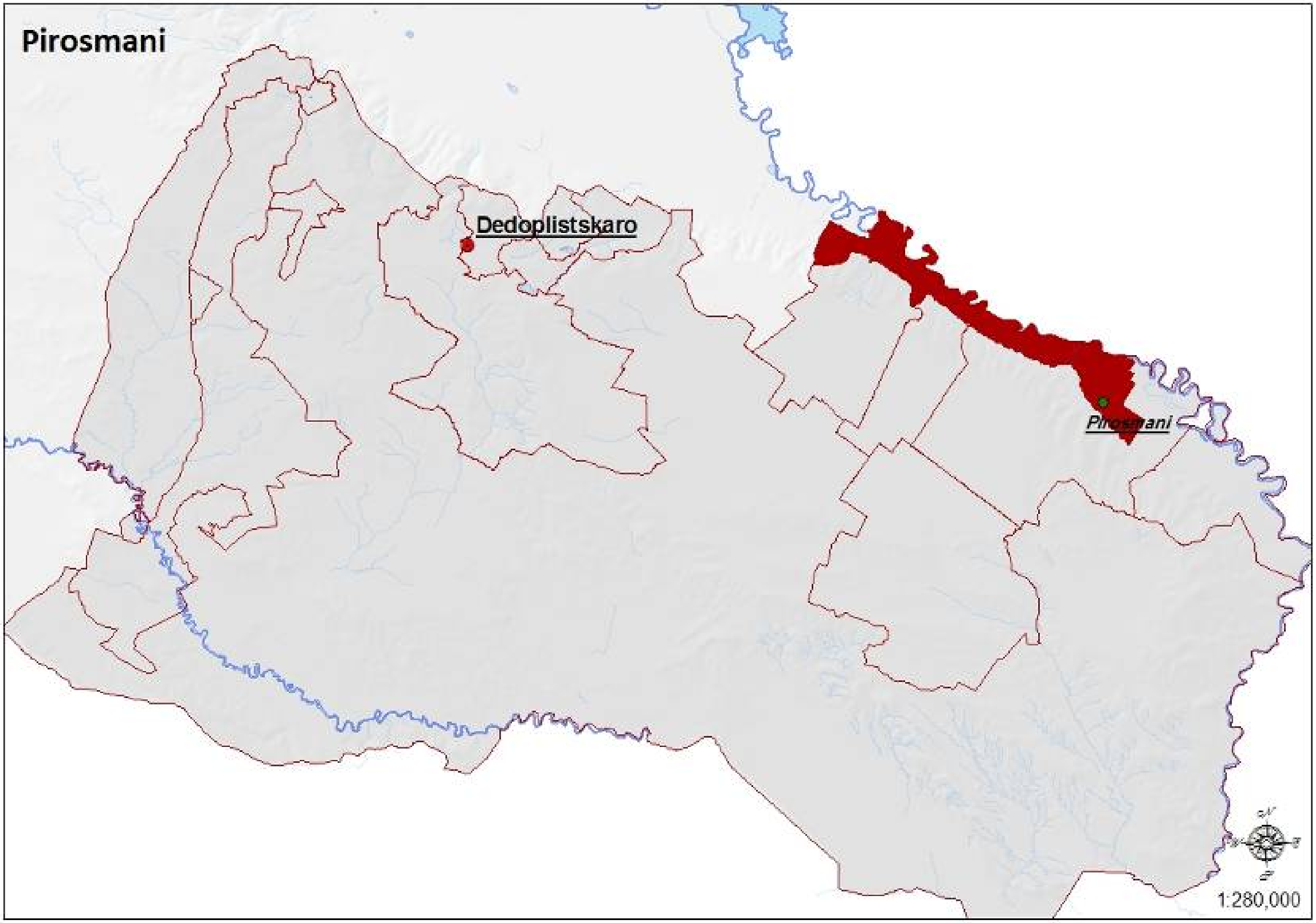
As a result of the research conducted within the scope of the program, the vulnerability of Pirosmani community was assessed to be 34.50 points. This indicator is lower than the average indicator of the municipality. The difference from the average is not significant (2.08 points, see the diagram). The vulnerability of the community towards climate change and natural disasters was assessed to be average (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).



As a result of the research, the level of risk for Pirosmani community was assessed to be 0.01 points. This indicator is slightly below the average indicator of the municipality. The difference is 0.01 points (see the diagram). The risk level of Pirosmani community was assessed to be very low (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).



As was mentioned, ***floods*** are the main problem faced by the Pirosmani community. The floods are most intense during flood season (spring), when snowmelt is abundant, and during conditions of significant rainfall (especially during fall season). When floods occur, the Alazani River goes over its channel and the water reaches Pirosmani village agricultural lands, which are mostly along the river channels (see satellite image, with the flood affected lands indicated in red). Around 130 ha of agricultural lands are under threat.


Pirosmani
Dedoplistskaro
Pirosmani
1:280,000

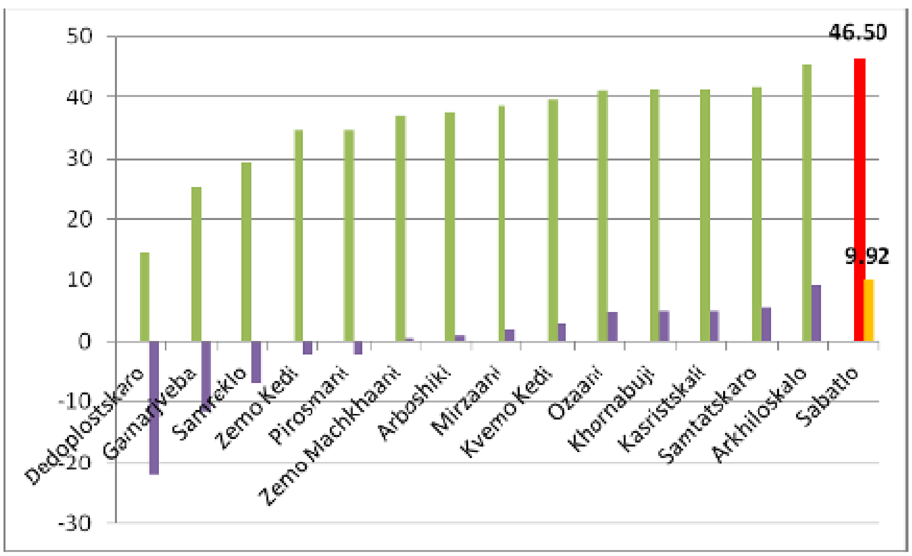
2.8.13 Sabatlo Community

Sabatlo community is located in the easternmost part of Dedoplistskaro municipality. Sabatlo community is the easternmost community not only in the municipality, but in whole of Georgia. Like Pirosmani community, the eastern party of Sabatlo community borders the Alazani River. Here, the eastern border of the community coincides with the Georgia-Azerbaijan state border. Besides the Alazani River, the community territory is crossed by irrigation channel beds.

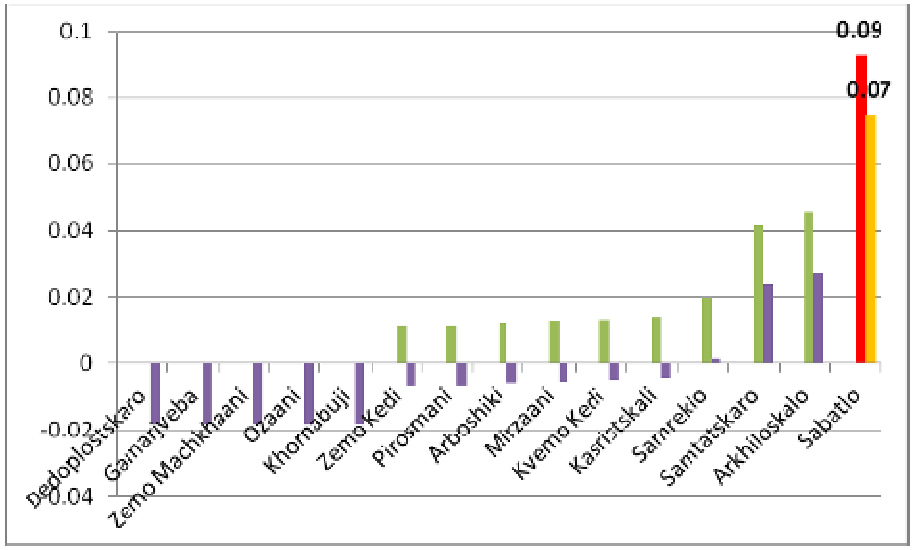
Sabatlo community consists of only one village – Sabatlo. The distance of the village from the municipal center is the furthest in the municipality, around 70 km.

Field research in the Sabatlo community territory has identified that the main hazardous natural event is associated with the erosive actions of the Alazani River.

As a result of the research conducted within the scope of the program, the vulnerability of Sabatlo community is the highest in the entire municipality and has been assessed as 46.50 points. The difference from the average is significant and (9.92 points, see the diagram). Such a high rating is due to the weakness of the community 's communications, drinking water infrastructure and the large spread of dangerous areas over urban and agricultural lands. The vulnerability of the community was assessed to be higher than average (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).



As a result of the research, the level of risk for Sabatlo community is the highest on the scale of the entire municipality and is assessed to be 0.09 points. The deviation from the average is 0.07 points (see the diagram). This high risk level is due to the vulnerability of the community, and the scale of hazardous natural processes. As for the general risk level, on scale of the target scope of the program it was assessed as above average (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).



Based on the assessment results, Sabatlo community has the most serious venerability status, which, together with the existing dangers, makes it the highest risk-leveled community in the municipality. Accordingly, Sabatlo community may be described as a so called "hot spot" on the scale of the entire municipality.

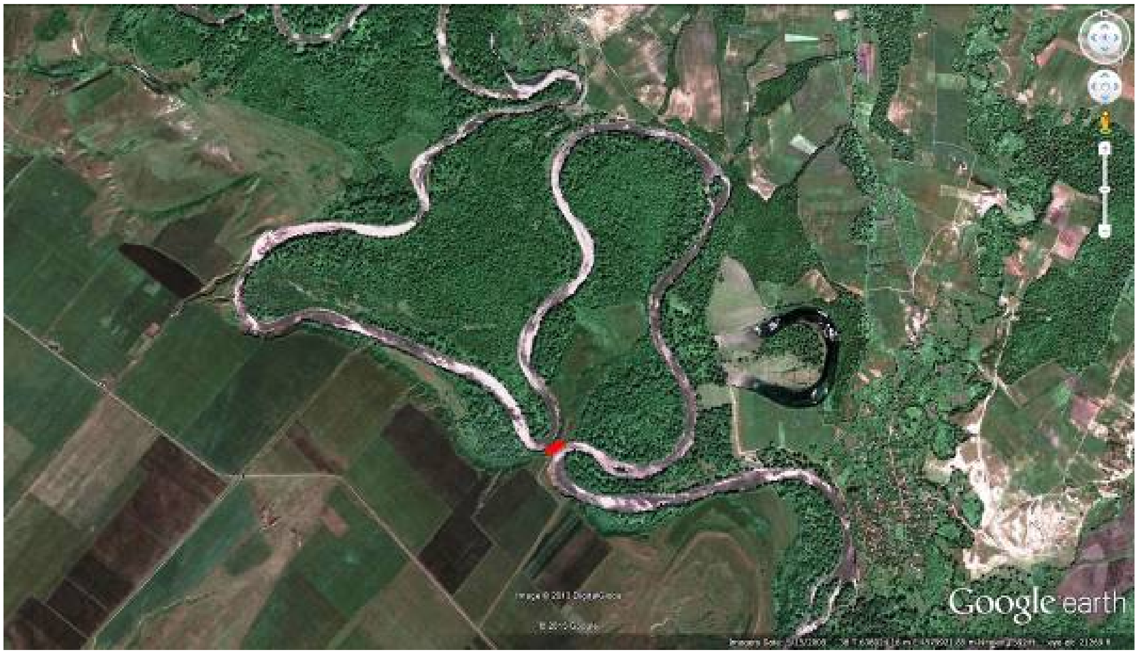
From the perspective of hazardous natural phenomena the situation the Sabatlo community is as follows:

As noted, the main problems are related to the Alazani River. It should be mentioned that Sabatlo community is the only community described in the reports of National Environmental Agency, which is a good indicator of the significance of the situation.

The most important problems are related to ***lateral erosion*** due to Alazani River activity, which is caused by the intense washing and erosion of banks. This is a problem that characterizes the whole lower flow of the river; however, it is most prominent in the territory of Sabatlo community. This section of the Alazani River, along the Georgian-Azerbaijani border, is considered to be meandering. In some places, as a result of intensive erosion, the river is trying to cut a straight line. One of the most significant occurrences of this problem is located in the Sabatlo community (so-called Kakliskure), where the 'meander throat' has narrowed to 5m. Given that the Alazani River banks are extremely prone to erosion, the 'meander throat' breakthrough is expected soon. As a result of this, 290 hectares will be transported to the left bank of the Alazani River, the territory of Azerbaijan. This has already occurred in the surrounding areas, notably in the village of Erisimedi (Sighnaghi municipality).

This problem is complicated by the fact that the Georgia–Azerbaijan border demarcation and delimitation process has not been completed since the Soviet period. The state border is not defined by geographical coordinates. The only arrangements state that the border lays on the Alazani River. As a result, the state border is fluid and varies with the changes in the river channel.

Satellite images give a good perspective of the problem. The red line indicates the narrowed 'meander throat'.


Google earth

In addition, the lower stream of the Alazani River is filled with the easily washable sediment. The banks of the river suffer from destruction, which is most intense during periods of flooding. Dozens of hacters of land is lost annually along the river channel. This is a significant problem for the Sabatlo community. Every year, during the river floods, the Alazani bursts the banks and waterlogs the agricultural lands (a total of 200 ha). According to the population, the river has moved 50m in the last 5 years. On the satellite image below, the red color indicates the affected area.

In addition to the described problems, during heavy rainfall, some houses in the village are waterlogged. This problem is due to the fact that during heavy rains, the drainage channel that carries the excess water cannot transfer enough water; consequently, the water floods the surrounding area, including 4 houses (the houses are almost ruined as a result of flooding), their ancillary buildings and plots (0.25 ha in total). Due to this process the village school, along with its basement, was also flooded.


Sabatlo
Dedoplistskaro
Sabatlo
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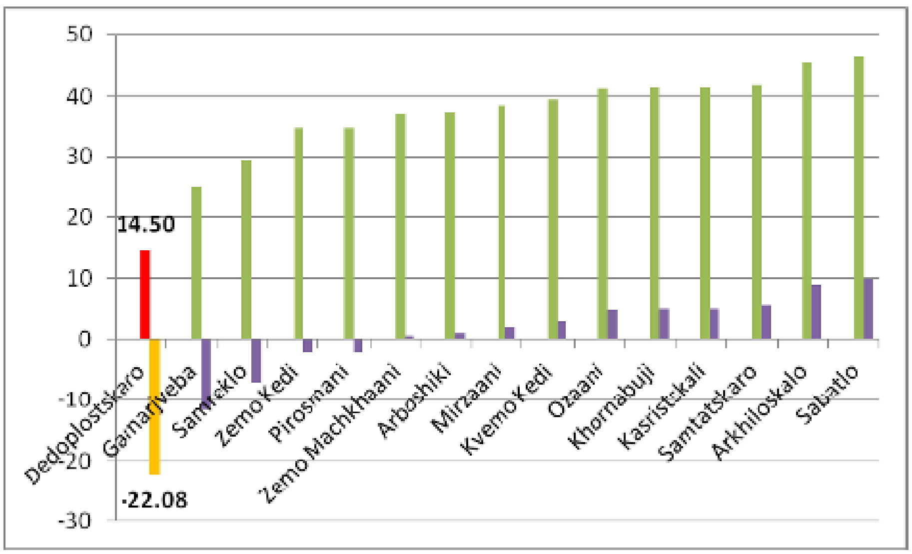
2.8.14 Dedoplistskaro Town

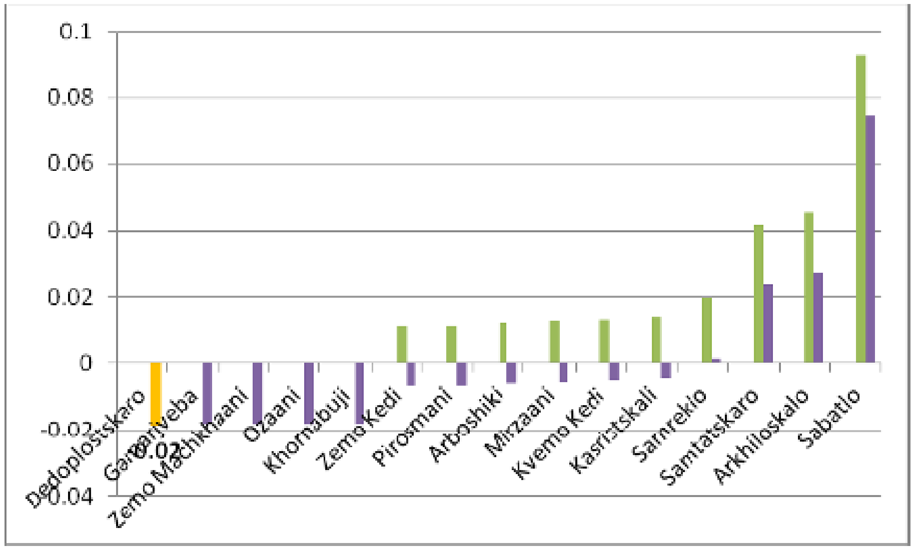
The town of Dedoplistskaro is located in the northern part of the municipality. It should be noted that there are no important surface waters present in the territory of the town.

During the field research, the research team did not reveal any hazardous natural events in the territory of the town of Dedoplistskaro. Therefore, it should be admitted that neither the reports of National Environmental Agency nor any other sources have revealed any kind of hazardous natural processes in the town.

The vulnerability of the Dedoplistskaro towards natural disasters and climate changes was assessed to be 14.50 points. This is a low indicator on the scale of the whole municipality. The difference from the municipality average indicator of vulnerability is significant, 22.08 points. Such a low index can be explained by the fact that in the town of Dedoplistskaro the social infrastructure and road communications are well developed and that the drinking water infrastructure is in a good condition. In addition, compared to villages, towns have a greater capability to counteract to the negative impacts of natural disasters. As for the vulnerability, the town of Dedoplistskaro has a very low level of vulnerability (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).



The fact that, accoriding to the sources discussed above, there are no hazardous natural events observed in the territory of the town, and that it has a low level of vulnerability, means the level of risk for the town of Dedoplistskaro is 0 points (see the diagram). Therefore, the risk level of the town was assessed to be very low (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).


0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
Dedoplostskaro
Gamarjveba
Zemo Machkhaani
Ozaani
Khornabuji
Zemo Kedi
Pirosmani
Arboshiki
Mirzaani
Kvemo Kedi
Kasristskali
Samreklo
Samtatskaro
Arkhiloskalo
Sabatlo


Dedoplistskaro
Dedoplistskaro
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2.8.15 Kasristskali Community (Akhmeta Municipality)

From a geographical perspective, Kasristskali community is located in the eastern part of Dedoplistskaro municipality. From an administrative point of view, Kasristskali community belongs to the Akhmeta municipality.

Akhmeta municipality also belongs to the Alazani River basin, however, it represents the upper stream of its basin. As a part of the Alazani River basin, Akhmeta municipality also lie within the scope of the INRMW program, as a target municipality.

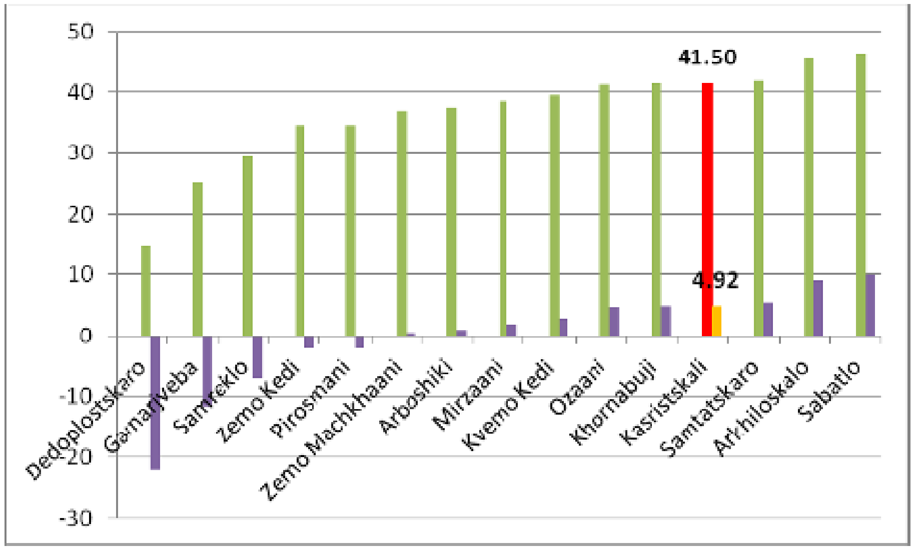
Taking into consideration the program objectives, where a particular emphasis is made on the location of the target municipalities in the river basins, we decided it would be logical to review Kasristskali community in this report as well. This will describe the situation in the lower stream, and particularly in Dedoplistskaro municipality. This decision is supported by the fact that the natural conditions (determining the character of the disaster) and socio-economic situation of the population (a decisive factor while evaluating the vulnerability) of the Kasristskali community, is more similar to its border territories than that of its municipal centre, which is located in the upper stream of the Alazani river. According to the research objectives, these factors are of greater importance than the administrative municiapality to which it belongs.

Based on this, a description of the situation in the Kasristskali community has been included in the present report (below). As was already noted, Kasristskali community is located in the eastern part of Dedoplistskaro municipality. The community territory is intersected by small rivers and artificial channel beds. A relatively bigger river, – the Mlashetskali (which is salty), also takes its source here; either it is a temporary river.

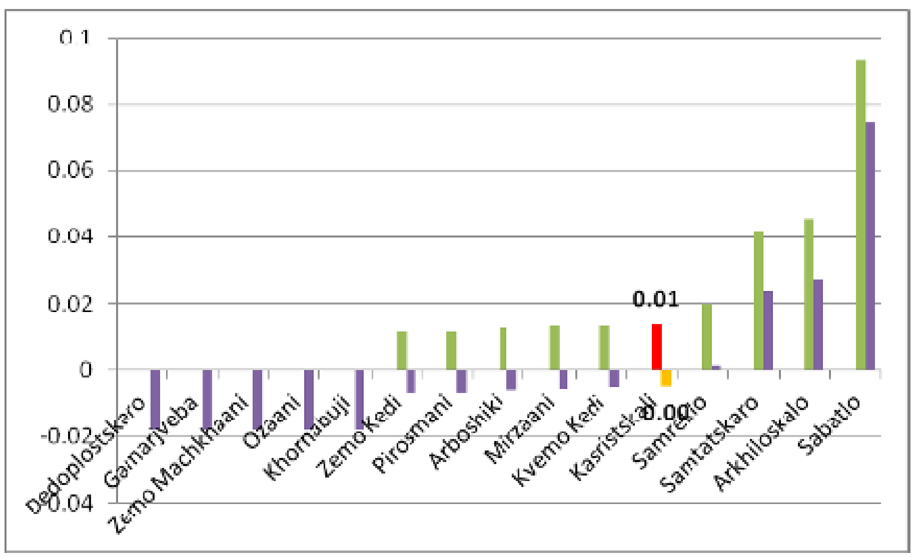
Kasristskali community consists of only one village – Kasristskali. The distance of the village from the municipal center is 40 km.

During the field research conducted within the scope of the program, the population of the community identified strong winds as their main problem. Other kinds of natural disasters have not been described in the community territory. Neither have the reports of National Environmental Agency revealed any other types of disasters in the territory of the community.

Within the scope of the program, the vulnerability of Kasristskali community was assessed to be 41.50 points. This indicator exceeds the average indicator for the municipality. The difference from the average is 4.92 points (see the diagram). The vulnerability of the community was considered to be average (see the map – Assessment of the Vulnerability of Dedoplistskaro Municipality).



The level of risk in the Kasristskali community coincides exactly that of the municipality average, 0.01 points (see the diagram). The overall risk level was assessed to be very low (see the map – Assessment of Disaster Risks of Dedoplistskaro Municipality).



The situation in the community from the perspective of hazardous natural events is as follows:

As was already mentioned, during the field research the local population identified ***strong winds*** as the primary natural hazard in the community. During the 1990s, the windbreaks created during the Soviet period were completely demolished. Consequently, this negatively affected agriculture in the village. Crops areas are being destroyed. In addition to this, the wind erodes the productive surface of the soil, and contributes to the process of desertification. Overall, according to the population, the wind affects around 800 ha of agricultural lands (about 20% of the total agricultural lands that belong to the village). As a result, the economic wellbeing of the community is seriously affected.


kasristskali
Dedoplistskaro
Kasristskali
1:280,000

2.9 Conclusions

A summary of the opinion concerning hazardous natural events in the territory of Dedoplistskaro municipality has been created in Table 2.4, where the hazardous natural events identified by the communities of the municipality are generalized.

Table 2.4. A summary of natural hazards detected in the Territory of Dedoplistskaro Municipality

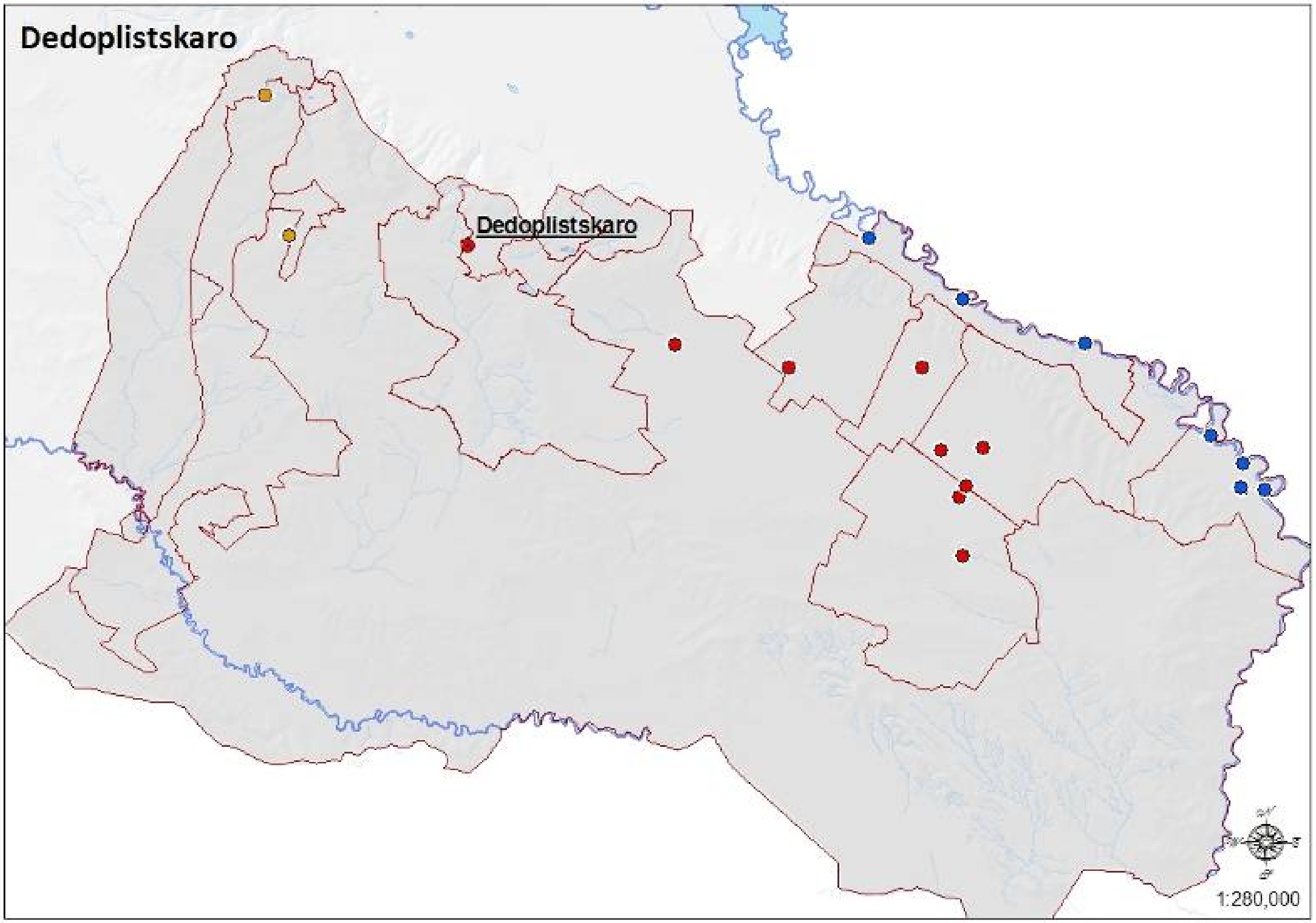
Community		Hazardous Natural Event			
		Flood	Debris flow	Bank Washing	Strong Winds
1	Zemo Machkhaani				
2	Mirzaani		+		
3	Arboshiki		+		
4	Gamarjveba				
5	Ozaani				
6	Khornabuji				
7	Samreklo				+
8	Zemo Kedi				+
9	Arkhiloskalo				+
10	Kvemo Kedi				+
11	Samtatskaro	+		+	
12	Pirosmani	+			
13	Sabatlo	+		+	
14	Town of Dedoplistskaro				
15	Kasristskali				+

An analysis of the table and a review of the situation in the communities lets us make several important conclusions. In particular, the municipality communities are negatively affected by floods and intense river erosion processes. The negative impacts of strong winds should also be noted.

The geographical difference between the events occuring in the municipality is evident. In particular, the main hazards that characterize Dedoplistskaro municipality, i.e. river erosions, floods, strong winds, mainly occur in the communities located in the eastern part of of the municipality (see the map 2.1 – Hazarodus natural events identified in the territory of Dedoplistskaro municipality during field research). From this perspective, a particular emphasis should be made on communities near the border of Azerbaijan, where the main problem of flooding exists. The intensive erosion of the banks of the Alazani River should also be noted, as it may result in political problems. As was shown in the detailed description, the configuration of the state border changes as a result of the erosive actions of the Alazani River (the border is not delimited and is connected to the river bank). This creates the possibility of some Georgian territories moving to within the borders of the Republic of Azerbaijan.

The problem of stong winds should be discussed seperately, it is characteristic not only of the Dedoplistskaro municipality, but of the southern part of entire Kakheti region. This problem is particularly urgent for the municipality of Dedoplistskaro. However, as the field research has revealed, only the eastern communities of the municipality have this problem. Wind erosion is caused by stong winds, as a result of which thousands of hacters of agricultural lands are destroyed and practically removed from the municipality.

Map 2.1. Natural Hazards Detected on the Territory of Dedoplistskaro Municipality in Result of Field Research



The information gathered by field research was summarized together with information from other sources and based on an analysis of GIS maps. A map of the possible distribution of natural disasters for Dedoplistskaro municipality was also prepared (see map 2.2 The distribution possibility of natural disasters in Dedoplistskaro municipality).

An assessment of the vulnerability of the municipality communities was also conducted within the scope of the program. Vulnerability was calculated by evaluating various socio-economical parameters of the villages within the municipality communities. Therefore, the natural disasters existing in the villages have also been taken into consideration. For the results of the assessment, please see map 2.3 - The vulnerability of the communities of Dedoplistskaro municipality, and table 2.5 – Distribution of the Dedoplistskaro municipality communities according to vulnerability level.

An analysis of the map and table show that an absolute majority of the Dedloplistskaro municipality communities belong to the category of average vulnerability. There are only two communities in the municipality that were assessed to have an above average vulnerability index. As for the high level of vulnerability, not a single community in the municipality is in this category.

An analysis of the vulnerability measuring components within the municipality has shown that the main factors causing vulnerability in the municipality communities towards natural disasters and climate change are: difficult economic situation of the comminities, low level of preparedness for possible disasters and climate change (a lack of coping information and skills). The quantitative indicator of economic capability (agricultural lands) in the zones of danger also had a significant impact on the vulnerability index.

Table 2.5. Distribution of the communities of Dedoplistskaro Municipality by the level of vulnerability

Community		Vulnerability Level				
		low	Lower than average	average	Higher than average	high
1	Zemo Machkhaani			+		
2	Mirzaani			+		
3	Arboshiki			+		
4	Gamarjveba	+				
5	Ozaani			+		
6	Khornabuji			+		
7	Samreklo		+			
8	Zemo Kedi			+		
9	Arkhiloskalo				+	
10	Kvemo Kedi			+		
11	Samtatskaro			+		
12	Pirosmani		+			

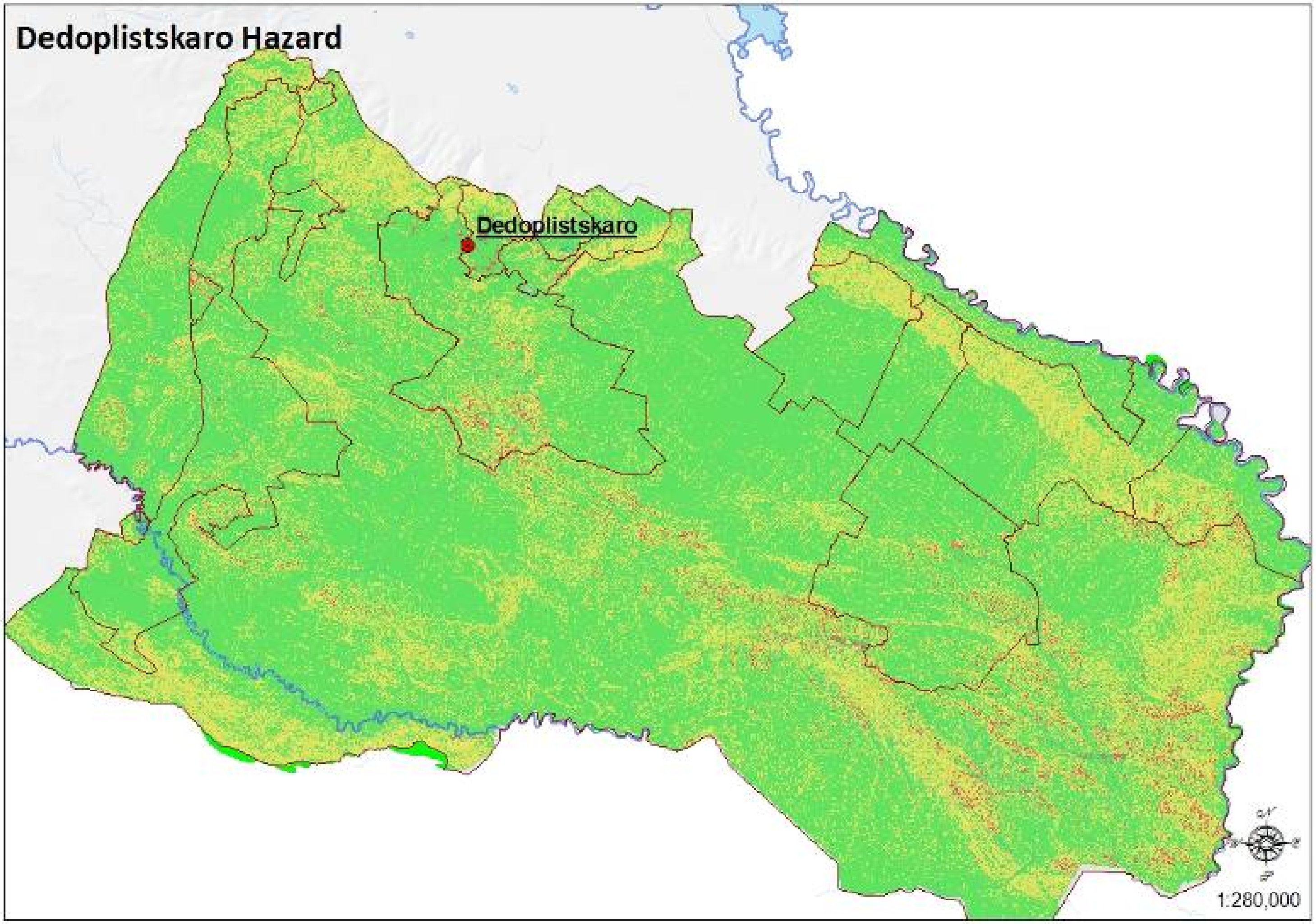
13	Sabatlo				+	
14	Town of Dedoplistskaro	+				
15	Kasristskali			+		

This vulnerability assessment, together with the disaster assesment, layed the foundation for the calculation of risk level in the municipality communities (see Map 2.4. The risk level of Dedoplistskaro municipality communities towards natural disasters). The assessment of the communities with regards to the risk level is represented in the Table 2.6. We can conclude that, based on the map and the table, and compared to other communities of the municipality, the eastern part of the municipality contains the highest risk communities. Sabatlo community should be noted as particularly high risk.

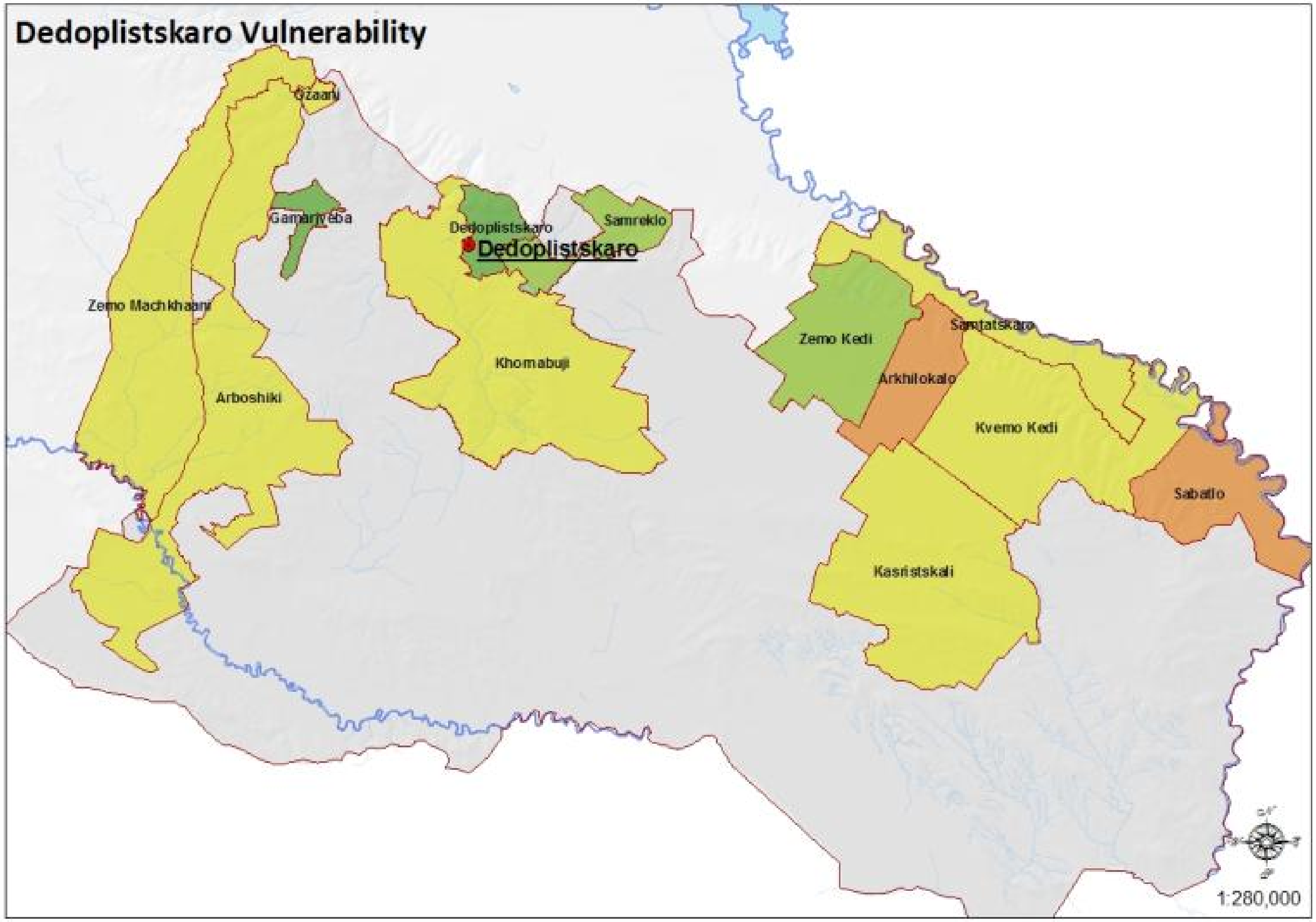
Table 2.6. Distribution of the communities of Dedoplistskaro Municipality according to the level of risk

Community		Risk Level				
		low	**Lower than average**	**average**	**Higher than average**	**high**
1	Zemo Machkhaani	+				
2	Mirzaani	+				
3	Arboshiki	+				
4	Gamarjveba	+				
5	Ozaani	+				
6	Khornabuji	+				
7	Samreklo		+			
8	Zemo Kedi	+				
9	Arkhiloskalo			+		
10	Kvemo Kedi	+				
11	Samtatskaro		+			
12	Pirosmani	+				
13	Sabatlo				+	
14	Town of Dedoplistskaro	+				
15	Kasristskali	+				

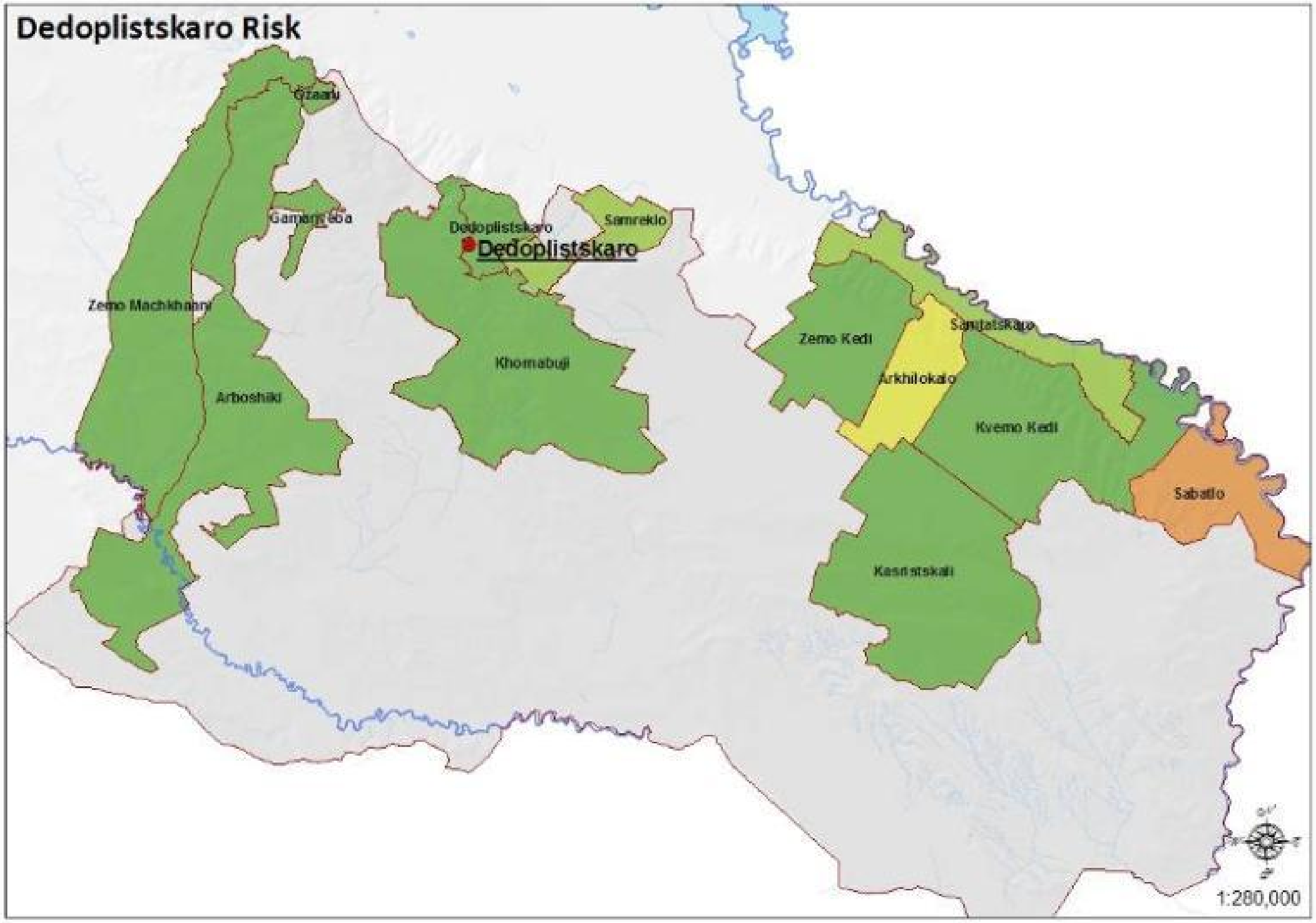
Map 2.2. Probability of Distribution of Natural Hazards in Dedoplistskaro Municipality



Map 2.3. Vulnerability of the Communities of Dedoplistskaro Municipality to Natural Disasters



Map 2.4. The Level of Risk of the Communities of Dedoplistskaro Municipality to Natural Disasters



3 Problems Related to Expected Climate Changes for the years 2020 to 2050 and Respective Adaptation and Mitigation Measures

A list of measures was developed based on the vulnerability and disaster assessment implemented in the municipality which is significant to be carried out in Dedoplistskaro Municipality to reduce its vulnerability to natural disasters and climate change and to increase endurance.

It should be noted that the list of the measures developed is somewhat general due to the scales of the implemented activities – the assessment fully covered Dedoplistskaro Municipality. The expert group assessed the situation in terms of the municipality, field surveys were carried out in every village of the municipality. Thus, the recommendations developed in the survey framework are, in a way, municipality level recommendations, which exclude specification of a place (community, village or a part of the village) with regards to a specific problem. At the next stage of the program framework the scale of the activities program is planned to be extended to the community level which will use the present survey outcomes and will allow to elaborate community action plan with maximum involvement of the local population which will reflect specific activities for risk reduction and resistance increase.

The comparative analysis results of the Dedoplistskaro meteorological station observation materials from 1956-2005 and regional PRECIS, global ECHAM4, HaDCM3 models and data of A-2 and B-2 scenarios of world social-economic development in 2020-2050 show that the following simulated climate parameter changes are expected on Dedoplistskaro municipality territory within the next three decades in comparison with the baseline period (1956-2005):

The average annual air temperature increase by 2.5-3^{0}C, absolute maximal temperature increase by 2.5-3^{0}C (42-42.4^{0}C instead of 39.5^{0}C observed in the baseline period), triple number of tropical nights, increase of the number of hot days, extension of vegetation period by 20 days in average. Increase of the length of continuous dry periods, minor increase of annual precipitations (6-7%), decrease of days with 10 and 20 mm precipitation, slight increase of the number of days with 50mm precipitation. 90mm precipitation day event probability equaling 0. Cases of annual atmospheric precipitation increase 200mm or more are not expected. Average and maximum speed of wind is the same as characteristic for the period of 1956-1980.

On the basis of comparative analysis of air temperature and atmospheric precipitation different parameter change, we can conclude that the arid climate characteristic for Dedoplistskaro municipality will become drier and hotter in 2020-2050. Climate aridization process on the municipality territory in these conditions may be stronger than adaptation ability of some agricultural fields and natural ecosystems (taking into consideration their vulnerability towards hot and dry climate).

Below are given the major problems caused by the expected changeability of meteorological elements and necessary adaptation activities for their mitigation in accordance to the future climate change scenario in Dedoplistskaro Municipality boundaries. Also, a list of the activities for the mitigation and adaptation of the problematic aspects identified as a result of the field survey for each community.

3.1 Spatial Planning

It is necessary to define areas implying high danger of natural disasters, so called “hot spots” at the municipality territory, management of which will be executed in accordance to the existing risks.

The risks faced by the municipality communities are stipulated not only by the territories implying danger but also by the vulnerability level of the municipality communities. It is important to implement vulnerability decrease activities in this regard which in turn will increase resistance of the communities towards the possible natural catastrophes and negative influences of the climate change. For the decrease of the vulnerability, it is important:

- To improve social infrastructure for the population of the municipality communities.
- It is necessary to increase readiness of the communities as well as for the whole municipality for the possible natural catastrophes. In this regards it is important:
    - To strengthen the regional rescue service through proper training and equipment.
    - To elaborate municipal response plan that will adequately reflect the dangers the municipality faces, will elaborate alternate scenarios of the development and will elaborate an action plan according to these scenarios taking into consideration the community vulnerability levels.
    - Periodical training on reaction to the catastrophes of the population; Awareness raising campaign in this regard
- Improvement of the economic well-being of the population through strengthening various prospective sectors (tourism, agriculture) that will support decrease of the vulnerability level as a result.

The abovementioned results will become a baseline for the introduction of the spatial planning elements in the municipality management that will ensure minimization of the risks faced by the municipality through most effective use of existing resources. Spatial planning – we believe this is the main recommendation in terms of adaptation for the climate change and increase of readiness. The work performed while preparing the present document may provide a significant assistance to the municipality administration in future in this regard.

3.2 Drought

The problem of drought is mainly reflected in the agricultural fields of the municipality. The main problem in this regard is the possible lack of irrigation water. For effective and rational consumption of the irrigation water and reduction of waste it is significant:

- Rehabilitation-extension of the existing water supply system, improvement of its technical condition, equipment with new water-saving systems;
- Irrigation system rehabilitation;
- Repairing irrigation channels leading to the villages and internal irrigation system on the village territory;
- Cleaning of the sections of the channels filled with ground and waste;
- Improvement of soil surface water-directing properties (permeability, water deterrence) and erosion resistance (which is a precondition of water saving) to mitigate the impact of drought;

- Setting strict control for restriction of unplanned, frequent and excessive irrigation;
- Introduction of irrigation regime and following it;
- Selection of respective types of irrigation – surface irrigation by drift using line, line-holes, subsoil irrigation;
- Compulsory introduction of the methods and rules of irrigation with artificial rain, irrigation by drops, which is an effective way of saving the irrigation water.

It is also significant:

- Restoration-rehabilitation of the logged down, strongly degraded or exploited windbreaks to mitigate the impact of winds, as one of the factors strengthening droughts;
- Restoration of climate-regulating and soil-protective forest stands on postforest areas never or less used for agriculture and setting strict control on unregulated logging of forest;
- Selection of drought resistant agricultures and checking their ability of adaptation with the local climate conditions;
- Permanent information of the municipality agrarian society on strengthening of droughts due to the expected climate change to learn agriculture vulnerability, adaptation and mitigation activities as well as information on water saving issues.

3.3 Desertification

In order to mitigate the desertification process, the following activities are significant to be carried out throughout the municipality:

- Forestation (fast growing, high thermal capacity, soil protection, drought resistance properties) plantations on the plots unused or difficult to use for agriculture;
- Setting strict control on unregulated forest logging;
- Restoration-rehabilitation of logged or exploited degraded windbreaks to reduce intensive evaporation of moisture from the ground, land depletion and its erosion;
- Rehabilitation-reconstruction of irrigation systems, setting irrigation regime to minimize water loss, selection of drought resistant agricultures, checking their ability of adaptation with the climate on specially selected plots.

Also:

- Creating of climate change monitoring system on the municipality territory;
- Implementation of permanent monitoring on flora and fauna of the protected areas (that do not have anthropological impact) in order to find the correlation between the ecosystem transformation and climate condition change (especially, regarding the desertification process development);

- Informing the municipality population (especially farmers) and local authorities on the desertification process developments.

3.4 Pasture Degradation

In order to mitigate pasture degradation and increase productivity, the following activities are necessary to be carried out:

- Introduction of integrated management system in cattle-breeding, introduction of new technologies together with restoration-renewal of old traditional rules;
- Optimal load of pastures with sheep flocks and cattle;
- Unconditional introduction of plot shift, pasture rotation, pasture breaks practice;
- Adding fertilizers, planting annual and perennial plants, cleaning of pastures, implementation of necessary activities against weed grass etc.

3.5 Floods and River Erosion

For the mitigation of erosive processes and floods and flash floods problem on the Alazani River the following activities are significant to be implemented

- Implementation of intensive bank protection activities on respective areas. In particular, construction of coastline dams, levees directing flows, retaining walls etc;
- Permanent informing of nearby village population on flood and flash flood risks and erosive processes caused by them, their involvement in implementation of the flood prevention activities;
- Establishing permanent monitoring on floods and flash floods and creation of early warning system;
- Permanent monitoring of river bank (river winds) and implementation of bank protection activities when necessary to avoid river erosion.

3.6 Mudflow Processes

In order to avoid agricultural lands, roads and population being covered by the mudflow sediments and breakdowns, the following activities are significant to be implemented on the territories subject to the identified mudflow processes:

- Regular cleaning of mudflow channels from excessive sediments;
- Restriction of different agricultural and construction activities at mudflow generating areas and channels;

Permanent informing of population of the mudflow zone nearby territories on the mudflow processes and territories under the mudflow risks.

A summary list of adaptation measures to be implemented is presented in the table 3.1.

Table 3.1. Summarized list of the adaptation measures to be implemented in Dedoplistskaro Municipality

Problem	List of Measures
Drought	• Rehabilitation-extension of the existing water supply system, improvement of its technical condition, equipment with new water-saving systems; • Irrigation system rehabilitation; • Repairing irrigation channels leading to the villages and internal irrigation system on the village territory; • Cleaning of the sections of the channels filled with ground and waste; • Improvement of soil surface water-directing properties (permeability, water deterrence) and erosion resistance (which is a precondition of water saving) to mitigate the impact of drought; • Setting strict control for restriction of unplanned, frequent and excessive irrigation; • Introduction of irrigation regime and following it; • Selection of respective types of irrigation – surface irrigation by drift using line, line-holes, subsoil irrigation; • Compulsory introduction of the methods and rules of irrigation with artificial rain, irrigation by drops, which is an effective way of saving the irrigation water. • Restoration-rehabilitation of the logged down, strongly degraded or exploited windbreaks to mitigate the impact of winds, as one of the factors strengthening droughts; • Restoration of climate-regulating and soil-protective forest stands on postforest areas never or less used for agriculture and setting strict control on unregulated logging of forest; • Selection of drought resistant agricultures and checking their ability of adaptation with the local climate conditions; • Permanent information of the municipality agrarian society on strengthening of droughts due to the expected climate change to learn agriculture vulnerability, adaptation and mitigation activities as well as information on water saving issues.
Desertification	• Forestation (fast growing, high thermal capacity, soil protection, drought resistance properties) plantations on the plots unused or difficult to use for agriculture; • Setting strict control on unregulated forest logging; • Restoration-rehabilitation of logged or exploited degraded windbreaks to reduce intensive evaporation of moisture from the ground, land depletion and its erosion; • Rehabilitation-reconstruction of irrigation systems, setting irrigation regime to minimize water loss, selection of drought resistant agricultures, checking their ability of adaptation

	with the climate on specially selected plots. • Creating of climate change monitoring system on the municipality territory; • Implementation of permanent monitoring on flora and fauna of the protected areas (that do not have anthropological impact) in order to find the correlation between the ecosystem transformation and climate condition change (especially, regarding the desertification process development); • Informing the municipality population (especially farmers) and local authorities on the desertification process developments.
Pasture Degradation	• Introduction of integrated management system in cattle-breeding, introduction of new technologies together with restoration-renewal of old traditional rules; • Optimal load of pastures with sheep flocks and cattle; • Unconditional introduction of plot shift, pasture rotation, pasture breaks practice; • Adding fertilizers, planting annual and perennial plants, cleaning of pastures, implementation of necessary activities against weed grass etc.
Floods and River Erosions	• Implementation of intensive bank protection activities on respective areas. In particular, construction of coastline dams, levees directing flows, retaining walls etc; • Permanent informing of nearby village population on flood and flash flood risks and erosive processes caused by them, their involvement in implementation of the flood prevention activities; • Establishing permanent monitoring on floods and flash floods and creation of early warning system; • Permanent monitoring of river bank (river winds) and implementation of bank protection activities when necessary to avoid river erosion.
Mudflow Processes	• Regular cleaning of mudflow channels from excessive sediments; • Restriction of different agricultural and construction activities at mudflow generating areas and channels; • Permanent informing of population of the mudflow zone nearby territories on the mudflow processes and territories under the mudflow risks

3.7 Activity Plan for Dedoplistskaro Municipality Communities

The described activities need to be specified according to the problems identified for each community. Thus, below is given a preliminary list of activities for each community and villages within the community, which will ensure the strengthening of the communities against natural catastrophes and future climate change. The activities are summarized in Table 3.2. Each problem is assessed respective to its significance (H – high, M – medium, L – low). Approximate budget of activities to be implemented was calculated on the basis of difficulty of the problem. List of organizations responsible for the activity implementation as well as possible financial sources have also been defined. The assessment was made on the basis of the field survey materials and data collected from other sources. In assessment, determination of the problem's significance level depended on the problem's influence scale (size of the territory affected by the problem, population influenced and infrastructure). The assessment is preliminary and does not represent an outcome of the problem detailed analysis thus the probability of error is quite high, however, we believe it gives an approximate image of the current situation. As for the list of activities, it is also developed based on the preliminary assessment. Implementation of a specific project is associated with detailed, large-scale research. In addition, the specific action plan should be developed on site with the direct engagement of the community in which the action plan was developed.

Table 3.2. Summarized list of adaptation and risk reduction measures to be carried out in the communities of Dedoplistskaro Municipality

Community	Village	Problems	Scale of Problems (L; M; H)	Executive Measures[4]	Cost Range (USD)	Time line[5] (ST; MT; LT)	Responsible Agent	Potential Source of Funding
Mirzaani	Mirzaani	Mudflow	**M→L**	• Regular cleaning of the village mudflow channels from the excessive sediments. • Implementation of bank protection activities on the village channels.	< 50,000	**ST**	• Municipal government	• Local budget; • Development agencies (USAID, UNDP, EU, Dutch government, GIZ, Sida, etc.); • NGOs.
Arboshiki	Arboshiki	Mudflow	**M→L**	• Regular cleaning of the village mudflow channels from the excessive sediments • Implementation of bank protection activities on the village channels. • Arrangement of the drainage system in the village.	< 50,000	**ST**	• Municipal government	• Local budget; • Development agencies (USAID, UNDP, EU, Dutch government, GIZ, Sida, etc.); • NGOs.
Samreklo	Samreklo	Strong wind	**M**	• Restoration-rehabilitation of windbreaks	50,000 – 100,000	**LT**	• Municipal government; • Regional government;	• Local budget; • Central budget;

[4] The measures were defined for the problems estimated as problems of average or high importance. The list of measures was worked out according to the preliminary estimations. The implementation of concrete activities should be in connection with additional thorough research and assessment.
[5] "Short-term"(ST) implying the period of time up to 1 year; "midterm" (MT) – 1-5 years; "long-term" (LT) – > 5 years.

							• Central government (Ministry of Environment protection).	• Development agencies (USAID, UNDP, EU, Dutch government, GIZ, Sida, etc.); • NGOs.
Zemo Kedi	Zemo Kedi	Strong wind	**M**	• Restoration-rehabilitation of windbreaks	50,000 – 100,000	**LT**	• Municipal government; • Regional government; • Central government (Ministry of Environment protection).	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, Dutch government, GIZ, Sida, etc.); • NGOs.
Arkhiloskalo	Arkhiloskalo	Strong wind	**M→H**	• Restoration-rehabilitation of windbreaks	50,000 – 100,000	**LT**	• Municipal government; • Regional government; • Central government (Ministry of Environment protection).	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, Dutch government, GIZ, Sida, etc.); • NGOs.
Kvemo Kedi	Kvemo Kedi	Strong wind	**M**	• Restoration-rehabilitation of windbreaks	50,000 – 100,000	**LT**	• Municipal government; • Regional government; • Central government (Ministry of Environment protection).	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, Dutch government, GIZ, Sida, etc.); • NGOs.

Samtatskaro	Samtatskaro	Flooding / Wash of banks	**M→H**	• Implementation of bank protection engineering activities on the Alazani river. • Application of bank protection bioengineering methods if possible.	50,000 – 100,000	**MT**	• Municipal government; • Regional government; • Central government (Ministry of Environment protection; Ministry of Regional development and infrastructure; NEA).	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, Dutch government, GIZ, Sida, etc.); • NGOs.
		Erosion	**L→M**	• Restoration/ rehabilitation of the damaged irrigation water channel	< 50,000	**MT**	• Municipal government;	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, Dutch government, GIZ, Sida, etc.); • NGOs.
Pirosmani	Pirosmani	Floods	**M→H**	• Implementation of bank protection engineering activities on the Alazani river. • Application of bank protection bioengineering methods if possible.	50,000 – 100,000	**ST**	• Municipal government; • Regional government; • Central government (Ministry of Environment protection; Ministry of Regional development and infrastructure; NEA).	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, Dutch government, GIZ, Sida, etc.); • NGOs.
Sabatlo	Sabatlo	Floods / Wash of banks by the Alazani river	**H**	• Implementation of bank protection engineering activities on the Alazani river. • Application of bank protection bioengineering methods if	100,000 – 1,000,000	**MT**	• Municipal government; • Regional government; • Central government (Ministry of Environment protection; Ministry of	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, Dutch

				possible • Rehabilitation/ improvement of the village drainage system			Regional development and infrastructure; NEA).	government, GIZ, Sida, etc.); • NGOs.
Kastistskali	Kasristskali	Strong wind	**M→H**	• Restoration-rehabilitation of windbreaks.	50,000 – 100,000	**LT**	• Municipal government; • Regional government; • Central government (Ministry of Environment protection).	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, Dutch government, GIZ, Sida, etc.); • NGOs.

3.8 Dedoplistskaro municipality - Climate Change Mitigation Activities

Within the program, greenhouse gas emission analysis for different sectors has been conducted. The sectors, which emit greenhouse gases into the atmosphere, have been identified. Furthermore, the volumes of emitted gases in Dedoplistskaro municipality has been calculated.

The obtained results by sector are presented in a generalized manner in the table 3.3.

Table 3.3. Emission of greenhouse gases into the atmosphere from the territory of Dedoplistskaro Municipality

Sector		Tons CO2 eq / Year
Agriculture	Enteric Fermentation	34,240.73
	Soil Management	54,282.55
	Manure Management	8,455.45
Total agricultural emissions		**96,978.73**
Landfill		**14,154.56**
Pipelines		**7,996.8**
Residential / Stationary		**5,014.82**
Transport		**23,413.9**
Total		**147,558.8**

Based on the performed analysis, a list of mitigation activities is recommended. Sepcifically:

Recommendations

To reduce the quantity of GHG Emissions from the municipality of Dedoplistskaro, the following activities are recommended:

Dedoplistskaro municipality is characterised by a high level of emissions from stationary sources, transport and agriculture, where it has the highest emissions of the target municipalities. With regards to these emissions the following activities are recommended:

- Construction and repairing of wind breaks;
- (Re)Irrigation of of degraded soils;
- Workshops on manure management techniques (storage and application practices);
- Improved crop and grazing land management to increase soil carbon storage;
- Implementation of energy efficiency standards for all new buildings;
- Insulation of municipal and public buildings;
- Exchanging public transport and municipal vehicles with new, more efficient replacements;
- Development of road infrastructure in the region to increase automobile efficiency.

Activity plan is presented in the form of a table in Table 3.4.

Table 3.4. The concluding list of mitigation activities that must be performed in Dedoplistskaro Municipality

Objectives	Measures	Scale of the measure	Cost Range (USD)	Time line[6] (ST; MT; LT)	Responsible Agent	Potential Source of Funding
Reduction in agricultural / land use greenhouse gas emissions	Construction and repairing of wind breaks	Dedoplistskaro municipality	5,000 - 20,000	LT	• Municipal government; • Regional government; • Central government (Ministry of Environment protection).	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, GIZ, Sida, etc.); • Development banks (ADB, EBRD, WB, KfW); • NGOs.
	(Re)Irrigation of degraded soils	Dedoplistskaro municipality	20,000 - 100,000	ST	• Municipal government; • Regional government; • Central government (Ministry of Environment protection; Ministry of Regional development and infrastructure).	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, ACF, GIZ, Sida, etc.); • Development banks (ADB, EBRD, WB, KfW); • NGOs.
	Workshops on manure management techniques (storage and application practices)	Dedoplistskaro municipality	5,000 - 10,000	ST	• Municipal government; • Regional government; • Central government (Ministry of Environment protection).	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, ACF, GIZ, Sida, etc.); • NGOs.

[6] "Short-term"(ST) implying the period of time up to 1 year; "midterm" (MT) – 1-5 years; "long-term" (LT) – > 5 years.

	Improved crop and grazing land management to increase soil carbon storage	Dedoplistskaro municipality	10,000 - 50,000	**LT**	• Smallholder farmers; • Farming cooperatives; • Municipal government; • Regional government; • Central government (Ministry of Environment protection).	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, ACF, GIZ, Sida, etc.); • Development banks (ADB, EBRD, WB, KfW); • NGOs.
Reduction in greenhouse gas emissions from residential / stationary sources	Energy efficiency standards for all new buildings	Dedoplistskaro municipality	10,000 - 20,000	**LT**	• Municipal government; • Regional government; • Construction companies; • Central government (Ministry of Environment protection; Ministry of Regional development and infrastructure).	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, GIZ, Sida, etc.); • Development banks (ADB, EBRD, WB, KfW); • NGOs.
	Insulation of municipal and public buildings	Dedoplistskaro municipality	10,000 - 50,000	**ST**	• Municipal government; • Regional government; • construction companies; • (Ministry of Environment protection; Ministry of Regional development and infrastructure).	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, ACF, GIZ, Sida, etc.); • Development banks (ADB, EBRD, WB, KfW); • NGOs.

Reduction in greenhouse gas emissions from transportation sources	Exchanging public transport and municipal vehicles with new, more efficient replacements	Dedoplistskaro municipality	10,000 - 100,000	**LT**	• Municipal government; • Regional government.	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, GIZ, Sida, etc.); • Development banks (ADB, EBRD, WB, KfW); • NGOs.
	Development of road infrastructure in the region to increase automobile efficiency	Dedoplistskaro municipality	50,000 - 100,000	**LT**	• Municipal government; • Regional government; • Central government (Ministry of Regional development and infrastructure)..	• Local budget; • Central budget; • Development agencies (USAID, UNDP, EU, ACF, GIZ, Sida, etc.); • Development banks (ADB, EBRD, WB, KfW); • NGOs.

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