

Abstract: Climate change poses a significant threat to Kosovo's economy, particularly agriculture, the backbone of the country's economy, and is developed mainly in rural areas that depend on climate-sensitive resources for their livelihoods. This study aims to thoroughly examine people's perceptions of climate change on rural development, with a particular emphasis on the socioeconomic aspects in the rural areas of the region of Prishtina. The methodology for investigating the impact of climate change on Kosovo's rural development involves quantitative methods, including a questionnaire. Our study found that agricultural productivity is affected by climate change in terms of planting seasons, crop yields, and irregular rainfall patterns; yet most respondents have not implemented specific adaptation strategies. The impact of climate change, particularly in rural areas, is seen in rising temperatures, natural disasters, and harsher weather. The primary climate-related hazards are drought, floods, and heat waves, followed by wildfires. Public awareness of climate change, especially in rural areas, is limited. The primary sources of information are social media and television; education and awareness initiatives are needed. Although Kosovo has developed frameworks and plans for addressing climate change, rural areas are receiving insufficient support from the public and private sectors.

Keywords: climate change, rural development, agriculture, socioeconomic impacts, Kosovo

Abstrakti: Ndryshimet klimatike paraqesin një kërcënim serioz për ekonominë e Kosovës, veçanërisht për sektorin bujqësor, i cili mbështet kryesisht zonat rurale të varura nga burimet natyrore të ndjeshme ndaj klimës. Ky studim synon të analizojë perceptimet e komuniteteve rurale në rajonin e Prishtinës mbi ndikimin e ndryshimeve klimatike në zhvillimin rural, me theks të veçantë në aspektin socio-ekonomik. Përmes një metodologjie sasiore të bazuar në pyetësor, u evidentua se ndryshimet klimatike kanë ndikuar negativisht në produktivitetin bujqësor, duke shkaktuar çrregullime në stinët e mbjelljes, rendimentet dhe reshjet. Pavarësisht kësaj, shumica e të anketuarve nuk kanë ndërmarrë masa konkrete për t'u përshtatur. Ndikimet më të theksuara përfshijnë rritjen e temperaturave, përmbytjet, thatësitrat, valët e të nxehtit dhe zjarret. Niveli i ndërgjegjësimit mbi ndryshimet klimatike në zonat rurale mbetet i ulët, ndërsa burimet kryesore të informacionit janë rrjetet sociale dhe televizioni. Megjithëse ekzistojnë politika dhe plane kombëtare për adresimin e ndryshimeve klimatike, mbështetja për zonat rurale mbetet e kufizuar si nga sektori publik ashtu edhe nga ai privat.

Fjalët kyçe: ndryshimet klimatike, zhvillimi rural, bujqësia, ndikimet socio-ekonomike, Kosovë

Highlights

- 60% of respondents in rural Prishtina regions showed low awareness of climate change, with significant gaps in understanding its impacts.
 - Agriculture, one of the main livelihoods in rural Kosovo, is highly susceptible to climate change, thus disturbing local economies and food security.
 - Increased climate hazards, such as heat waves, floods, and droughts in Kosovo, exacerbate the socioeconomic issues faced by rural communities.
 - While there are some climate strategies, their execution remains weak, especially at the rural level, and gender issues are neglected while formulating climate policies.
 - The study emphasizes the need for tailored strategies to build resilience in rural communities against the increasing impacts of climate change.
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1. Introduction

Kosovo has a territory of 10,887 km² (Zeqir et al, 2012), it's located in Southeast Europe, in the heart of the Balkans, and has an excellent geographical position providing connectivity with other nations and acting as an essential connection for regional cooperation, trade, and transportation in the Balkans (Kastrati et al, 2014). Even though it is a small territory, Kosovo is known to be gifted with a sizeable area of rich, cultivable terrain and a moderate environment ideal for the commercial production of basic grains, fruits, nuts, vegetables, and cattle (USAID, 2018).

According to the report of the Kosovo Agency of Statistics (2018), agriculture is crucial to Kosovo's national economy and plays a big part in the integration process. Additionally, agriculture is one of the most significant sectors of the economy, which raises the standard of living and promotes the long-term growth of rural areas. The sector is supplying employment possibilities and energizing economic expansion, especially in rural areas. It contributes 11.9% to the gross value added and accounts for 26% of the employment and 16.2% of the export value (MBPZHR, 2017). Based on the last census in Kosovo, 50% of the population lives in rural areas (KAS, 2025), and the population in those areas mainly relies on agriculture (European Commission, 2020). Although agriculture is a major factor in the economic growth of rural areas, it is also one of the sectors most susceptible to changes in temperature and other effects of climate change. Regardless of its economic importance, the sector is unable to ignore the effects of climate change, which is now an indisputable and widely acknowledged phenomenon that will influence food systems and rural economies in the future (Zemankovics, 2012).

Kosovo, like many regions worldwide, is already struggling with the multifaceted challenges of climate change, which significantly impact rural livelihoods and development. This research aims to address the limited information on this topic by exploring local communities' perceptions of climate change and its effects on their livelihoods, particularly in the rural areas of the Prishtina region. With an emphasis on rural communities' resilience, this research aims to provide focused strategies for sustainable development by addressing these vulnerabilities and their socioeconomic effects.

2. Climate Change Challenges and Policy Responses in Kosovo

As a worldwide issue, climate change poses hazards and threats to which Kosovo is not immune (Apostolova, 2017). IPCC, known as the Intergovernmental Panel on Climate Change, which is the leading scientific authority on the politics that are related to climate change, defined climate change as a shift in the climate that can be detected by variations in the mean and/or variability of its attributes and that lasts for a long time, usually decades or longer (IPCC, 2007). Multiple studies have examined the significant spatial heterogeneity of climate change impacts; increased risks to human health, changes to the forestry and agricultural sectors, effects on recreation and tourism, negative effects on indigenous communities, and additional effects linked to an increase in unfavorable weather events are some of the potential effects of climate change on rural communities, and economic development (IPCC, 1998). The Western Balkans region has experienced more regional warming than the global average, particularly in mountainous areas (Zupanic et al., 2021; EU4Green, 2024).

As a result, overall yearly precipitation has decreased, but winter precipitation has increased (IMF, 2023). Temperatures in the Western Balkans have risen dramatically since 1960, with summers experiencing significant warming and more frequent heat waves. While precipitation trends are less evident within the same period, there has been a general reduction. Since the 1960s, Kosovo has seen rising temperatures and heat waves; since the 1980s, there have been frequent floods caused by heavy rainfall; and since the 2000s, there have been forest fires. Droughts were documented in 1993, 2000, 2007, 2009, and 2012, raising new environmental issues (Caka, 2021).

The ongoing nature of this situation persists. Kosovo is particularly subject to natural hazards such as droughts, wildfires, landslides, earthquakes, and floods, which can significantly impact economic activity, fiscal balances, and vulnerable populations (World Bank, 2021; IMF, 2023). In 2013, 2014, 2016, 2021, and 2023, significant rainfall in Kosovo resulted in devastating floods (SEEUrbans, 2017). Corresponding to this,

the estimated costs of the floods in 2013–2016 were EUR 4 million, and 2021 is expected to surpass EUR 1 million (Performance Audit Report, 2021).

Kosovo is highly vulnerable to climate change due to antiquated industrial technologies, uncontrolled urbanization, significant socioeconomic vulnerability, an unstable economy, and low social welfare resources (IMF, 2023). Factors such as insufficient infrastructure, poor land use, and unsustainable activities enhance this susceptibility (MESP, 2018). A key contributor to Kosovo's greenhouse gas emissions is its coal-fired power plant, located in Kastriot. These facilities produce over 90% of the country's electricity but emit significant amounts of pollutants and CO₂ (Bekteshi, 2016; Di Bella and Thaci, 2023). Additionally, deforestation undermines the capacity of forest land to absorb carbon, while agriculture, forestry, and land-use changes contribute further to emissions (UNDP, 2022). Furthermore, the capital city of Kosovo, Prishtina, is known as a city that struggles with air quality issues and provides an essential backdrop for environmental study. Due to emissions from coal-fired power stations and urban activity, the city often has PM_{2.5} and PM₁₀ levels above WHO standards. According to the Health and Environment Alliance (2021), respiratory and cardiovascular diseases present serious public health risks because they are more common in vulnerable groups, such as children and the elderly.

Thus, studying Prishtina's perceptions of urban pollution and climate change provides an opportunity to examine the connection between environmental risks and social inequities. This analysis is further enhanced by the World Air Quality Report, which uses ground-based PM_{2.5} data gathered by regulatory apparatus and sensors run by a variety of stakeholders, including people, non-profits, and government organizations. This approach makes sure that historical and current pollution levels are more accurately represented than satellite-modeled data. The urgent need for solutions is shown by the fact that Prishtina was the 60th most polluted city in the world in 2023, with PM_{2.5} levels three to five times higher than WHO limits (IQAir, 2023).

Moreover, the Prishtina region's rural communities are a major focus for policy and awareness campaigns, as they face additional challenges due to industrial pollution, particularly from the Kosovo A and B coal power plants. These regions, which are largely dependent on agriculture and home to the majority of the population, are particularly vulnerable to climate hazards such as heatwaves, floods, and droughts (KAS, 2013). Rural households rely on natural resources like fuelwood and wild herbs, participate in climate-sensitive activities like farming and raising livestock, and heavily rely on climate-sensitive resources like nearby water sources and agricultural land (Shackleton & Shackleton, 2004). The study by Ceccarelli et al. (2010) found that the poorest farmers and the poorest nations are most at risk because of the current climatic changes, which are already harming food production and quality. Therefore, rural areas are essential to transition to economies with net-zero emissions and to adapt to climate change. Although rural areas represent the majority of the OECD territory, they still face issues, such as high emissions per person caused by the transportation and industrial sectors. To reduce these emissions, a swift transition to sustainable alternatives is required. Policies must adopt broader perspectives and move beyond agriculture to optimize the potential of rural areas in the fight against climate change. This entails encouraging transportation that emits no emissions and shifting rural economies away from carbon-intensive industries (OECD, 2021).

Current climate change research is primarily focused on energy efficiency, emissions, and pollution reduction, addressing concerns in urban regions rather than rural ones (Caka & Caka, 2022). This highlights the need for a comprehensive approach that takes into account the impacts on rural areas, which is what the Environmental Country Assessment (ECA) seeks to accomplish. Over the next five years, the ECA will be crucial in bringing Kosovo's environmental policies into compliance with EU regulations. Its main objectives are to increase energy efficiency, provide access to clean water, and lower industrial emissions. Kosovo's future hinges on adopting renewable energy sources and increasing energy efficiency due to its antiquated lignite power plants and unsustainable heating techniques (GIZ, 2021).

Furthermore, according to the study by UNDP (2022), there is support for lowering the usage of fossil fuels, even if doing so results in higher electricity prices. Institutions acknowledge the problems caused by climate change, but they point to financial restraints. While civil society demands more action from all stakeholders, the corporate sector recognizes its impact on the environment and looks for institutional

support for mitigation actions. Corresponding to this, government programs with an effective framework have a significant chance of enhancing socioeconomic growth and reducing vulnerability caused by climate change (Jha et al, 2017).

Kosovo has only recently started to incorporate climate issues into its public investment management procedures. Efforts are underway to develop a new strategic framework with the assistance of the partners, but a significant barrier is the lack of accurate information regarding Kosovo's unique circumstances (IMF, 2023). According to a 2022 United Nations Development Programme (UNDP) assessment, Kosovo has a severe lack of awareness of climate change. Although the majority of people are aware of climate change, they are not well-informed on its effects, mitigation techniques, or environmental rights.

However, institutions require more knowledge to modify national plans to the local context, and Kosovo currently lacks programs specifically focused on climate change (Caka, 2021). In 2015, Kosovo signed the Stabilization and Association Agreement with the European Union, despite not being recognized by the UN. Kosovo is attempting to align its laws with EU standards, as catastrophe and environmental risk reduction, as part of the EU process. This will indirectly link the requirements of international treaties such as the UNFCCC with Kosovo's legal system. The Kosovo Agency for Environmental Protection is responsible for maintaining environmental quality through monitoring, reporting, and promoting renewable energy. The Ministry of Environment and Spatial Planning oversees environmental and climate policy (MBPZHR, 2017).

Based on the last census in Kosovo, 62% of the population lives in rural areas (KAS, 2013), and the population in those areas mainly relies on agriculture (European Commission, 2020). Although the agriculture sector is crucial to enhancing the development of rural communities, agriculture will be directly impacted by variations in temperature and the effects of climate. Therefore, regardless of its economic importance, the prevailing scientific consensus firmly acknowledges climate change as an undeniable truth. It evolved to become the dominant worldview in our global society (Zemankovics, 2012).

According to the MESP (2018), Kosovo's Climate Change Strategy, which is funded by the UNDP, is aligned with government priorities and focuses on emissions reduction, resilience building, and climate adaptation. The Action Plan on Climate Change 2018–2021 highlights disaster intervention, institutional strengthening, capacity building, rural assistance, and job creation (MESP, 2018). Strengthening institutional and strategic frameworks, boosting investments in the environmental sector, implementing laws, and bringing them into compliance with EU Directives, are the top goals of state institutions in Kosovo.

However, according to the EU Progress Report for 2022, the strategic and legislative frameworks must be modified to bring them into line with the EU's strategic objectives, as stated in the Green Agenda for the Western Balkans. Kosovo's 2019–2028 Climate Change Strategy and Action Plan has been approved, although there is still a need for improvement in terms of execution and development, as gender hasn't been recognized in any climate document in Kosovo (Hessenberger & Popovicki, 2023).

3. Methods and Methodology

This study integrates a comprehensive literature review with primary data collected through a questionnaire survey, emphasizing the importance of both scientific and community-driven insights.

The primary research instrument employed was a questionnaire survey, as it provides an organized method for gaining insights and advancing knowledge across various fields (Kuphanga, 2024). Following the methods outlined in other studies on climate perception and adaptation (Bryan et al., 2009; Below et al., 2010; Deressa et al., 2011), the structured questionnaire used in this study aimed to assess the socioeconomic impacts of climate change and its perception in rural communities. The questionnaire was developed following a thorough examination of the literature and consideration of surveys on climate perception conducted in comparable rural areas in South Asia and Africa. These surveys place a high value

on gathering demographic and socioeconomic data together with characteristics pertaining to perception in order to investigate local knowledge, adaptation practices, and climate impact awareness. The majority of the questionnaire's questions were closed-ended, with some semi open-ended questions. The questionnaire included household and individual characteristics that are known to affect vulnerability, adaptive capacity, and climate perception, such as:

A. Demographic and Socioeconomic Variables: gender, age, type of settlement, education level, and type of occupation (e.g., student, housewife, farmer, etc.). Given that demographic characteristics frequently influence access to resources, information, and risk perception, these are consistent with standard variables used in climate-livelihood research (Adger et al., 2009; Below et al., 2010).

B. Factors Affecting Livelihoods and Perceptions of Climate Change. This section analyzes respondents' perceptions of the effects of climate change, community behaviors, and trends in climate change, including: climate change awareness, perceived shifts in regional climate patterns, such as elevated temperatures and unpredictable weather, perceived risks, such as wildfires, droughts, and floods, environmental change that has been noticed (e.g., access to water, arable land), information sources about the climate (TV, social media, friends and family, etc.), changes in agricultural productivity as perceived, impacts on traditional rural practices, adaptation strategies (such as water conservation and agricultural diversity), socioeconomic impacts and views on the efficacy of policies.

To determine whether and how rural households are adjusting to perceived climate hazards, questions about adaptive responses, such as changing farming methods or adopting water-saving habits, were added. Similar studies conducted in Kenya (Ogalleh et al., 2012), Bangladesh (Uddin et al., 2014), and Ethiopia (Bryan et al., 2009; Deressa et al., 2011) included these elements, which align with international standards for documenting local adaptation behavior (IPCC, 2022).

This novice empirical study in Kosovo made a deliberate methodological choice to focus only on the rural districts surrounding Prishtina. A distinctive mix of lowland and upland communities, thriving smallholder farming (Herzfeld et al., 2022), and noticeable climate stress, including rainfall and decreased crop yields, can be found in this area (UNICEF, 2024).

According to local agricultural reports, Barilevë is one of the most active settlements in the Municipality of Prishtina, with a reputation for growing cereals and vegetables. Although Bardhosh and Siqevë are not specifically mentioned in scholarly works, studies on the rural periphery of Prishtina show that smallholder farming and livestock production are common in the nearby villages (Sallahu, 2022; Musliu et al., 2023). The selection of Bardhosh and Siqevë as recipients of rural development programs is further supported by recent municipal development projects that focus on farming, beekeeping, and cattle throughout the region.

The survey was conducted in-person with 186 respondents, predominantly during April 2024. The sample was chosen using stratified random sampling, which ensured representation across age, gender, and occupation while capturing significant household-level variance across the study area. According to the data from the Kosovo Agency of Statistics (ASK, 2013), the total number of respondents was divided proportionately among the three chosen villages depending on their respective populations:

- Bardhosh (4,778 residents): 87 surveys
- Barilevë (2,212 residents): 86 surveys
- Siqevë (337 residents): 13 surveys

After completing the survey, Microsoft Excel files were used to organize participant responses carefully. The information was then transferred to the software program Statistical Package for Social Sciences (SPSS), considered one of the most significant and effective statistical methods for the examination of quantitative data (Rahman and Muktadir, 2021), for additional analysis. This application was used to perform a thorough examination that included numerous variable combinations and in-depth comparisons.

This research questionnaire was designed to encapsulate complex factors and clarify the perception landscape related to climate change. To provide a thorough understanding and robustness of findings, this study employed a combination of descriptive methods, cross-tabulation analysis, and inferential statistical testing. The descriptive technique was used to define sociodemographic traits, enabling a detailed description of relevant variables. Cross-tabulation analysis helped to clarify relationships within the dataset by examining connections between categorical variables. Furthermore, the one-way Analysis of Variance (ANOVA) test was used to determine correlations and delve deeper into the relationships between variables. This statistical tool facilitated an assessment of differences in group averages, revealing possible trends and correlations.

4. Results

The research included a cohort of 186 participants, conducted in the rural areas of the Prishtina region, comprising 105 females (56% of the sample) and 81 males (43% of the sample). Given the impact of climate change on future generations, cultivating awareness and understanding of this subject is imperative. At the highest level of education attained, a considerable proportion of respondents had a degree, constituting approximately 50% of the sample. Moreover, 44% of participants had a high school diploma. Conversely, a mere 5% of respondents had attained primary education levels. The accuracy of the sample used for this study can be shown in the fact that the majority of respondents (62%), when it came to the settlement, were from villages. While 38% of responders were from the city.

Climate change affects both existing and future jobs in multiple ways; therefore, understanding the occupation of the respondents provides valuable insights into societal perceptions and priorities (Lehr & Pela, 2024). With active workers (52%) and students (36%), most responders are closely involved in rural development and living. Active employees, likely to be involved in industries like forestry and agriculture, can provide personal knowledge of how environmental changes impact people’s lives, while students, who will eventually become leaders, represent changing perspectives on sustainability. The involvement of housewives (8%) and pensioners (4%) in the research also adds a variety of viewpoints, emphasizing the significance of historical context and household resilience in understanding the consequences of climate change. Table 1 provides a summary of some of the descriptive statistics for the sample’s sociodemographic characteristics.

Tab 1. Socio-demographic characteristics of the respondents (%). Source: own contribution, 2025

Gender	N=186	%	Settlement	N=186	%
Female	105	56	City	70	38
Male	81	43	Village	116	62
Highest education level	N=186	%	Occupation	N=186	%
Primary school	9	6	Active employee	96	52
High school	83	44	Pensioner	8	4
University	94	50	Housewife	15	8
			Student	67	36

Predominantly, Figure 1 shows the age distribution of the sample. The respondents within the age range of 25 to 34 years comprised the majority, with 37% representing this demographic segment. The cohort included a modest representation of 9% of respondents within the 18–24 years age group. Conversely, the 35–44 age group exhibited a more notable presence with 25% of participants. Similarly, the 45–54 age category was represented by 13% of respondents, while those aged 55–64 constituted a total of 16% of participants, and those over 65 were not part of the study.

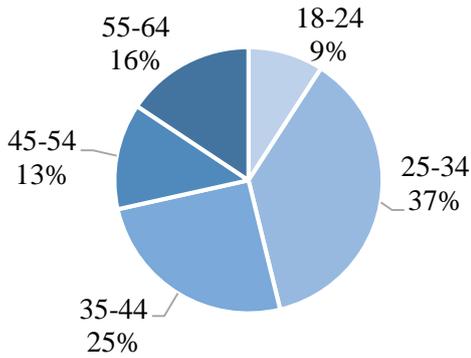


Fig 1. Age distribution of the sample (%). Source: own contribution, 2025

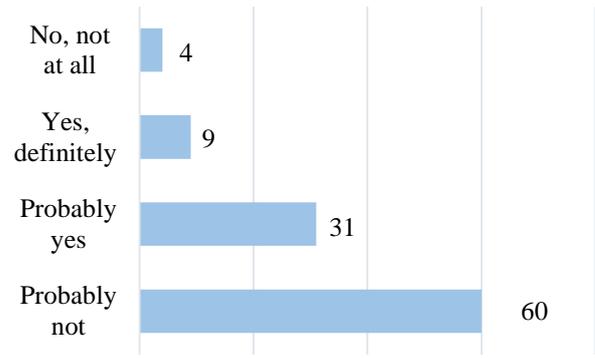


Fig 2. Public Awareness of Climate Change (%). Source: own contribution, 2025

A thorough understanding of the persistent challenges caused by climate change requires increased knowledge of this important topic. Therefore, Figure 2 shows that, notably, 60% of respondents showed low awareness, 31% showed some comprehension, and 9% showed strong awareness. Interestingly, 4% of respondents had no idea how serious the situation was.

The perception of the effects of climate change, particularly in the context of rural communities in Kosovo, is another important topic that this study examines. The results show that a significant number of respondents (46%) acknowledge Kosovo’s vulnerability to climate change, indicating a reasonably informed understanding of the risks and consequences of climate change for rural development, as shown in Figure 3. This knowledge is essential for facilitating community-level involvement and successful adaptation tactics. Nevertheless, 36% of respondents continue to exhibit low awareness, frequently because of the influence of misinformation or limited access to information. The idea that Kosovo is less vulnerable to the effects of climate change because of its small size is a recurring misperception that jeopardizes local efforts at resilience and preparedness. Figure 3 examines respondents’ perceptions of the specific effects of climate change in Kosovo, particularly in rural regions, in contrast to Figure 2, which evaluates respondents’ broad awareness of the phenomenon. Figure 3 illustrates perceived local risk, showing how global information may not always transfer into local concern or action, whereas Figure 2 assesses awareness as scientific understanding.

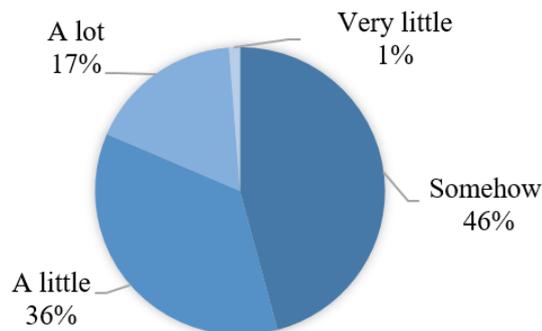


Fig 3. Assessing public awareness of climate change impacts in rural communities (%). Source: own contribution, 2025

Awareness of climate change impacts in rural communities varies based on the type of settlement, specifically between cities and villages. Of the total 186 respondents, 38% were from urban areas and 62% from rural areas. According to the findings in Table 2, the majority of urban respondents (69%) reported signs of climate change effects, although they were not yet completely apparent. Of those surveyed, only 7% acknowledged these implications (“Yes”), 17% denied any such impacts (“No”), and 7% said they were unsure. Rural respondents were more split, with 48% noticing new signs, 9% identifying direct consequences, 41% denying any obvious effects, and 2% saying they were unsure. According to

these findings, denial and uncertainty, particularly among rural respondents, remain major obstacles, even though a significant proportion of both urban and rural populations recognize early indicators of climate change in rural areas.

Notably, the association between settlement type and awareness levels is statistically significant ($p = 0.005$), underscoring the need for targeted educational initiatives to enhance awareness of climate change impacts in both rural and urban contexts.

Tab 2. Awareness levels of climate change impacts among respondents in urban and rural settlements (%). Source: own contribution, 2025

Settlement	Yes	No	No, but there are indications	I'm not sure
City	7	17	69	7
Village	9	41	48	2

Climate change is an ever-evolving phenomenon that manifests through shifts in temperature patterns, precipitation levels, and the frequency of extreme weather events over time (EU4Green, 2024). The impact is seen in rural areas in various hazards as significant in their communities; therefore, the respondents have selected more than one option. The findings in Table 3 conclude that over the past decade, climate change in rural areas has become more intense in terms of droughts, floods, and heat waves, with droughts being the most mentioned, followed by wildfires and other hazards, such as damage to infrastructure and water scarcity.

Tab 3. Identifying key climate hazards for rural communities (%). Source: own contribution, 2025

Primary climate-related hazards	N	Percent	Percent of cases
Heat waves	48	21	26
Floods	63	27	34
Droughts	68	29	37
Wildfires	48	21	26
Others	2	0.9	1
Total	229	100	124

The research was conducted in the rural areas of the Prishtina region, and according to most of the respondents, representing 56% of the sample, they haven't seen any changes in natural resource availability, such as water and arable land, in their area due to climate change. Conversely, 43% of participants reported tangible observations of such changes, signaling a notable divergence in perceptions among respondents regarding the climate change effects within the region. This finding, presented in Table 4, emphasizes how differently people in the Prishtina region see climate change, with a complex interplay of environmental, socioeconomic, and cultural elements influencing people's viewpoints.

Tab 4. Perceived changes in natural resource availability due to climate change. Source: own contribution, 2025

Observations	%
Yes	43
No	57

However, participants described observable shifts when asked about climatic patterns in their rural areas during the last ten years. Among those surveyed, 49% reported a clear rising temperature pattern in their locations, confirming that this is one of the biggest issues that people are facing nowadays. Furthermore, according to 37% of participants, there is an increase in climate variability, which is primarily seen in erratic rainfall patterns throughout the past decade, turning into a potential hazard due to the floods

created. On the other hand, 11% of the minority group reported that there had been no noticeable changes to their local climate. Furthermore, 3% of respondents indicated a perception that winters are less severe compared to previous years, indicating that winter conditions do not evoke the traditional essence associated with the season, as shown in Table 5.

Tab 5. Climate perceptions in rural areas over 10 years (%). Source: own contribution, 2025

Climate change over the past decade	N=186	%
Becoming warmer	91	49
More unpredictable	69	37
No noticeable change	21	11
Other	5	3

Table 6 shows that the perception of the frequency and severity of climate-related hazards compared to the past varies mainly between increasing and being stable. In comparison to the past, the majority of respondents (33%) believe that the frequency and severity of climate-related dangers in their rural community are stable. Meanwhile, a comparable proportion (32%) perceives that these hazards are increasing, whereas 17% report a decrease due to different agricultural activities. However, there appears to be a lack of understanding or agreement among community members, as seen by the noteworthy percentage (18%) of respondents who are unsure about the trend in climate-related threats. Respondents who noted rising or falling trends in climate hazards frequently attributed these variations to changes in farming methods. For example, some described their perception of increased hazard intensity as a result of reduced water availability, delayed planting and harvesting seasons, and more frequent crop failures. On the other hand, some pointed to changes in crop types (such as moving to more drought-tolerant varieties) or upgrades to irrigation infrastructure as potential causes for the perceived decrease in hazard consequences.

Tab 6. Evaluating changes in climate-related hazards in rural communities over time. Source: own contribution, 2025

Primary climate-related hazards	N	Percent
Increasing	59	32
Stable	61	33
Decreasing	33	17
Not sure	33	18

Figure 4 represents the sources of climate change information in rural communities. The majority of respondents who use social media for information about climate change are between the ages of 19–25 and 26–35, with an average age of approximately 25.5 years. The predominant portion of respondents, constituting 46% of the sample, derive their information predominantly from social media platforms, including Facebook, Instagram, or TikTok. Subsequently, this shows that in Kosovo, there is a lack of university programs on climate change and the integration of climate change policies into various academic disciplines. However, online awareness can be extremely powerful in spreading information and awareness about climate change (Gómez-Casillas & Gómez Márquez, 2023). 34% of respondents acquire information primarily from television broadcasts, expert analysis, and visual representations of climate change events. The information on television is easily accessible and provides further detailed information regarding adaptation strategies and mitigation efforts. A lesser proportion, 14% of the respondents, obtain information through internet-based sources, including news articles, educational websites, and scientific journals. Through this, there is a higher possibility of delving into specific topics of interest, getting a wider range, and being correctly informed about climate issues and actions. Approximately 5% of respondents rely on familial or peer networks for information, where the majority of respondents share their personal experiences about climate change and the accumulated knowledge from it, while a minimal proportion, constituting 0.5% of the sample, indicates a lack of engagement and effort in addressing this subject matter.

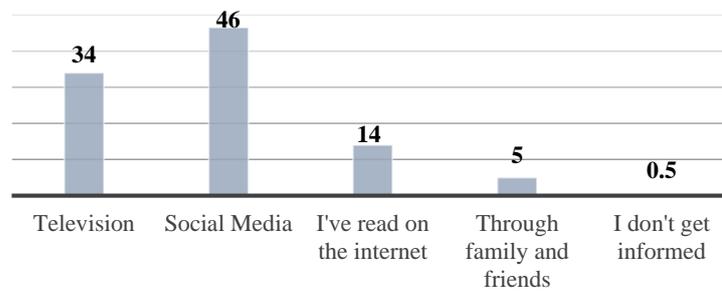


Fig 4. Sources of climate change information in rural communities (%). Source: own contribution, 2025

Regression analysis in Table 7 shows that settlement is the most important variable influencing climate change awareness in rural communities, with urban residents demonstrating noticeably greater knowledge than those in villages ($p = 0.001$). The results thus emphasize the necessity of focused awareness initiatives in rural regions. Although more research is needed, gender exhibits a minor influence ($p = 0.056$), indicating that women might be somewhat more alert than men. Remarkably, factors such as occupation ($p = 0.098$), age ($p = 0.884$), and education level ($p = 0.860$) have no significant effects on awareness, suggesting that formal education and job duties may not have as much of an impact on perceptions as previously thought. Perceptions of climate-related risks ($p = 0.410$) and information sources ($p = 0.258$) also do not significantly affect awareness. These results highlight the significance of reconsidering outreach in rural areas, developing more effective informational campaigns, and investigating other elements that can raise climate awareness in these areas.

Tab 7. Regression analysis of the factors affecting rural communities' climate change awareness. Source: own contribution, 2025

Coefficients²

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.006	.451		6.660	<.001
Age	-.007	.049	-.012	-.146	.884
Gender	.209	.108	.147	1.924	.056
Settlement	-.361	.108	-.249	-3.340	.001
Level of education	-.016	.088	-.013	-.177	.860
Occupation	-.055	.033	-.147	-1.665	.098
Sources of Information	.069	.061	.083	1.136	.258
Frequency and severity of climate-related hazards (e.g., floods, droughts, wildfires) in your rural community compared to the past	-.040	.049	-.061	-.825	.410

Despite observed shifts in temperature patterns and precipitation levels due to climate change, traditional livelihood practices such as collecting fuelwood and reeds have remained largely unchanged, as reported by the majority of respondents (74%), with only 26% noting significant alterations. However, climate change has been having an extended and significant effect on agricultural productivity in rural communities, mainly in crop yields, and shifts in planting seasons, as indicated by 36% of the respondents, having a significant negative effect on agricultural productivity in various mechanisms such as changes in temperature and irregular rainfall patterns, influencing the changes in the duration of seasons. Followed by 31% reporting stable condition, 23% reporting a moderate decrease, and 10% indicating a significant decrease. Moreover, a low percentage of respondents (0.5%) indicated that climate change has a low impact on agricultural productivity in their community.

² Dependent variable: Your awareness of climate change in rural communities

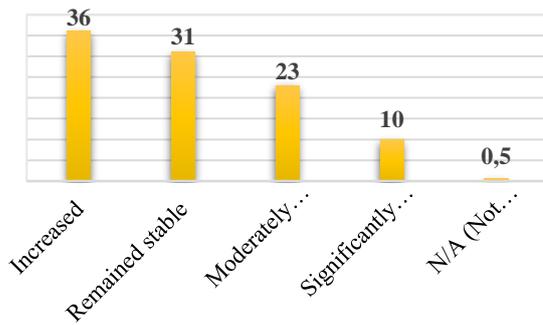


Fig 5. Perceived effects of climate change on rural communities' agricultural output (%). Source: own contribution, 2025

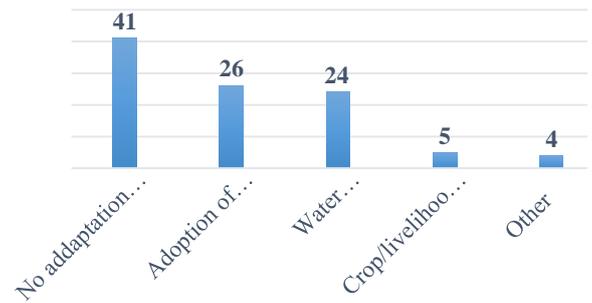


Fig 6. Adaptation strategies taken by rural communities to cope with climate change (%). Source: own contribution, 2025

Considering the impact of climate change on agricultural productivity, there is a significant need to implement adaptation strategies. However, regarding the measures that have been undertaken in the community to adapt to climate change impacts, most respondents (41%) haven't taken any specific adaptation measures to adapt to those changes. A significant proportion indicated that they have been implementing new farming techniques (26% of the respondents), aiming to implement more conservation agriculture and water conservation measures (24%), using mostly drip irrigation. Furthermore, diversification of crops/livelihoods has been implemented by approximately 5% of the respondents, intending to lower the risk of crop failures due to weather changes, while 4% mentioned other adaptation measures, such as soil conservation practices, aiming to improve soil health and enhance the resilience of the soil due to weather events.

Regarding the efficacy of implemented strategies aimed at mitigating the impacts of climate change on rural livelihoods, findings in Table 8 indicate that 46% of respondents rated these measures as moderately effective, followed by 33% who deemed them effective. On the other hand, only 5% of respondents considered these techniques highly effective, while 15% perceived these strategies as weakly effective. This underscores the need for more effective adaptation strategies to address the ongoing impacts of climate change.

Tab 8. Effectiveness of the strategies in mitigating the impacts of climate change on rural livelihoods. Source: own contribution, 2025

Effectiveness of strategies used	N	Percent
Very effective	10	5
Effective	61	33
Average	86	46
Weak effectivity	28	15

To better understand the economic impact of climate change on rural communities, respondents were asked whether they or their households had suffered any economic loss (decline of income, property damage) that they associate with climate-related changes. The vast majority (64%) reported they had suffered such losses. Seasonal job losses, higher food or heating costs, and severe weather-related damage to gardens, small-scale farming plots, or domestic infrastructure, were among them. A participant mentioned, "Part of our yard and storage area was damaged by floods in 2023. Additionally, because of the erratic rain and heat, we were unable to cultivate as much food and had to purchase more". In contrast, 21% of the participants reported not having undergone any direct economic impacts. One stated, "We haven't had big problems. The weather seems different, but it hasn't really changed our income or daily life". Conversely, 15% were uncertain as to whether the recent changes in expenses or losses could reasonably be blamed on climate change or might have been caused by something else. One participant said, "I don't know if it's the weather or just prices going up, but things have definitely gotten

harder". These results demonstrate the need for increased knowledge, support, and focused community-based resilience efforts since they show that while many rural inhabitants are already feeling the economic pressure of climate change, others are either unaffected or unaware of it.

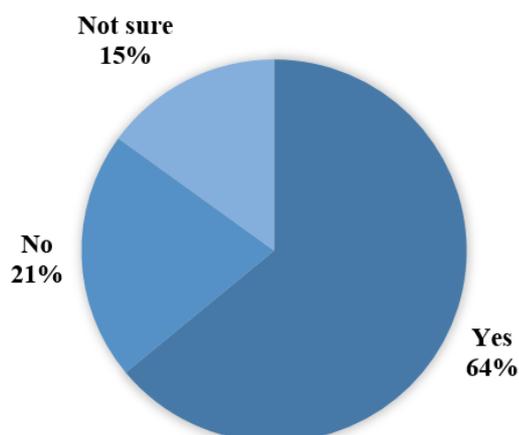


Fig 7. Perceived Economic Impacts of Climate Change. Source: own contribution, 2025

Table 9 illustrates the connection between governmental approval and support for policies to cope with climate change. Despite efforts by the Ministry of Economy in Kosovo in 2023 to encourage energy efficiency through financial assistance, the majority of respondents (97%) reported not receiving any support from governmental or non-governmental organizations. The Ministry allocated 6 million euros to assist 100,000 families in purchasing energy-saving appliances, such as standalone biomass burners, heat pumps, efficient air conditioners, and biomass boilers, to reduce heating power usage by up to 70% (Ministry of Economy, 2023). Only 3% of respondents indicated they had received such assistance. Additionally, respondents were asked to assess the effectiveness of these policies. A significant majority (47% of respondents) rated them as ineffective, citing shortcomings in the selection criteria for beneficiaries as unclear beneficiary eligibility requirements, and the fact that households with lower energy consumption, which is common in many rural areas, were not eligible for assistance because they did not meet the minimum usage threshold. Due to technical selection criteria, rural families that were at risk from climate consequences were inadvertently left without assistance.

However, 32% of respondents expressed satisfaction. This feedback highlights the need for more inclusive processes to ensure the equitable implementation of such policies.

Tab 9. Association between Governmental approval and public perception of climate change policy effectiveness (%). Source: own contribution, 2025

Support	Very effective	Somewhat effective	Ineffective	Not sure
Yes	0	67	33	0
No	6	32	46	16

5. Conclusions and Discussion

Climate change is one of the biggest threats that the world is currently facing, and Kosovo is not exempt from this (Caka & Caka, 2022). Kosovo is vulnerable to climate change due to several factors, including socioeconomic challenges, the development of the agricultural sector, and the industrial sector (IMF, 2023). Such factors will have an impact on rising temperatures, natural disasters, and harsher weather, and those impacts will be transferred into the environment and rural areas.

This research provides insights into the perception of climate change's impact on Kosovo's rural development, specifically in the rural areas of the Prishtina region. Our study found that most of the respondents are not aware of the impact of climate change in Kosovo, and they relate this to the fact

that Kosovo is a small country and is not influenced by climate change. Therefore, the level of perception of climate change is also limited; this is more applicable in rural areas, where the level of perception of climate change impact is lower than in the city. Additionally, the study found that in the last few years, there have been shifts in the climatic patterns in rural areas, where it is becoming hotter, unpredictability in rainfall patterns, and shorter winters. Furthermore, over the past decade, climate change has intensified in rural areas through increased droughts, floods, and heatwaves.

Agriculture is crucial to the nation's economy and is mainly developed in rural areas, where half of the population lives. However, climate change still impacts agriculture and produces high levels of greenhouse gas emissions. Agricultural productivity in rural areas is influenced by climate change in terms of crop yields, shifts in planting seasons, irregular rainfall patterns, and changes in temperatures. This was also concluded from the study of Mahato (2014), where agriculture is extremely sensitive to changes in temperature and precipitation. The adoption of adaptation measures, such as new agricultural techniques and conservation practices, is prompted by the visible impacts of climate change on agricultural productivity and its influence on livelihoods, but the majority of respondents have yet to adopt specific adaptation measures to adapt to those changes. The effects of climate change are predicted to be profound for people, farmers, and agriculture (EU4Green, 2024). As a result, encouraging rural development becomes an effective way to counteract the negative effects.

There is a lack of public understanding of climate change, with social media and television serving as primary information sources, even though the majority of respondents had a degree. This suggests that education and awareness initiatives should be intensified, especially in rural areas. This conclusion is further supported by the research of Mutarak and Lutz (2014), which found that highly educated individuals and society are better prepared, react to disasters more quickly, recover more quickly, and have fewer negative effects. Furthermore, the low level of getting information from scientific journals and educational websites is explained by the fact that in Kosovo, there is a lack of an education system including climate change topics at all levels (European Commission, 2020), therefore, there is a need for increased research focus on climate change regarding awareness and adaptation.

Kosovo isn't part of the EU and UN yet; however, there are frameworks and plans developed and implemented, but there is little support from the public and private sectors for climate action in rural areas. Although there is still potential for improvement in the implementation of policies and the identification of gender issues within them, programs for emissions reduction, resilience building, and adaptation are part of the efforts to combat climate change. Moreover, most respondents (64%) have suffered financial losses, which they attribute to climate change, emphasizing the need for more knowledge, assistance, and community resilience initiatives. Other respondents are either unaffected or unsure of the reasons behind their challenges.

Although our research identifies important gaps in Kosovo's climate change, the following policy suggestions are mostly based on proven regional and global best practices that have demonstrated a high degree of promise for resolving comparable issues in rural areas. First, climate change education campaigns should be expanded, especially through social media and the primary channels, which are the main sources of information for survey respondents. Climate literacy is urged by UNESCO, and similar initiatives have been successful in including youth and rural communities in Kosovo and other Balkan nations (UNESCO, 2021; Gómez-Casillas & Gómez Márquez, 2023). Secondly, the setting up of early warning systems (EWS) for droughts, floods, and other hazards remains imperative, as evidence states that an EWS can cut down on disaster damage by 30% and bring returns of investment up to 10 times (UNDP, 2022; Onyeaka et al., 2024). Thirdly, as suggested in Adaptation Fund concepts and resilience initiatives, creating community-level emergency funds is a practical means of offering prompt financial assistance to rural communities after a disaster (GIZ, 2021; UNDP, 2022). Fourthly, it is crucial to promote climate-resilient agriculture, which aligns with the Western Balkans' Green Agenda objectives. Examples of this include conservation farming, drip irrigation, and crop diversification (OECD, 2021). Fifthly, since participatory techniques improve the efficacy and durability of climate interventions, it is advised that communities actively participate in the creation and execution of adaptation strategies (Jha et al., 2017). Finally, it's critical to incorporate climate adaptation into rural development strategies. The EU's Common

Agricultural Strategy serves as an example, with at least 35% of rural development expenditures aimed at climate-related goals (European Commission, 2020). These suggestions not only address the needs that have been identified in Kosovo's rural areas, but they also follow the best international and regional practices.

This study is subject to several limitations. The research relied solely on quantitative methods, which limited the depth of understanding of respondents' attitudes and adaptation behaviors. The capacity to investigate context-specific viewpoints was limited by the lack of qualitative instruments like focus groups and interviews. Also, the findings may not be as broadly applicable because the sample size was modest (186 participants) and solely included rural Prishtina.

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Appendix 1: Questionnaire

A: Demographic Characteristics of Respondents

1. Gender:	1. Male 2. Female 3. Prefer not to answer
2. Age:	1. 18–24 years old 2. 25–34 years old 3. 35–44 years old 4. 45–54 years old 5. 55–64 years old
3. Settlement:	1. City 2. Village
4. Level of education:	1. No education 2. Primary school 3. High school 4. College/University
5. Occupation:	- Active employee - Pensioner - Soldier - Housewife - Student - Unemployed - Other (please specify): _____

B: Climate Change Perception

6. Do you think Kosovo is affected by climate change?	1. Yes, definitely 2. Probably yes 3. Probably not 4. No, not at all
7. How would you rate your personal awareness of climate change in rural areas?	1. Very aware 2. Somewhat aware 3. Slightly aware 4. Not aware at all
8. Have you observed any effects of climate change in your community?	1. Yes, significant effects 2. Yes, minor effects 3. No, I have not observed any effects 4. I'm not sure
9. How would you describe the climate in your rural area over the past decade?	1. Becoming warmer 2. More unpredictable (e.g., erratic rainfall patterns) 3. No noticeable change 4. Other (please specify): _____
10. In your opinion, what are the most significant climate-related hazards that rural communities in Kosovo face?	1. Heat waves, 2. Floods, 3. Droughts, 4. Wildfires, 5. Other (please specify): _____
11. Have you observed any changes in natural resource availability (water, arable land, etc.) due to climate change in your area? If yes, please describe.	1. Yes (please specify): _____ 2. No
12. How do you perceive the frequency and severity of climate-related hazards (e.g., floods, droughts, wildfires) in your rural community compared to the past?	1. Increasing 2. Stable 3. Decreasing 4. Not sure
13. What sources do you rely on for information about climate change and its impacts on rural communities?	1. Television 2. Social Media (Facebook, Instagram, TikTok, etc.) 3. I have read on the internet 4. Through family and friends 5. I don't get informed about this topic

<p>14. To what extent has climate change affected agricultural productivity in your community? e.g., changes in crop yields, shifts in planting seasons, etc.</p>	<ol style="list-style-type: none"> 1. Significantly decreased 2. Moderately decreased 3. Remained stable 4. Increased 5. N/A (Not applicable)
<p>15. Have you experienced any changes in traditional livelihood practices (e.g., collection of fuelwood, reeds) as a result of climate change?</p>	<ol style="list-style-type: none"> 1. Yes (please specify): _____ 2. No
<p>16. What measures have you or your community undertaken to adapt to climate change impacts?</p>	<ol style="list-style-type: none"> 1. Diversification of crops/livelihoods 2. Adoption of new farming techniques 3. Water conservation measures 4. None 5. Other (please specify)
<p>17. How effective do you consider these strategies in mitigating the impacts of climate change on rural livelihoods?</p>	<ol style="list-style-type: none"> 1. Very effective 2. Somewhat effective 3. Ineffective 4. Not sure
<p>18. Have you or your household experienced any economic losses (e.g., income reduction, crop loss, livestock loss) that you associate with climate change?</p>	<ol style="list-style-type: none"> 1. Yes 2. No 3. Not sure
<p>19. Have you received any support or assistance from governmental or non-governmental organizations to cope with climate change impacts?</p>	<ol style="list-style-type: none"> 1. Yes (Please describe the nature of support): _____ 2. No
<p>20. In your opinion, how effective are current governmental policies in addressing climate change impacts on rural communities?</p>	<ol style="list-style-type: none"> 1. Very effective 2. Somewhat effective 3. Ineffective 4. Not sure