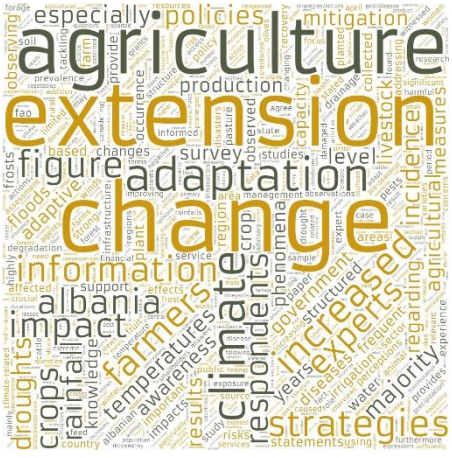
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AWARENESS OF CLIMATE CHANGE IMPACT AND ADAPTATION IN AGRICULTURE – THE CASE OF ALBANIA

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Abstract: The Albanian agriculture sector is deeply affected by climate change. To cope with climate change, it is necessary to understand its consequences. The views of agriculture extension service experts are crucial in improving farmers' understanding and resilience, especially when farming practices are poorly adapted to the changing climate. This paper analyses the risks from climate change and the adaptive capacity of farmers based on an expert evaluation survey. The respondents identified prolongation of drought durations, rising temperatures, above-average occurrences of floods, pre-seasonal rainfall and frost as primary risks during recent years. Extension experts view a high (negative) impact from climate change through processes such as increased plant diseases occurrence, increased exposure to rodents, harmful insects and pests for plants and livestock, as well as forest and pasture degradation. The paper also provides experts' opinions on the policy implications, such as considerations about adaptation strategies towards climate change.

Keywords: Climate change, agriculture extension service, agriculture, Mediterranean, Albania

Abstrakti: Bujqësia në Shqipëri është ndikuar shumë nga ndryshimet klimatike. Për t'u përballuar me ndryshimet klimatike është e nevojshme të kuptojmë pasojat që ky fenomen sjell në sektor. Pikëpamjet e ekspertëve të shërbimit këshillimor janë të rëndësishme në përmirësimin e qëndrueshmërisë së fermave, veçanërisht kur praktikat bujqësore nuk janë përshtatur me ndryshimet klimatike. Ky punim analizon kapacitetin adaptues dhe rrezikun nga ndryshimet klimatike në Shqipëri bazuar në një vrojtim me ekspertë të shërbimit këshillimor publik për bujqësinë. Të anketuarit kanë identifikuar gjatë viteve të fundit rritje mbi nivelin mesatar të kohëzgjatjeve të thatësirës dhe ndryshimeve të temperaturës, shpeshtësisë së përmbytjeve, reshjeve të parakohshme të shiut dhe ngricave. Ata pohojnë se ekziston një ndikim i lartë negativ i ndryshimeve klimatike në bujqësi i cili dokumentohet nëpërmjet rritjes së rasteve të shfaqjes së sëmundjeve tek bimët dhe kafshët, në rritjen e ekspozimit të bimëve dhe kafshëve ndaj dëmtuesve, si dhe në degradimin e pyjeve dhe kullotave. Punimi gjithashtu paraqet mendimet e ekspertëve mbi implikimet e politikave në lidhje me strategjitë e përshtatjes ndaj ndryshimit të klimës.

Fjalë kyçe: Ndryshimet klimatike, shërbimi këshillimor, bujqësia, Mesdheu, Shqipëria

Highlights

- Albanian agriculture is dominated by smallholders affected by climate change.
- A scarcity of information on climate change risks and adaptation strategies.
- Extension experts highlight negative effects of climate change on agriculture.
- Awareness about climate change are higher compared to that about adaptive actions.
- A need to prioritize climate change adaptation actions in the agriculture extension program.

1. Introduction

Agriculture is the most vulnerable economic sector hit by climate change, especially in the case of developing countries (REC, 2011). The impact of climate change on agriculture affects not only the economy but also the livelihood of the population, particularly small-scale family farmers, by threatening food security and thereby increasing poverty and inequality (Ahmed et al., 2009; FAO et al., 2018; Hertel and Rosch, 2010; Müller et al., 2011).

Agriculture is among the key economic sectors of Albania – it accounts for about one-fifth of the gross domestic product and provides employment to more than one-third of the total employed (Ciaian et al.,

2018; Martinovska Stojcheska et al., 2021). Agriculture structures are very fragmented (Zhllima et al., 2021a) and the majority of agricultural holdings in Albania are family farms. Small farms (which are considered those with up to 2 hectares) make up 86 percent of the farm population, while the rest (14 percent) have more than 2 ha (FAO, 2020). Family farms and smallholders are critical for food security as well as for poverty reduction of rural areas in Albania. Being the second most exposed country to the increased extreme weather or extreme climate events in the region (Baettig et al., 2007), Albania is becoming more vulnerable to climate change due to its high dependence on the agriculture sector (FAO, 2020).

In Albania, increasing temperatures and decreasing precipitation have been projected and thus the duration of droughts should (further) increase (Sutton et al., 2013). Supplemental crop water requirements increase due to decreasing precipitation throughout the year, and if water supply reliability is not maintained, the water stress on irrigated crop yields worsens (Nelson et al., 2009). Temperature volatility affects the harvesting period for cereals, the production cycle for winter wheat, grassland production, as well as the reproductive cycle of weeds and pests, including the appearance of new pests and diseases (REC, 2011). On the other hand, floods and storms have also been the cause of significant damage for forests (FAO, 2015). However, the vulnerability of crops to water availability depends on geographical location. For example, vegetables, grapes, and olives in lowland areas as well as maize in mountainous areas, are (negatively) affected in terms of yields whereas some other crops are reported to have benefited (Sutton et al., 2013).

In this regard, access to information on climate-related risks is crucial for making locally appropriate and adequate adaptation strategies (McSweeney et al., 2010). While mitigation strategies address the causes of climate change, adaptation strategies refer to responses to the impacts of climate change, which is the focus of this study. Adaptation activities aim at reducing the vulnerability of human or natural systems to the impacts of climate change and climate-related risks by maintaining or increasing adaptive capacity and systems resilience (OECD-DAC, 2011). Adaptive capacity is defined as "the ability of a system to adjust to climate change (climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" (IPCC, 2007).

In agriculture, adaptation strategies can be a combination of specific actions and systemic changes. Primary measures/actions of adaptation may include changes in sowing structure, modification of crop rotation, agricultural water management programs, building canals for irrigation, etc.; while examples of secondary measures include the education of farmers or other stakeholders about new soil cultivation technologies, improving the application of organic and mineral fertilizers, applying measures to reduce methane emissions through new practices for livestock breeding and feeding, training in the protection of livestock from extreme heat, assisting farmers to cover the cost caused by weather disasters, and other technology transfer measures (Akinnagbe and Irohibe, 2014; Belay et al., 2017; Below et al., 2010; Below et al., 2012; Custovic et al., 2012; Fadina and Barjolle, 2018).

A deficit of information and knowledge has impeded effective decision making and the assessment of climate-related risks, thereby making relevant adaptation strategies, especially among vulnerable populations, important (McSweeney et al., 2010). Public extension services are crucial for transmitting information and innovation to farmers, especially in the case of smallholders who have limited capacity (e.g., financial resources) to access specialized services. However, the effectiveness of extension service delivery is dependent on the knowledge of extension experts regarding the various agricultural innovations (Oladele and Tekena, 2010; Umar et al., 2018) – thus it is important to assess the state of information awareness among agriculture extension specialists in Albania (for which there is a gap in the literature). This paper aims to contribute to filling this gap, in order to guide evidence-based adaptation measures.

This study focuses on the view of Albanian public agricultural extension experts on climate variability and their perception of events associated to climate change – rainfall, strong winds, hail, frost, floods, droughts, and temperature fluctuations – and their possible impact on animal and plant health, water and soil quality and availability, as well as forest and pasture diversity. The paper also provides experts' opinions on the need for policy action, such as considerations about adaptation strategies to climate

change. The study is based on a structured survey with Albanian public agricultural extension experts. The structured survey results were complemented with findings from semi-structured interviews with agriculture experts operating in four different agro-climatic regions of the country.

The paper is structured as follows: The next section consists of the literature review, the third section describes the methods, the fourth section details the results, while the last section provides the discussion followed by concluding remarks.

2. Literature review

Climate change impact studies are usually based on secondary data and farmers' observations (Ayanlade et al., 2017; Banerjee, 2015; Debela et al., 2015; Mertz et al., 2009). Few studies acknowledge farmers' accuracy in observing climate change impact (see Roco et al. (2015) and Halder et al. (2012)). Empirical research suggests that local community observations can correspond to the broader scientific projections of the impacts of climate change in India (Halder et al., 2012), and as such can be subject to further research.

However, other studies emphasize farmers' inability to recognize the nature of climatic changes (Maddison, 2007). Muller and Shackleton (2014) show that major climatic trends recognized by farmers, such as the decreasing trend in rainfall, markedly contrasted with the meteorological records. Such contrasting perceptions seem to have resulted from the lower levels of awareness on concepts about climate change among smallholder farmers (Hitayezu et al., 2017). It is also interesting to note that existing studies commonly argue that the reason behind the incorrect perception could be attributed to the fact that farmers recall impact to production rather than the climate itself (Gandure et al., 2013; Gbetibouo, 2009; Muller and Shackleton, 2014). The econometric model shown by Roco et al. (2015) describes the significance of education and access to meteorological information for climate change perception.

However, even when the farmers' perceptions of climate change are in line with the climatic data records, only about half of the farmers have adjusted their farming practices to adapt to the impacts of climate change due to the lack of access to credit/finance as the main factor inhibiting adaptation (see Gbetibouo, 2009). In addition to farmer and farm characteristics, the role of and access to extension services is a key factor that enhances adaptive capacity. In this context, it is important to analyze public advisory services perception and views in addressing climate change (ibid). Furthermore, observing this stakeholder segment provides more accurate assessments (when compared to farmers), given their competencies and knowledge (linked to education, experience, and wider area of coverage).

Despite the importance of extension agents in observing the impacts of climate change and enabling a critical view of the type of measures for addressing it, few papers have explored extension agents' perceptions on climate change. Most of the studies that do exist focus on African countries (see Abegaz and Wims, 2015; Ebenehi et al., 2018; Ifejika Speranza et al., 2009; Monroe et al., 2014; Ogunlade et al., 2014).

The findings of this paper are an added contribution of the limited literature on climate change impact in Albania, especially regarding adaptive strategies/policies. Apart from studies observing the changes of variables related to climate conditions, (Nelson et al., 2009; Sutton et al., 2013; Teqja et al., 2017) and most recently Müller and Hofmann (2022), few studies have observed the occurrence of climate change and its effect on agriculture. Pojani et al. (2013) collected evidence and views of the Albanian population on climate change, but with scarce focus on agriculture. Rama (2016) explored farmers' adaptability in terms of water management and crop planning by observing their behaviors and efforts for collective action. The author found that many of the adaptation strategies that farmers undertake are not directly linked to climate or environmental change but are still a positive step for adaptation efforts in response to climate change (ibid). Observations made by Imami et al. (2019) found regional differences in the manifestation of climate change phenomena and impact – in some parts of Albania, orchards have been exposed to more frequent hail, or vineyards and olives to more intense droughts. Dairy and meat production is indirectly affected through the negative impact of climate change on animal feed (e.g.,

forage) production. In addition to the adverse effect of high temperatures on feed availability (particularly pasture feed), frequent rains in specific seasons have led to faster development of aflatoxin concentrations in cereals and forage, which can negatively affect milk quality and safety standards (ibid). This study provides additional evidence on climate with special focus on adaptive strategies/policies addressing climate change.

3. Methods

3.1 Sample characteristics

The public agricultural extension service in Albania is under the umbrella of the Ministry of Agriculture and Rural Development (MARD), which has 238 employees, of whom 170 are advisers with defined roles and responsibilities for extension delivery, while other functions include statistics collection and data gathering. Considering the farm population in Albania, it can be concluded that on average, each extension specialist should reach out to 1,000–2,000 farmers. The advisory service is provided for free, based on public funding and has been subject to continual reforms since the beginning of the 1990s (Zhllima et al., 2013).

The paper is based on primary data collected through a structured survey carried out during the period of March-April 2020 with extension agents in various areas of Albania. The survey was filled by 140 Albanian public agricultural extension experts from different fields/disciplines, which comprises the majority of the MARD extension experts. The questionnaire was sent to all agricultural extension staff operating under MARD using a list of addresses provided by the institution upon request. More than 85% of them responded, while a few questionnaires were not processed due to a high number of missing answers. The following table (Table 1) shows a summary of the socio-demographic profile of the sample which was subject to the analysis. Around 55% of the respondents are 51–60 years old, indicating extensive experience. The majority are men (66% of the sample) and agronomists by profession (65% of the sample).

Tab 1. Socio-demographic characteristics of the sample. Source: Structured survey results

Main profession	**N**	**%**
Agronomist	88	65%
Zoo technician	23	17%
Agricultural Economist	13	9%
Other	16	11%
Total	140	100%
Institution	**N**	**%**
Municipalities' administrative unit	11	7%
Agricultural extension service	116	85%
Other (veterinary service, env. agency)	13	8%
Total	140	100%
Age	**N**	**%**
<30	5	3.6%
31–40	16	11.5%
41–50	21	14.4%
51–60	77	55.4%
61<	21	15.1%
Total	140	100%
Gender	**N**	**%**
Male	93	66%
Female	47	34%
Total	140	100%
Experience (average no. of years)		21.8

In addition to the structured survey, 25 semi-structured interviews were carried out during 2020 with agriculture experts in four different climatic zones of the country using a snowball approach. Snowball sampling (Sadler et al., 2010) is a sampling outreach strategy to identify an individual (the "source", also referred to as the "seed") who has the desired characteristics and uses the person's social networks to recruit similar respondents in a multistage process. The information collected by the interviews was analyzed using a content analysis approach where statements and opinions were cited according to the respondents' expressions. The information served as the systematic approach for the explanation and discussion of the results, and the validation of the findings.

3.2 Data analysis

This paper makes use of descriptive analysis of primary data. The descriptive statistical analysis provides the respondent's assessment regarding:

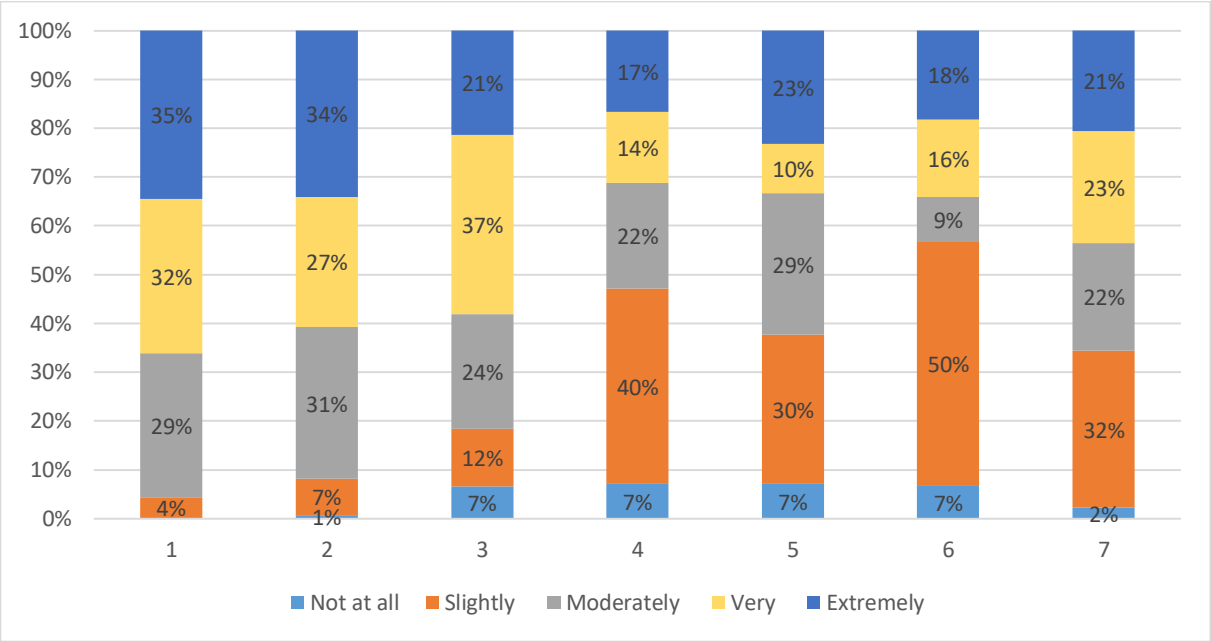
1. The observed incidence of climate change phenomena including: i) observed frequency of occurrence, ii) perceived signs of climate change phenomena, and iii) the assessment of exposure to climate change related impacts in the working region.
2. Awareness about adaptation strategies/actions including: i) level of awareness of information on impact and adaptation capacity, ii) adaptation actions that can be taken in response to climate change phenomena, and iii) preferred policy support for improving adaptation to climate change.

Most questions/indicators are in the form of 5-point Likert scale questions (i.e., scaling responses about the occurrence and impact of climate change, awareness, adaptation actions, and preferred policy support).

4. Results

4.1 The observed incidence of climate change phenomena

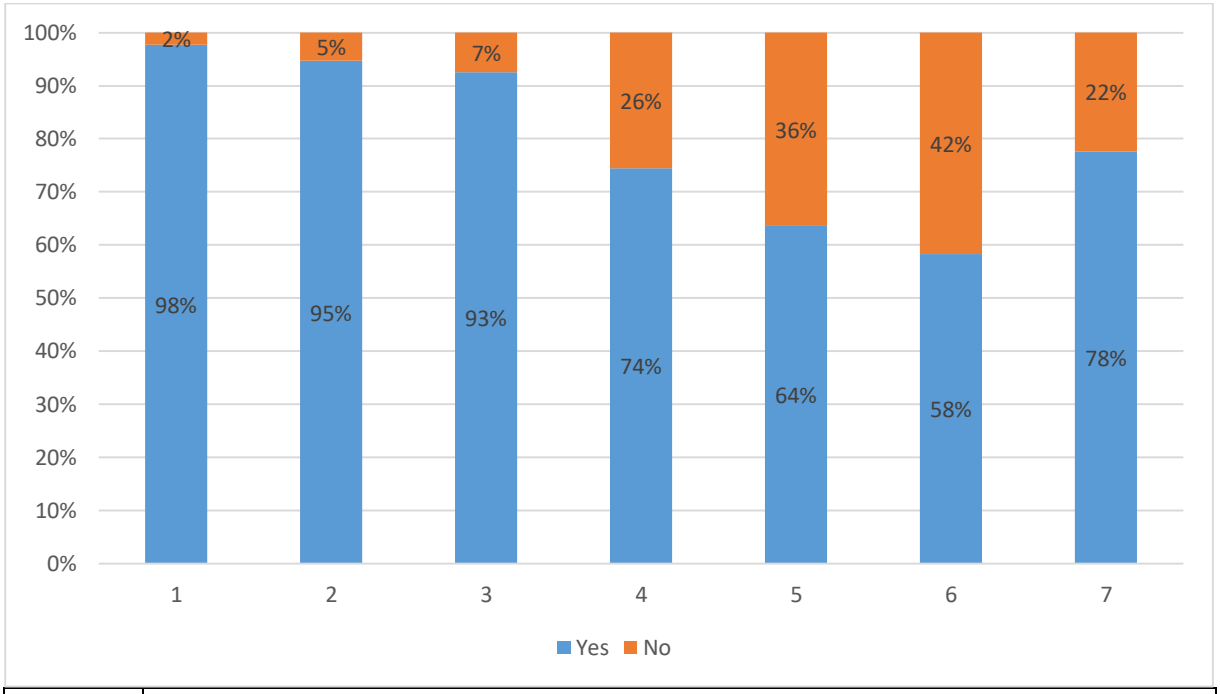
Respondents indicated their observations regarding the incidence of climate change phenomena related to the region where they operate/work. Results show that there is a consensus among extension experts regarding certain changes in weather patterns and the frequency of extreme events during the last 10 years (refer to Figure 1 below). Most respondents outline that they have observed an extreme incidence (highly frequent recurrence) of phenomena such as increased drought durations (35% – Figure 1: Bar 1), frequent change of temperatures (34% – Figure 1: Bar 2), increased incidence of hail (23% – Figure 1: Bar 5), and increased incidence of pre-seasonal rainfall and floods (21% – Figure 1: Bar 3) during the last 10 years. Differences in views may reflect the differences in regional patterns in which climate change phenomena are manifested.



1	Increased duration of droughts
2	Frequent change of temperatures
3	Increased incidence of pre-seasonal rainfalls and floods
4	Increased incidence of frost
5	Increased incidence of hail
6	Increased incidence of strong winds
7	Increased duration of rainfalls

Fig 1. Frequency of occurrence of climate change phenomena: responses to the question: "Please indicate the progress of the following phenomena in the recent 10 years in your area of work". Source: Structured survey results

The respondents were asked if the above mentioned frequencies reflect climate change hazards in order to assess their perceptions and knowledge regarding climate change signs. The vast majority stated that these phenomena, except the case of strong winds, are signs of climate change (see Figure 2).

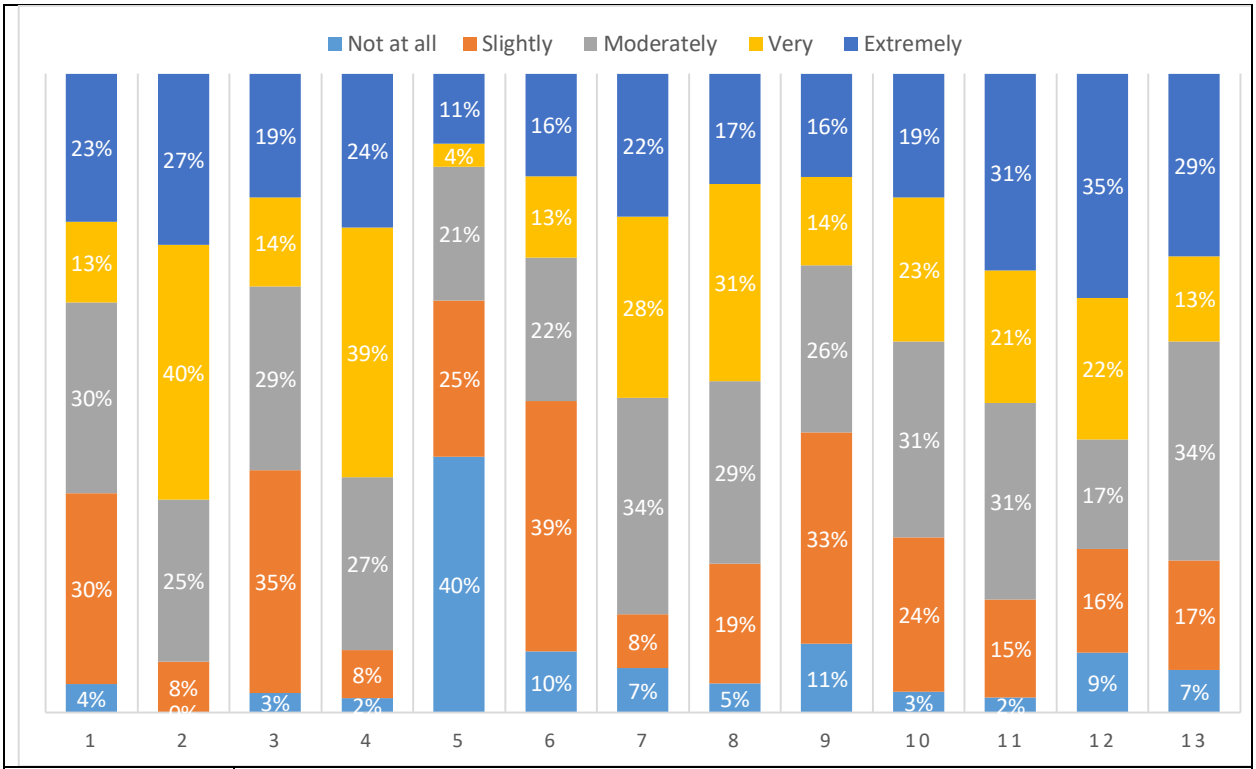


1	Drought duration increase
2	Frequent change of temperatures
3	Increased incidence of premature rainfalls and floods
4	Increasing incidence of frost
5	Increasing incidence of hail
6	Increased incidence of strong winds
7	Increased duration of rainfalls

Fig 2. Answers for the question: "Are the above mentioned phenomena signs of climate change in the recent 10 years in your area of work?". Source: Structured survey results

Figure 3 below shows the assessment of respondents regarding climate change impacts on the working region during the last 10 years. The majority of them witnessed increased prevalence of plant and animal diseases (Figure 3: Bar 1 & 2), loss of water supply (Figure 3: Bar 4) and shifted times of occurrence of certain plant health risks (Figure 3: Bar 8 & 7). Also, they observed a very high increase in the exposure to rodents / harmful insects / pests for plants and livestock, as well as forest and pasture degradation (Figure 3: Bar 11 to 13).

As outlined above, it has been reported that possible climate change manifestations already being experienced in the regions where extension experts are operating include frequent changes of temperature meaning warmer temperatures during summer and cooler temperatures / frosts during winter, as well as changing rainfall patterns, which means the decreased incidence of rainfall and increased incidence of droughts.



1	Increased prevalence of animal diseases
2	Increased prevalence of plant diseases
3	Increased prevalence of arable land degradation
4	Loss of water supply
5	Soil degradation and salinization
6	Shifted times of occurrence of a certain animal health risk
7	Shifted times of occurrence of a certain plant health risk
8	New diseases emerging
9	Loss of adaptability of traditional varieties
10	Adaptation of new varieties / products (not adapted / planted before)
11	Increased exposure to rodents / harmful insects / pests for plants and livestock
12	Forest degradation
13	Pasture degradation

Fig 3. Answers to the question: "Please assess the impact of the climate phenomenon on your area of work during the last 10 years". Source: Structured survey results

The extensionists are more aware of losses in perennial crops, whose damage is higher in financial terms. Damages to fruit crops, especially in fruit production areas of Southeast Albania, have been more evident. One agronomist from Korçë stated:

"In 2016, as a result of late frosts at the end of April, the majority of apple production in Devoll was damaged. During the last year (2019), there have been thunderstorms and abundant hails in the area that have damaged production causing orchard uproots".

Another extensionist (located in central Albania) raised concerns about fruits, namely citrus:

" Recently, there have been early blossoms for nut trees recorded (especially chestnuts) damaging the output".

Frost and hail have brought financial losses for the fruit production sector. One expert stated:

"In the region which I provide advisory services, frost that occurred on April 20–23, 2019 damaged 40–60% of fruit trees and vineyards production…. As a result of prolonged frosts periods, some citrus species, mainly lemons, have dried up".

Also with olives, a crop which is very resilient to temperatures, an extensionist from Central Albania witnessed the fact that:

"In January 2017, the temperature reached -17°C and olive groves were destroyed, completely dried out".

The occurrence and the potential impact varied from region to region. An expert from Kukës (Northeast Albania) made additional remarks on the pests' prevalence and adaptability of grape varieties. He described the problem by stating that:

"During the last 10 years, the cultivars of Concord grapes (Çylek) which is historically planted in the backyards of family farms, isn't producing enough in terms of quantity and quality. While grafted vineyards have improved production because of high temperatures during summer. But there are some damaging pests that have not been previously known and spread in the area which now are found abundantly such as Virgifera Diabrotika, Virgifera (Corn root pest), Eurydema, other soil pests, etc."

In some regions, climate change caused shifting of the season of production. One expert from Dibër region (Northeast Albania) stated that:

"On April 21–23, 2017, the snowing, strong winds and rain typical for the winter season mainly affected fruit trees – the majority of fruit production was damaged. These conditions caused adverse effects also on livestock breeding as food stocks were scarce, thus jeopardizing the herds. During the fall of 2017, as a result of prolonged drought during the summer-autumn period, whole areas that had to be planted with wheat were left without planting hoping that during spring, it would be replenished with maize, but in spring, constant rainfall did not favor the planting of maize on large areas. This phenomenon is recurring every year: in 2018, for example, severe droughts during autumn and spring did not favor planting these seasons' crops. In 2019, same as before, the high temperatures without precipitation made it difficult to plant autumn crops such as rye, barley, wheat, forages etc."

The prevalence of diseases appears more frequently in coastal lowland areas. For instance, a veterinary expert from Lezhë stated the following:

"In our area of work, we have noticed during recent years skin diseases in small ruminants and cattle, for example, Nodular dermatitis of cattle and Bluetongue disease (a noncontagious, insect-borne, viral disease of ruminants, mainly sheep and less frequently cattle transmitted by mosquitoes, the number of which increases in prolonged and dry summers)".

A zootechnician expert from Shkodër (coastal region in northwest Albania) mentioned that:

"Frequent changes of temperatures (droughts, sudden floods) have caused significant damages to agricultural pastures and lands cultivated with maize, wheat but also to livestock. The floods in 2011 had a negative impact on the structure of agricultural holdings based on livestock activities with consequences of reduced number of animal heads (reducing the size of herd)".

Pasture management problems and volatility of rainfall raised additional concerns for those regions which are destinations for transhumance trails. As one zootechnician from Southeast Albania explains:

"The prolongation of the drought periods has affected the reduction of the grazing season in summer pastures due to lack of water".

Climate change appears to also increase the exposure to risks from fires and floods. The linkage between high temperatures and increased incidence of rainfall is highlighted by an expert from Fier who stated that:

"High temperatures and prolonged droughts have increased the number of fires, especially in fruit trees, vineyards, olive groves and forests in our area of work. Strong winds and frosts have damaged vegetation and greenhouse constructions. Floods over the Vjosa River have damaged crops, livestock and investments".

An expert operating in central Albania pointed out that:

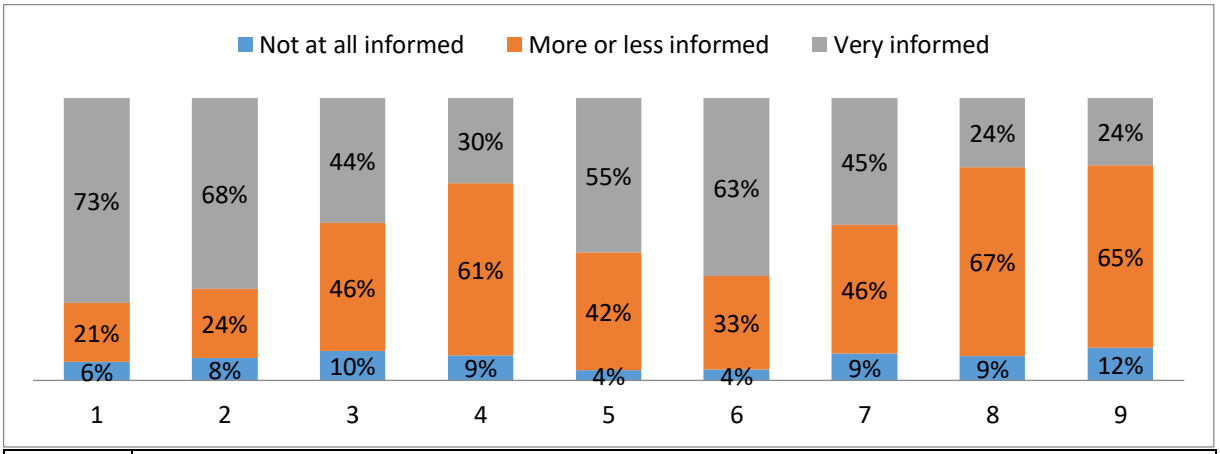
"The floods of the last two years have caused damage of 100 small-ruminant animals in Hardhishte village and of about 100 ha planted with forage crops along the Erzen River".

Although negative effects are more common, there are also positive observed effects from climate change. One agriculture extension agent from the central regions of southern Albania stated:

"I think climate change has had a positive effect on the prolongation of vegetation of crops such as vegetables and fodder plants, but they have increased the possibilities of infection by viral, bacterial, fungal and pest diseases for crops. Drought extension periods from 1 to 2 months require investment in irrigation, which increases the spending of livestock and agricultural production activities".

Awareness about adaptation options

Figure 4 outlines the level of information/awareness of respondents about climate change impact, adaptation, and mitigation measures. Generally, extension and advisory experts state that they have a good level of knowledge regarding climate change's impact on agriculture and livestock-related activities, but they state that they possess an insufficient level of knowledge regarding adaptation strategies to climate change. More specifically, the majority of respondents claim to have a high level of information on issues like climate change impacts on agriculture or livestock sectors (i.e., 63% of the respondents are very informed about the impact of climate change on agriculture – Figure 4: Bar 6). On the other hand, regarding mitigation and adaptive strategies to climate change, the share of extension experts which are very informed is relatively low: only 24% of respondents are very informed on mitigation and adaptation strategies/action to climate change (Figure 4: Bar 9 & 10).



1	Agriculture product seasons
2	Agricultural practices
3	Livestock production seasons
4	Livestock management practices
5	Women and men division of roles in agriculture
6	Impact of climate change on agriculture
7	Impact of climate change on livestock
8	Adaptive strategies for climate change
9	Mitigation strategies for climate change

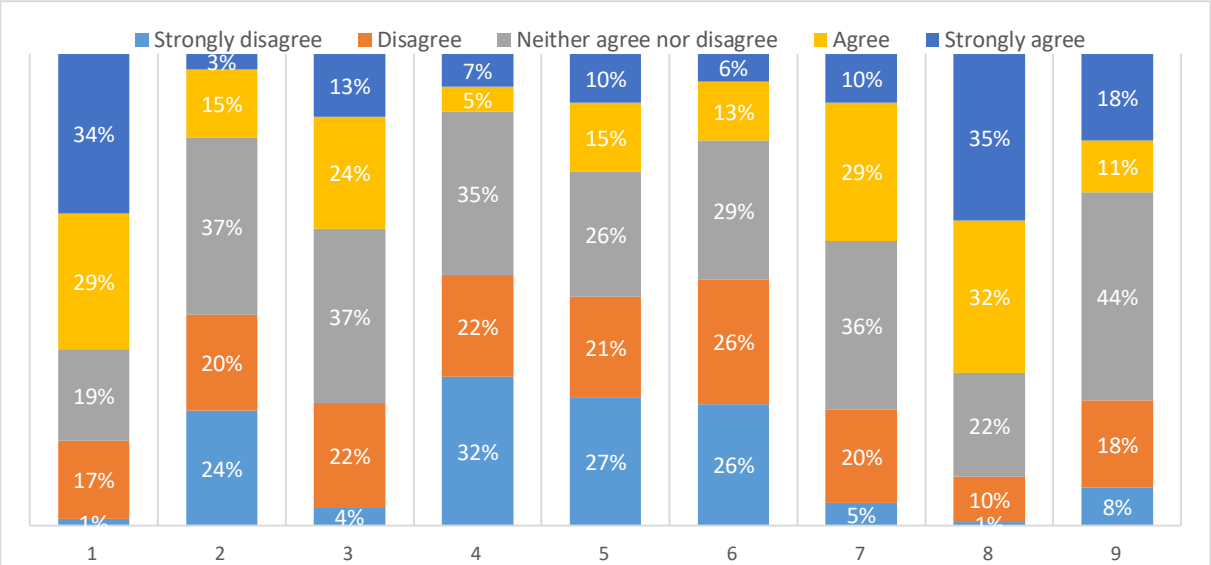
Fig 4. Level of awareness of information on climate change impact, adoption, and mitigation measures. Source: Structured survey results

Note: Answers to the question: "How informed are you for the following issues: 1. Not at all informed, 2. More or less informed, 3. Very informed".

More than 60% of the respondents agree or strongly agree that in response to climate change, it is necessary to change the "pest and disease battling management timeframe/calendar". In addition, there is a high level of agreement with the statement "People are not ready to invest in changing crops and livestock". A similar result was obtained for the statement "difficulties in forecasting natural disasters and erratic weather impair adaptation" (see Figure 5: Bar 1, 7 and 8). Additionally, 37% of respondents

indicated that farmers are willing to change/adapt but have little information and knowledge (Figure 5: Bar 3).

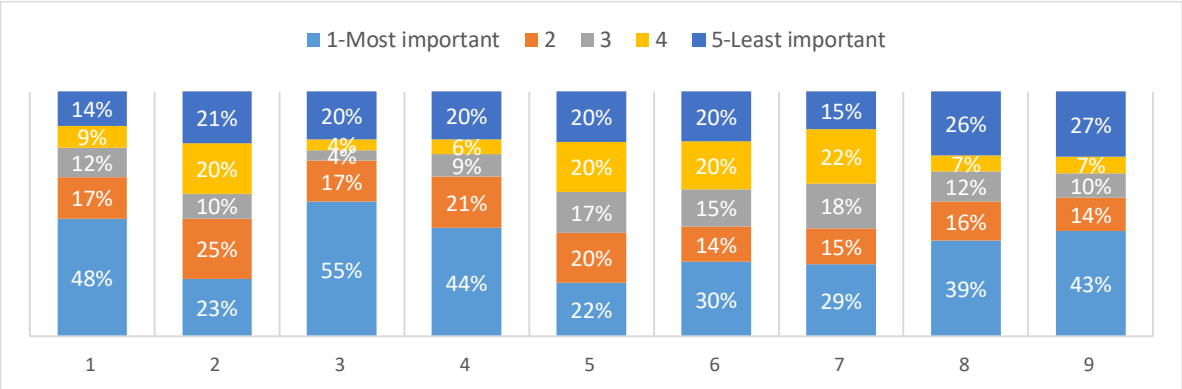
The respondents' level of disagreement with statements regarding government policies and adaptation capacities (the change of crop structure to adapt to climate change; irrigation and drainage infrastructure for tackling climate change; information regarding climate change) appear to be high. That means, according to the respondents, that government policies have not contributed to increased irrigation and drainage infrastructure for tackling climate change, nor provided information regarding climate change or how to change crop structure to adapt to climate change (statement/bar 4 – "Government policies does not orient on change of crop structure to adapt to climate change.", statement/bar 5 – "Government policies have not contributed to irrigation and drainage infrastructure for tackling climate change." and statement/bar 6 – "Government policies have not contributed sufficiently towards information in response to climate change.") (Figure 5).



1	There is a need to change the calendar for battling pest/disease
2	No need to change crop structure since there is no climate change
3	Farmers are proactive to change although have little information and knowledge
4	Government policies do not orient on change of crop structure to adapt to climate change
5	Government policies have not contributed to irrigation and drainage infrastructure for tackling climate change.
6	Government policies have not contributed sufficiently towards information in response to climate change.
7	People are not ready to invest in changing crops and livestock
8	Difficulties in forecasting natural disasters and erratic weather impair adaptation.
9	Farmers do not believe that climate change is happening in their locality.

Fig 5. Expert's opinions and perceptions of experts on the policies implemented by the government and other general statements on climate change. Source: Structured survey results

Since the observed manifestation of plant and animal diseases was at a high level, most respondents declared that changing pest/disease management is the respective useful adaptive action or measure (34% and 29% of respondents agree and strongly agree (Figure 6: Bar 1). Most respondents (55% of the sample – Figure 6: Bar 3) view that "innovation grants for farms" is the most important policy support for improving adaptation to climate change. Supporting investments for irrigation and drainage infrastructure, was also assessed as one of the most important policies by more than 44% of respondents (Figure 6: Bar 4). According to them, it is highly important that the government should support disaster recovery and crop failure. 43% ranked this option as the most important (Figure 6: Bar 9). In addition, approximately 40% of the extension agents support the option that "Government should provide information and warnings for natural disasters and epidemics" (Figure 6: Bar 8).



1	Higher budget for your institution/work
2	Government should facilitate the replacement of plant varieties
3	Provide innovation grants for farms
4	Irrigation and drainage infrastructure investments
5	Assessment of climate change impact on agriculture
6	Increase information for raising awareness
7	Increase trainings for teaching women and men about adaptation techniques
8	Government should provide information and warnings for natural disasters and epidemics
9	Government should support disaster recovery and crop failure

Fig 6. Preferred policy support for improving adaptation to climate change (Answers to the question: "In the future, what would be the best policy support you would like to receive in order to improve adaptation to climate change? Rank from 1= most important to 5=least important. Source: Structured survey results

5. Discussion

Most respondents stated that they have observed increased drought durations, frequent change of temperatures, and increased incidence of hail and pre-seasonal rainfalls and floods during the last 10 years. The stated importance on causes of climate change is in line with results from other studies carried out for Southeast Europe. Rising temperatures and disruptions in the precipitation regime are the most significant exposures for the region (Müller and Hofmann, 2022).

The vast majority of experts stated that these phenomena, except the case of strong winds, are signs of climate change. Considering the changing level of temperatures at the subregional level (Teqja et al., 2017), it is understandable that illustrations based on statements collected by the semi-structured interviews on changes happening to plants, animals, and natural resources differ.

More attention should be paid to experts' level of knowledge on climate change impacts rather than on knowledge regarding adaptation strategies to climate change. These knowledge gaps and awareness concerns are in line with those witnessed by Pojani et al. (2013), finding that even among highly educated participants, the understanding about climate change's relationship with development is limited.

Extensionists agree or strongly agree to address the main problems by adopting an appropriate pest and disease calendar, increasing investments at the farm level, and addressing the gaps in forecasting natural disasters. This is in line with observations from farmers and policy experts identified by Imami et al. (2019). They are conscious not only of the agricultural effects, but also of the detrimental effects on the environment and natural resources, such as the case of pasture and forest deterioration. Although the impact of climate change on livestock is scarcely studied (Müller and Hofmann, 2022), the incidence of diseases and safety deterioration has been made evident (Misiou and Koutsoumanis, 2021) recently.

Extensionists perceive farmers as crucial agents for change, but with a limited role due to limited information and knowledge. Considering that collective action is weak (Rama, 2016), and capacity to react at the farm level is limited due to financial weakness, an increased role from the state emerges as the most demanded for help with climate change in terms of awareness and adaptation. The respondents emphasize the need for financial mechanisms, irrigation and drainage infrastructure improvement, and insurance for disaster recovery and crop failure.

Awareness and information about climate change's impact on the overall sector and related issues among experts is high, however awareness and information about adaptive strategies/actions are not significantly high. These results also go hand-in-hand with the adaptive capacity index[6] comparison outcomes for the country and other Southeast Europe countries. Similar to Bosnia and Herzegovina and Serbia, Albania has a somewhat middle level of adaptive capacity (ENVSEC, 2012).

6. Conclusions and recommandations

Albania, similar to other Mediterranean countries, has been and will continue to be deeply affected by climate change (Baettig et al., 2007; REC, 2011; Sutton et al., 2013). The climate change impact in Albania is particularly strong, considering the high contribution of the agriculture sector to the national economy and the fact that the agriculture sector is dominated by smallholders. The understanding of the consequences of climate change and extension experts' perceptions will help the management's ability to cope with climate risks (Roco et al., 2015), as well as introducing government-led extension interventions to farmers (Lasco et al., 2016).

The paper provides insight into the impact of climate change on the agriculture sector in Albania. Results reveal that during the last 10 years, Albanian regions have been affected by highly frequent changes of temperature and less rainfall (causing long durations of droughts), a scenario described by respondents, which is also in line with the study results (forecasts) of the World Bank (Sutton et al., 2013). As would be expected, exposure to such events varies between regions, particularly regarding forecasted precipitation patterns. Information collected based on statements and qualitative expressions of extension agents displayed a diversity of effects according to region.

The agricultural extension experts have identified prolonged droughts, more frequent temperature changes, floods, pre-seasonal rainfall, and even frosts as occurring above the average level during the last decade. Most respondents view that such phenomena are caused by climate change. Extension service experts witness a high impact of climate change on plant disease (increased prevalence), loss of water supply, emergence of new diseases, and shifted times of occurrence of a certain plant health risk. Furthermore, higher vulnerability to insects/pests has been observed, as well as forest and pasture degradation. On the other hand, a few cases of positive impacts have been observed.

Adaptive capacity is crucial for improving farmers' resilience, especially in those areas and sectors where financial capacity is weak. Therefore, support with innovation grants for farms, rehabilitation of irrigation and drainage infrastructure, and introduction of disaster recovery and crop failure insurance alongside the provision of information and warnings for natural disasters and epidemics, are suitable options for policymakers at relevant line Ministries. The findings highlight the urgent necessity to prioritize climate change as an extension programming component and to develop clear adaptation approaches.

This study has several limitations. The result of this study is based on a survey / interviews with service experts; their perceptions and considerations are limited to their knowledge and observations. Furthermore, the answer to most questions related to awareness is based on self-declarations/perceptions, and as such there may be certain biases. Cross-checking and validating this information with farmers' perceptions, views, and experience using a comparative framework would provide a more solid assessment of the gap between users, providers, and advisory services. Considering the recent trends of feminization and the relevant effects in agriculture structures (Zhllima et al., 2021b), special focus should be given to women and men separately. Last but not least, further studies should also detect for policymakers' awareness and willingness to introduce actions toward climate change, with a focus on mitigation issues. In the future, it is necessary to study mitigation capacity and innovativeness by systematically observing actors in the view of a better functioning agriculture knowledge and innovation system (AKIS) in order to increase farmers' resilience, particularly smallholders. In this frame,

[6] The adaptive capacity index combines social and economic measures with institutional measures and an aggregate measure of government effectiveness, where the higher scores indicate higher adaptive capacity (refer to Sutton et al., 2009).

research on the cognitive and social factors (Kreft et al., 2021) are crucial for finding behavioral obstacles to creating collective action mechanisms.

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