Environmental and Socio-Political Security Risks Correlation in Mountainous Areas

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Abstract. The article is devoted to the study of the relationship between risks for the systems of environmental and socio-political security of mountainous territories (countries, regions) based on a special methodology developed in [5], as the main barriers to achieving sustainable development of mountainous territories and regional socio-political stability. In [5], the author introduced a new concept - "Climate Conflict Vulnerability Index" (CCVİ) as a unique metric for assessing the relationship between climate change and socio-political risks. Calculated using a special formula, CCVİ determines the degree of predisposition or inclination of any country, including mountainous ones, to the negative impact of climate conflicts as direct and indirect consequences of global climate change. This paper focuses on mountainous countries and regions in terms of conducting a correlation analysis of environmental and socio-political security risks, taking into account their specificity in terms of direct and indirect impact of climate change on mountainous areas, their cultural, socio-economic life, religious and mental characteristics, social traits, etc. In addition, the article analyzes some potential risks of climate conflicts in the Caucasus region, as well as the role of international cooperation institutions in the timely prevention of such political risks.

Keywords: climate change, environmental security, socio-political security, international relations, sustainable development of mountains, adaptation, climate conflicts, Climate Conflicts Vulnerability.

1 Introduction

Nowadays the main threats and risks hindering achievement of sustainable development goals are political confrontations, armed conflicts, economic and financial crises, as well as global environmental problems, new possible waves of pandemics and other challenges. In some cases, we could observe a high correlation of these risks when they can reinforce each other.

In this regard, diplomatic confrontations, or even armed conflicts in various regions of the planet, with direct or indirect participation of global geo-political players could certainly

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lead to some economic crises on a regional or even global scale. Moreover, these conflicts could create new environmental threats or make existing ones more dangerous and cascading in terms of their scales and impacts. We could add to these environmental risks significant amount of greenhouse gas emissions into the atmosphere during various military operations, as well as the damages to the ecosystem and biodiversity degradation. By the way, it should be noted that up to 5.5% (about 3.3 Gt CO_2 eq.) of the annual global GHG emissions is emitted into the atmosphere during military operations (war, military operations, exercises, etc.).

At the same time, there are some comprehensive researches on negative impacts of environmental, particlularly global climate change risks to the global and regional socio-political security system of some country or even whole region [1-5]. Therefore, the study of correlation of the mentioned risks in the context of international relations, sustainable development is high importance. All the mentioned aspects form a **"matrix of risks correlation**" that describes interdependence between political security, environmental, energy, food and other security risks.

In this paper we will focus on some key aspects of mountainous countries, regions in terms of correlation analysis of environmental and socio-political security risks, taking into account their specific features being impacted of direct and indirect climate change, their cultural, socio-economical life, religious and mentality peculiarities etc. Below, we will provide the methodology for the calculation of the climate conflict vulnerability indices for mountainous countries and regions and compare them with the lowland ones in order to better confirm that the climate conflict risks mapping for mountainous regions is much more multifaceted and uncertain to a great extent. In our general view, mountain regions provide indispensable goods, opportunities and services to all regions. The half of the global population gets fresh water for domestic use and lowland irrigation from mountains. Green energy transition services and products (hydropower, green hydrogen etc.) also mostly depend on the water resources of the mountains which are also rich for their biological resources, raw materials as well as very attractive tourist destinations. Moreover, the mountains are oases of ethno-cultural and religious diversities. All these resources and assets would enable to provide a robust sustainable development not only for such regions, as well as for all adjacent territories.

Despite all these assets, nowadays many mountain regions have come across with multiple environmental, socio-political and economical risks and hazards because of inadequate level of inclusivity of the governance, low attention to the needs and aspirations of the local communities, as well as high speed of industrialization sometimes having nothing to do with famous "just transition". As a result, globally, approximately 40% of the mountain population in developing and transition countries is vulnerable to food insecurity, and half are chronically hungry. Therefore, many mountain inhabitants have chosen to migrate to lowland areas and urban centers in search of employment and income. This has led to land abandonment, that leads to loss of cultural heritages.

2 Climate Conflicts Vulnerability Index

Before passing to the climate conflict vulnerability indices measurement for mountainous countries and regions and comparing them with the lowland ones, let's refer to [5-7], where the author of the current paper introduced new methodology of calculation of the **"Climate Conflicts Vulnerability Index" (CCVI)** as a metrics for assessment of vulnerability of the country to the local or international climate conflicts on the base of correlation analysis between environmental and socio-political risks. Thus, herewith we bring some formulas of CCVI etc. for application to the mountainous countries or even regions. First of all let's remind the notion climate risk that is of a core one for adaptation polices and measures. This

notion is introduced by the following formula in a number of reliable scientific sources:

$$\text{Risk} = \text{Probability of climate hazards}^* \text{ Climate Vulnerability} \quad (1)$$

In this formula, the Climate Vulnerability of the each country, including mountainous one, to the negative effects of global climate changes is measured by the Climate Vulnerability Index that is calculated throuhg the following formula:

$$\begin{aligned}\text{Climate Vulnerability Index} = \{&(\text{Exposure})+\\ &+\text{Climate Sensitivi}+\\ &+ (1- \text{Adaptive Capacity})\}/3\end{aligned} \quad (2)$$

Thus, according to the definition given by the IPCC to the concept of "**Climate Vulnerability**" to climate change, this concept expresses the degree of vulnerability and inability of geophysical, biological and socio-economic systems of any country, including mountainous one or entity to the negative impacts of global climate change, including climate change (vulnerability) to extreme climate events. Actually **Climate Vulnerability Index (CVI)** expresses the mean of the values of indices of climate sensitivity, probability of exposure to climate change and adaptability. The value of these indices for each component in this formula vary between 0 and 1. The detailed information on explanation and calculation methodology of the mentioned components is in the same source [8-10].

Taking into account this approach, we are going to introduce the notion of **"Climate Conflicts Vulnerability - CCV"** for any country (or their union), including mountainous one, which expresses the degree of weakness and inability of the socio-political security system (security in a broad sense) of any country or union of countries vis-a-vis to risks that are directly and indirectly related to the negative effects of climate change.

Thus, to measure the value of the concept of vulnerability to climate conflicts, the following formula was used for **"Climate Conflicts Vulnerability Index" (CCVI)**:

$$\begin{aligned}\text{Climate Conflicts Vulnerability Index} = \{&\text{Climate Vulnerability Index}\\ &+ \text{Climate Sensitivity Index of Security}+\\ &+(1 - \text{Climate Conflict Prevention Capacity})\}/3\end{aligned} \quad (3)$$

where the Climate Vulnerability Index (CVI) is determined by the above-mentioned formula (2), Climate Sensitivity Index of Security (CSIS) (in a broad sense) is calculated by the following formula:

$$\text{CSİS}=(A1+A2+A3+B1+B2+C+D+E+F+G+H1+H2+İ+J1+J2)/15, \quad (4)$$

where

- **A1-** index of influence of global and regional geopolitical players (states and their unions) having local or regional political interest in the given country (or region). The index is equal to the absolute value of the difference between the number of “negative” states - N (i.e. N- the number of global and regional geopolitical players not interested in stability in the given country) and “positive” states - P (i.e. P- the number of global and regional geopolitical players interested in stability in the given country) states over the sum of N and P:

$$A1= |N-P|/(N+P) \quad (5)$$

where, if P is greater than N, A1 should be taken as zero;

- **A2** - the number of unresolved political items in the bilateral or multilateral diplomatic relations agenda with neighbourng countries or confrontations since the base year until now (here the base year is taken as 1991), related to the joint use of transboundary water basins or their contaminations as well as transboundary mountain natural resources, cultural, religeous assets etc. in the region where the country is located. These unresolved items are those that could lead any time to serious regional confrontations or even armed conflicts, difficult political and economic situation in the region, actively used by the geopolitical players not interested in the socio-political stability of the region

A3 – the number of confrontations or armed conflicts with neighboring countries in the region that have not been ultimately resolved with a peace agreement since the base year (the base year is taken as 1991);

- **B1**- the difference of total sum of changes in the share of population number of each ethnic minority in total population number of the given country (or its region, depending of the scale of assessment) compared to the base year (base year is 1991) with the change of number of the total population (in percentage) in the current year compared with the base year total population number (if the change in the share of population number of some ethnic minority or the total population is negative in the given period, this change should be taken as 0);

- **B2** - the maximum value of the ratio of the annual number of inflow of foreign migrants to the country (or region correspondingly) to the number of the total population at the same year (or population of the region) within last ten years;

- **C** - the ethno-conflict sensitivity of the country (correspondingly, in region), that is expressed as a ratio of the total number of conflicts (or confrontations) between ethnic groups since the base year till now to the number of years since the base year (base year - 1991);

- **D** - the ratio of conflicts (or confrontations) related to the direct or indirect effects of climate change in the country (correspondingly, in the region) to the overall number of conflicts (confrontations) between population groups (including ethnic ones), social and ethnic communities in place (base year - 1991);

E - the ratio of ethnic conflicts (confrontations) between ethnic groups in the country (correspondingly, in the region) that occurred as a result of their migration to the total number of conflicts between ethnic groups since the base year (base year - 1991);

- **F**- the degree of dependence of the country (correspondingly, region) economy on agriculture or on the main economic sectors and resources (water resources, mountain, forest resources) that are very sensitive to the effects of climate change.This degree of dependence could be measured as a sum of shares in GDP and shares in population incomes) (high - 3, medium - 2, low - 1);

-**G**- degree of sensitivity of the country's (correspondingly, region) climate response measures (mitigation and adaptation policies, measures), in terms of their turning in local and international conflicts (confrontations). The sensitivity indicator is expressed as the ratio of the number of conflicts that have occurred since the base year as a result of climate measures (mitigation and adaptation policies, measures) to the total sum of number of local conflicts (confrontations) between population groups, social and ethnic communities, and between states of the considered region (if there's no any local conflicts etc., including climate measure related ones, the total sum is taken as zero, base year - 1991);

-**H1**- the maximum value during last ten years of the sum of the annual differences (if the difference is negative, zero should be taken) of the percentage of unemployment, as well as the percentage of poverty in each ethnic minority of the country (correspondingly, region), respectively, with the percentage of unemployment and poverty for the whole population;

-H2 – the maximum value during last ten years of the sum the sum of the differences (if the difference is negative, 0 should be taken) of indicator of distribution of average of annual incomes for each ethnic minority (calculated on the basis of the Gini coefficient) with the

indicator of distribution of average of annual incomes of the general population in the country (correspondingly, region)

-**I** - the maximum value (during last ten years) of the total statistics of the separate social stress factors sensitive to climate changes in the country (correspondingly, region) (i.e., loss of some jobs by some social groups as a result of the negative socio-economic effects of climate changes, disappearance of some specialties from the labor market during the climate measures (adaptation and mitigation), decrease in income, increase of health problems of the population etc.);

-J1 – the maximum value (during last ten years) of indicators of the country distribution of Inclusive Development Indices (IDI, calculated on the basis of the Gini coefficient) among different administrative regions of the country, which equals the sum of absolute values of differences between IDI of separate regions of the country with the IDI of the whole country;

-**J2**- the maximum value (during last ten years) of indicators of the regional distribution of Inclusive Development Indices (IDI, calculated on the basis of the Gini coefficient) among different states in the region where the given country is located, which equals the sum of absolute values of differences between IDI of each countries of the region with IDI of the given country

In addition, the Climate Conflict Prevention Capacity (CCPC) is defined as:

$$CCPC= (K+L+M+N+O)/5 \quad (6)$$

K - the potential of the country for neutralization of the geopolitical and economic influences of the main geopolitical players having in the region (country): taking into account the combat capabilities of its armed forces (i.e. international rating of the country armed forces), flexible diplomacy, membership or active participation in a influencive strategic-military alliances (high - 5, good - 4, average - 3, weak - 2, low - 1);

L - the number of preventive measures carried out in the country (or region) on political, ideological, and legal issues with contingents prone to ethnic conflicts and social discontent;

M - level of diversification of economy of the country (region) (high - 3, medium - 2, low - 1);

N- the potential of elimination of dependence of the GDP of the country (region), income of the population from agriculture or other sectors which are highly sensitive to the adverse effects of the global climate change (water resources, mountain, forest resources, coastal agriculture etc.) (high - 5, good -4, medium -3, weak - 2, low - 1);

O - the potential of the country (or region) to adapt to the negative effects of the global climate changes, i.e. the Adaptive Capacity mentioned in the formula (2). As a matter of fact, CCV determines a degree of propensity or predisposition of some mountainous country or region be negatively impacted by the climate conflicts as direct and indirect consequences of the global climate change. In addition, here below we will pay a special attention to the analysis of the risks of climate conflicts in the regions of the South Caucasus and the Caspian basin, as well as role of institutions of international cooperation towards prevention of such risks.

3 Correlation of socio-political and environmental risks in the mountainous areas

If we consider the components of the Climate Sensitivity Security Index and the Climate Conflict Prevention Capacity Index for mountainous countries or regions and compare them with the indices for lowland regions, we can easily see that the indices associated with mountains are much higher than the latter due to traditional socio-economic difficulties caused by problems of access to energy and resources, ethno-social and communication

problems, etc., as well as vulnerability to climate change and low capacity to adapt to climate change in mountainous regions. Since the mountain ecosystems have been identified by the IPCC among the most vulnerable to climate change, as temperature evolves faster in these regions, both in terms of impacts on the population that live there, but also in the ecosystem services they provide. Moreover, the severity of climate events, meaning the scale of their destructive impact, is also increasing. As it's well known, the processes related to global climate change, especially the intensity and amplitude of extreme climate events are increasing. According to the last - 6th Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC), the frequency of heatwaves could increase four times, droughts could double, and extreme precipitation events could increase by 50% by 2030. Moreover, according to another prominent organization - WMO reports, while the number of extreme climate events increased by more than five times from 1970 to 2019, the cost of the damage caused by these events increased approximately eightfold during the same period. Therefore, the Climate Conflict Vulnerability Indices for mountainous countries and regions (particularly cross-border ones) are essentially higher than for lowland regions.

Generally, the vital role of mountainous regions for upstream and downstream populations has increasingly been recognized at the international level. The preservation of mountain environmental assets improvement of local livelihoods are clearly reflected in Chapter 13 of the UN Conference on Environment and Development's (UNCED) Agenda 21 (Conference in Rio de Janeiro) and in the Rio+20 outcome document. Mountains are mentioned in a special chapter in the UN Convention on Biological Diversity (CBD), and efforts are under way to include them in the UN Framework Convention on Climate Change.

In view of these circumstances, only comprehensive planning for sustainable development of mountain regions and cooperation of all bordering countries can alleviate the socio-economic backwardness and comparatively low standard of living of a certain number of mountain countries and regions. Only through these progressive actions can the vulnerability indices to climate conflicts for mountain countries and regions be reduced, which is of great importance for regional and global political security.

There are huge number accidents in all over the world, proving once more a high level exposure and sensitivity of daily life and economic activities of the mountain population to the climate change.

Coming to the Caucasus mountains region issues, it should be noted that in the recent years, the terrible glacier slides, mudflows happened in the mountain tourism areas bordering with Russia, Georgia and other countries, as a result of a long period of extreme warming. These glacier slides had not only seriously damaged the sector premises and local communities but also led to loss of lives. For example, on September 20, 2002, in North Ossetia (Russia) and on September 14 in the Alibek Valley near Russia's famous "Dombay" mountain tourism center, as well as on August 3, 2023, devastating mudflows resulting from glacier melt due to global warming caused severe damage to the famous Shovi resort (formerly known as Shamshovi) near the village of Glola in the North-western Georgia, and led to a loss of lives. Thus, during the Shovi Tragedy, part of the famous resort infrastructure, nestled in the forest, was washed away by a mud flood descending from the mountains in a matter of minutes, resulting in over 32 deaths as people were trapped under mountain debris and tree remains. Actually, despite the high likelihood of such events recurring at the Shovi resort, according to experts, all tourist activities are still continued. Glacier monitoring is provided annually through a special modeling by a Swiss institution specialized in mountain glacier processes.

In addition to mountain problems, the interrelated issues of water, agriculture and energy are particularly sensitive in the South Caucasus. This is due primarily to the practice of using water resources at the national level in various sectors and the existence of an effective mechanism for the coordinated use of water resources between countries upstream and

downstream of transboundary rivers. All these factors should certainly be taken into account by the relevant international organizations, specialized UN organizations, the European Organization for Security and Cooperation, and the relevant EU institutions monitoring security and political stability issues and promoting cooperation in the region, with a view to providing timely assistance to prevent diplomatic or armed conflicts between the states of the region for the above reasons. This could be done by international organizations by developing mechanisms to stimulate the earliest possible accession of Georgia and Armenia to the above-mentioned Helsinki Convention or by accelerating the process of signing new effective international bilateral agreements on the coordinated use and protection of water resources on transboundary rivers.

However, the signing of any agreement with Armenia on the matter could be realized only after signing of the expected comprehensive peace agreement with the Republic of Azerbaijan. In this regard, at the Munich Security Conference (MSC) in February 2023, the President of the Republic of Azerbaijan Ilham Aliyev made a clear message: "...I believe that Azerbaijan and Armenia should demonstrate their distance from the long-standing clash and put an end to mutual enmity and hostility. We are currently working on a peace agreement between Armenia and Azerbaijan. We hope that we will complete this work soon, not later. I think this can serve as a good example for countries with serious historical differences to come together and close the page of hostility.

Let's remark that in the global tourism sector, including mountain tourism, there are still potential investment opportunities, a high human capital share for creating assets, and even the capacity to replace tourist destinations as adaptation actions to the climate change. However, businesses based on sensitive natural assets, such as mountain tourism, where tourist sites cannot easily be relocated, will face serious challenges with intensification of the climate change impact. In some cases, ski tourism operators may adapt to global warming by moving to higher foothill areas. At the same time, as mentioned earlier, mountain tourism and health tourism facilities in mountainous regions planning to relocate to higher foothill areas should carefully analyze the new locations' vulnerabilities to the risks from glacier slide, other direct and indirect climate change impacts.

4 Conclusion

Taking into account the above arguments, we can suggest that only by making the vulnerability of mountains to climate change more visible, by collaborating to strengthen the voice of mountain areas, can the international community give mountains the importance they truly deserve and reduce CCVI. Moreover, only by enhancing adaptive capacity and resilience through nature-based solutions can the above-mentioned losses and damages to mountain peoples and their livelihoods be minimized. In endorsing this proposal, the Parties to the UNFCCC welcome the establishment of the Dialogue on Mountains and Climate Change and agree to request the Convention Secretariat, through a plenary decision of COP 28, to host the first edition during COP 29 in Baku, 11-22.11.24.

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