



The Impact of Climate Change on Women in Forest Villages: The Case of Kastamonu, Türkiye

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Received: 4 March 2025 / Accepted: 18 August 2025 / Published online: 11 September 2025
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Abstract

Scientific research demonstrates that climate change disproportionately increases both the workload and vulnerability of women living in rural, nature-dependent communities. Although previous studies have highlighted the general vulnerability of rural women, there is a lack of research specifically addressing the impacts on women in Türkiye's forest villages particularly those in Kastamonu Province. This study investigates the effects of recent, significant climate change on forest villages in Kastamonu, which has the highest number and population of forest villages in Türkiye. The research focuses on the lived experiences of women in these communities. In Kastamonu, the rural population constitutes 37.2% of the total population, encompassing 1054 villages (1021 of which are classified as forest villages), with 70,384 women among the 141,622 rural residents. Within the scope of this study, surveys and interviews were conducted with 523 female forest village residents across 92 villages. The data collected via Likert scales were analyzed using chi-square tests, correlation analysis, one-way analysis of variance (ANOVA), and independent samples t-tests. The findings reveal that women with lower levels of education and those facing higher rates of poverty have experienced the effects of climate change most intensely over the past decade, primarily as a result of increased workloads. Livelihoods have become particularly vulnerable in the last five years. The workload of women in forest villages has risen due to factors such as climate change, drought, wildlife pressures, and unpredictable weather events. In light of these results, the study offers policy recommendations aimed at strengthening the adaptive capacity of women in forest villages to better cope with the impacts of climate change.

Keywords Climate change · Forest villages · Vulnerability

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Introduction

Women make up 70% of the 1.3 billion people living below the global poverty line (Denton 2002; Ozdemir and Erol 2023). International forums, such as the Fourth World Conference on Women in Beijing (1995), have underscored that women's poverty is a worldwide concern. According to the 2024 update of the Global Multidimensional Poverty Index (MPI), which incorporates new data from 20 countries and covers 112 countries with 1359 sub-national regions, 1.1 billion out of 6.3 billion people are living in acute multidimensional poverty (2024 Global Multidimensional Poverty Index). While gender is not the only factor contributing to women's vulnerability to climate change, livelihood strategies and land rights also play significant roles (Friedman et al. 2018). Food security threats arising from climate change have particularly adverse effects on pregnant women and children (Reyes 2009). Vulnerable women often have limited access to information and nutritional resources, increasing their susceptibility to food shortages, food insecurity, and malnutrition. Regarding gender disparities in food insecurity, 27.8% of women experienced moderate to severe food insecurity in 2022, compared to 25.4% of men (FAO SOFI 2023). When mothers face food shortages and malnutrition, it can perpetuate a cycle of deprivation, negatively impacting child mortality, morbidity, educational attainment, and work productivity (FAO, IFAD, UNICEF, WFP, and WHO 2024).

The knowledge and contributions of women living in rural areas who play a vital role as food producers in agriculture, animal husbandry, and forestry are often overlooked (Chanamoto and Hall 2015). Although women possess traditional knowledge and experience that enable them to anticipate and respond to many extreme weather events by closely observing and interpreting natural signs, the increasing unpredictability of climate change has diminished the effectiveness and transmission of this knowledge (Lane and McNaught 2009). In forest-dependent communities, access to forests and resource ownership are critical determinants of women's livelihoods. However, the changing conditions brought about by climate change have led to the neglect of women's unmet needs, particularly as they relate to forest resources (Djoudi et al. 2012). The severity of disasters also exacerbates gender inequality (Neumayer and Plumper 2007; UN Women 2024). Recent research has shown that women living in rural areas whose livelihoods depend on natural resources are more vulnerable to the adverse effects of climate change than other segments of society (Buechler 2009; Friedman et al. 2018; Khondker 1996; Tandon 2009; WEDO 2018). While climate change affects everyone on Earth, its impacts differ across continents, regions, and even within social and family structures. Therefore, it is essential to examine climate change from a gender perspective to accurately assess both the material and non-material damages it causes (Coirolo and Rahman 2014; Bush and Clayton 2023).

Türkiye is a developing country situated at the crossroads of Asia, Europe, and Africa, occupying a strategic location and encompassing a diverse range of ecosystems. Its unique geographical position, where multiple climate zones converge, makes Türkiye exceptionally rich in biodiversity and serves as a vital bridge connecting three continents. In Türkiye, the global impacts of climate change are already becoming apparent, and these effects are expected to intensify over time (Demirdogen et al. 2024; Korkmaz and Kuriqi 2024; Yalcın 2024). Climate change projec-

tions for Türkiye indicate increased mortality due to drought, a reduction in water resources, ecological degradation, more frequent forest fires, and rising temperatures. In recent years, Türkiye has experienced widespread floods and droughts that have affected nearly the entire country, and the frequency of such disasters is expected to rise in the future. In 2023 alone, 5233 natural disasters were recorded nationwide (Disaster and Emergency Management Directorate 2023). Anticipated water shortages are also emerging as a major concern, as declining water resources contribute to growing food security challenges. Over the past decade, soil productivity in Türkiye has decreased by 23% (Ministry of Agriculture and Forestry 2021).

Climate-related disasters in Türkiye disproportionately affect women in rural areas and are likely to continue doing so. Factors such as rural women's roles within the social structure, lack of economic independence, limited participation in decision-making, gender inequality, and social exclusion increase their vulnerability to domestic crises (Alkan 2007). Most forest villages in Türkiye are situated in high-altitude and arid regions, exposing residents to challenging geographical and climatic conditions. The topography limits the availability of agricultural land, confining agricultural activities primarily to small-scale family operations (Alkan and Toksoy 2008; Bulut 2018). As a result, the social and economic structures of forest villages are generally weaker than those in other regions of the country. In high-altitude forest villages, challenges such as access to water resources, infrastructure services, and food security are more acute than in other communities. Reduced rainfall and drought not only threaten food security in these areas but also contribute to the spread of invasive species, increased health problems, and diminished livelihoods.

As industrialization has progressed in Türkiye, internal migration has increasingly concentrated in urban centers and large cities, particularly from forest villages. Often, male heads of households have migrated for work and financial gain, leaving women, children, and the elderly in the forest villages. While villages that were largely abandoned due to this out-migration have seen a resurgence in recent years with seasonal returns, life in these forest villages is becoming increasingly challenging due to extreme weather events caused by climate change. Forest villagers, who depend on nature and derive their livelihoods from natural resources, face a growing threat to their way of life. Within these communities, women are disproportionately affected by the impacts of the climate crisis.

In the forest villages of Kastamonu Province, women have traditionally organized their agricultural activities by closely observing natural cues and weather patterns. However, they are often unprepared for the sudden and unpredictable events brought about by climate change. As part of this research, surveys and interviews were conducted with 523 women in 92 forest villages within the study area. The aim was to identify the effects of climate change on forest villages and to assess the extent to which residents are impacted. This study also explores how changes in women's work schedules, driven by these climate-related disruptions, have influenced their overall workload. Data collected through these surveys were analyzed using chi-square tests, correlation analysis, one-way analysis of variance (ANOVA), and t-tests in SPSS. The findings reveal the impacts of climate change on agriculture, animal husbandry, and forestry in the forest villages of Kastamonu, as well as how these changes affect women in these communities. Observed effects of climate change in

Kastamonu's forest villages highlight the importance of identifying the factors that intensify its impact on women. Understanding these factors is crucial for developing policies that enhance the adaptive capacity of women in forest villages to climate change.

Materials and Methods

Study Area

Kastamonu Province contains 1054 villages, of which 1021 are classified as forest villages the highest number in Türkiye. The total rural population is 141,622, with 70,384 women living in these areas, representing 37.2% of the province's total population. Kastamonu was selected as the study area because its large number of forest villages and residents offers a comprehensive perspective on the effects of climate change, particularly regarding the vulnerability of women in these communities. Research indicates that Kastamonu is expected to shift to an arid climate type within the next 20 years, which is likely to lead to significant food security challenges and biodiversity loss (Gur 2024).

Kastamonu Province, selected as the research area, is situated in the western Black Sea region of Türkiye. The province has an average elevation of 775 m above sea level and covers an area of 13,108.1 square kilometers, representing 1.7% of Türkiye's total land area. While the terrain is generally rugged, the province is characterized by the Western Black Sea Region mountains in the north, the İsfendiyar (Küre) Mountains north of the city center, and the Ilgaz Mountains in the south. Approximately 74.6% of the province is mountainous and forested (65%), with plains comprising 21.6% and flatlands making up 3.8%. As this land distribution indicates, Kastamonu lacks extensive areas suitable for large-scale agriculture; however, the small plains surrounding the valleys are notable (URL-1 2025). Kastamonu Province is located on the North Anatolian Fault Line, the most active fault line in Türkiye. Consequently, the coastal areas of the province are classified as third- and fourth-degree earthquake zones, while the inland areas are designated as first-degree earthquake zones. Figure 1 gives a satellite image of Kastamonu from Google Earth.

Kastamonu Province's diverse topography results in two distinct climate types: the Black Sea climate in the north and the Central Anatolian climate in the south. The central district has an average annual temperature of 9.8 °C, with January and February being the coldest months and July and August the warmest. On average, 18% of annual precipitation occurs in winter and 27% in summer. The central district receives an average annual rainfall of 449.7 mm, with precipitation levels increasing toward the coastal areas. The lowest rainfall is recorded in December, January, and February, while the highest occurs in April and May. Snowfall is observed for an average of 19.5 days per year in Kastamonu, and the city center remains under snow cover for an average of 37.3 days. The prevailing wind is the Lodos (southwest), which blows an average of 3524 times per year at an average speed of 14 m/s (URL-1 2025).

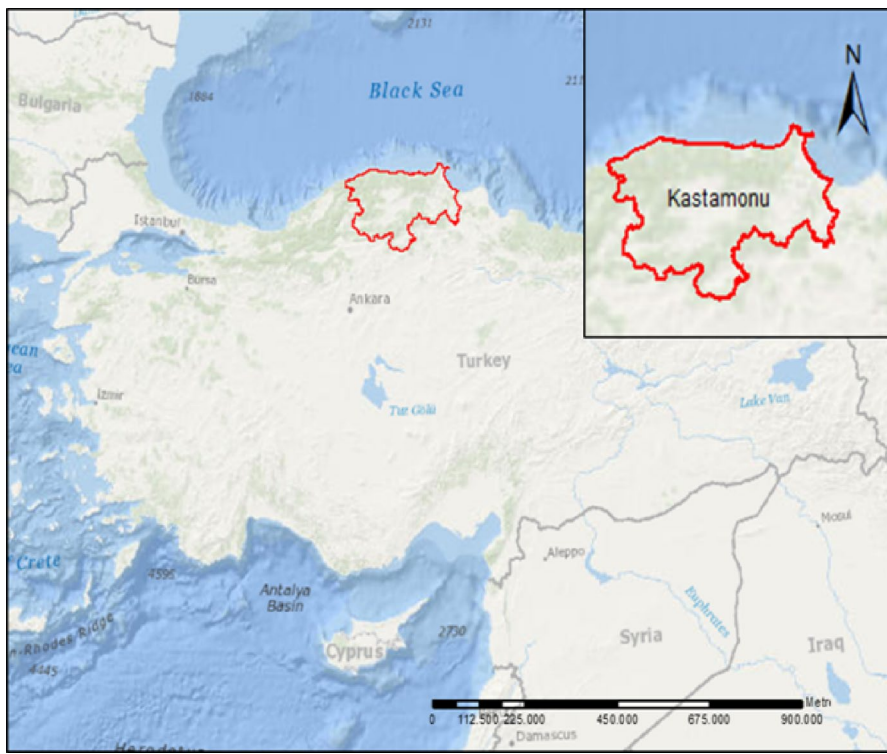


Fig. 1 Google earth image of Kastamonu province in Turkey

Sample Size

Data were obtained through enumeration during the research process. Given that the population size was known and the variables were determined through counting, the sample size was calculated using the formula provided by Yavuz (2007). This calculation assumes a 95% confidence level and a 5% margin of error. The formula is as follows:

$$n = N \times t^2 \times P \times Q \div ((N - 1) \times d^2 + (t^2 \times P \times Q))$$

where: n =sample size, N =the total number of units (representing the female population residing in villages within Kastamonu province), P =prediction rate, $Q=1-P$, t =critical value for the desired confidence level (1.96 for a 95% confidence level), d =margin of error (0.05 for 5%).

Using the same formula, the female population of Kastamonu Province (192,628) (TSI, 2024) was used to calculate an initial sample size of 382, based on a 5% margin of error. To increase the reliability of the research, a total of 523 surveys were ultimately conducted. The survey targeted women over the age of 18 who reside permanently or seasonally in the forest villages of Kastamonu District. Of the total population of Kastamonu Province, 141,622 individuals live in villages, with 70,324

being women (KASTABIL 2024). Accordingly, the sample size for this study was determined based on the female population residing in these villages.

Participants were selected using a simple random sampling method. First, the forest villages within Kastamonu Province were categorized by district. Each village name was then written on a slip of paper, folded, and placed into a bag. Villages were subsequently drawn at random, with selection proportional to their respective district populations. Within the chosen villages, participants were then randomly selected without any specific targeting.

Survey Questions and Analysis

The first part of the study was designed to assess the socio-economic structure of women living in the forest villages of Kastamonu Province and to analyze how this structure affects their vulnerability to climate change. The subsequent section examines both the observed and projected impacts of climate change globally, focusing on four time periods: 1980–2000, 2001–2010, 2011–2015, and 2016 to the present. The population of forest villages declined markedly in the 1980s due to migration to urban areas, leading to the expectation that climatic and labor force changes would not differ significantly during the 1980–2000 period. In the years that followed, return migration began, prompting the use of shorter time intervals to more accurately capture the evolving impacts of climate change on forest villages and women.

The survey, comprising 57 questions, was structured around themes of socio-economic status, agriculture, animal husbandry, forestry, and climate change. To obtain clearer responses, the survey emphasized closed-ended questions. Likert scales were used to gauge participants' attitudes toward climate change and their perceptions of its effects. Data were collected through face-to-face surveys with 523 women in 92 forest villages and entered into Excel for organization. Statistical analyses were conducted using SPSS (Statistical Package for Social Sciences). Chi-square tests were applied to assess changes in variables across different periods, enabling a periodic analysis of participants' socio-economic status and climate change awareness. Pearson's correlation coefficient was used to examine relationships among responses related to agriculture, livestock, and forestry. To evaluate whether the hypothesis that women are more affected by climate change was widely supported, and to analyze participants' perceptions, the most significant impacts were identified and measured using Likert scales. A 5-point Likert scale (1: strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree; or 1: minimum, 2: less, 3: medium, 4: more, 5: maximum) and a 4-point Likert scale (0: never, 1: sometimes, 2: usually, 3: always) were utilized in the study. Additionally, one-way analysis of variance (ANOVA) and independent samples t-tests were conducted to evaluate the effects of the identified variables on participants' responses.

The reliability of the scale used for participant-rated questions was evaluated using Cronbach's alpha coefficients. Cronbach's alpha is a widely used method for estimating the reliability of test measurements and is applicable to both binary (0, 1) and weighted (e.g., 1, 2, 3, 4, 5) items (Bademci 2006). It is primarily employed to assess the reliability of scales designed to measure participants' opinions and attitudes on specific issues. The Cronbach's alpha coefficient represents the weighted

standardized average of covariances and is calculated as the ratio of the sum of the variances of the items in the scale to the total variance (Kılıc, 2016). The formula for Cronbach's alpha coefficient is as follows:

$$\alpha = k / (k - 1) * \left[1 - \left(\sum \sigma^2_i / \sigma^2_T \right) \right]$$

where: k =number of test items, σ^2_i =measurement variance of item i , $\sum \sigma^2_i$ =total measurement variance of i items, σ^2_T =variance of total test measurements.

Common classifications in the literature for interpreting Cronbach's alpha coefficients are as follows: $\alpha \geq 0.9$ is considered excellent, $0.7 \leq \alpha < 0.9$ is good, $0.6 \leq \alpha < 0.7$ is acceptable, $0.5 \leq \alpha < 0.6$ is poor, and $\alpha < 0.5$ is unacceptable (Kılıc 2016). In this survey, the Cronbach's alpha coefficient for the Likert scale questions assessing participants' attitudes was calculated using SPSS and found to be 0.95, indicating excellent reliability.

To determine the appropriate statistical tests for identifying variables affecting responses to the question, "Do you think that the potential impact of climate change affects you more?", it is necessary to assess whether the responses follow a normal distribution. A normal distribution is characterized by symmetry (skewness, $\alpha_3=0$) and a specific kurtosis ($\alpha_4=3$), which allows for comparison in terms of skewness and kurtosis. The skewness and kurtosis values of the data are compared with those of a normal distribution to determine whether the distribution is flatter or steeper, and whether it is skewed to the left or right (Karagoz 2014). If the skewness and kurtosis values fall between -1.5 and $+1.5$, the distribution is considered approximately normal (Tabachnick and Fidell 2013). Table 1 presents the skewness and kurtosis values for the responses.

The skewness and kurtosis values shown in Table 1 fall within the range of -1.5 to $+1.5$, indicating that the data are approximately normally distributed. As a result, parametric tests were deemed appropriate for further analysis. An analysis of variance (ANOVA), as a parametric test, was employed to assess whether specific variables significantly influenced responses to particular questions. For bivariate comparisons, independent samples t-tests were used. Table presents the results of the ANOVA tests conducted to determine the coefficients for the responses to the questions.

Table 1 Values related to normal distribution

			Statistic	Standard error
Do you think that the potential impact of climate change affects you more?	Average		3.652	0.084
	Average with 95% confidence interval	Lower limit	3.487	
		Upper limit	3.819	
	Distortion		-1.128	0.107
	Kurtosis		-0.445	0.213

Results

Socio-Economic Profile of the Participants

Regarding the socio-economic profile of the study participants, 41% were aged 61 years or older, while 24% were between 51 and 60 years old. Participants aged 18 to 29 comprised 9% of the sample ($n=44$). In terms of educational attainment, 58% of participants had completed primary school, 22% were illiterate, 7% were literate but had not completed formal schooling, 5% were secondary school graduates, 4% had completed high school, 1% were university graduates, and only 0.01% held a master's or doctoral degree.

Participants aged 51 and above reported that schools existed in their villages during the 1970s, and families were compelled to send their children to school due to pressure and mandates from teachers. However, it was noted that girls were often discouraged from continuing their education beyond primary school, whereas boys were encouraged to pursue further studies. The limited access of girls to higher education was attributed to expectations that they would contribute to housework, agriculture, gardening, and animal husbandry, as well as to social pressures on household heads to restrict girls' education in accordance with patriarchal norms.

I did not allow my daughters to continue their education beyond primary school, but I ensured that my sons became teachers. My daughters pleaded with me, often in tears, to let them attend school, but I refused because my husband was working out of town. He warned me that if he heard anything negative about our daughters, he would hold me responsible.

With respect to marital status, 79% of survey respondents reported being married, 9% were single, and 12% were widowed. The majority of respondents aged 18 to 29 were single, indicating a notable decline in child marriages and an increase in the age at first marriage in forest villages.

When asked about the number of children, 28% of participants reported having three children. On average, households consisted of three to four individuals, with the mean household size in the village being three. The relatively small household size, despite the number of children, is likely attributable to children living apart from their families for reasons such as education, employment, or marriage.

Among the women surveyed, 88% identified as housewives, 5% as farmers or forest workers, 6% as students, and 1% as belonging to other professional groups. Of those who identified as housewives, 66.5% were involved in agriculture, 60.7% in animal husbandry, 90.4% in field or garden work, and 77.8% in barn-related tasks. Specifically, 57.4% were responsible for grazing animals, 72.6% for collecting wood, and 17.6% (half of whom were agricultural and forestry workers) for transporting water. The proportion of women not engaged in formal education or employment was expected to be higher in rural areas, as young women classified as unpaid family workers were projected to leave the workforce by 2021. Although participants identified themselves as housewives, their significant involvement in agriculture, animal

husbandry, and forestry suggests that this designation likely reflects their status as unpaid family workers.

I worked tirelessly—waking before dawn and going to bed late at night—caring for animals, carrying children on my back, working in the fields, fetching water, and collecting wood. Now, my legs hurt even when I walk, and the pain does not subside.

The majority of women in the forest villages reported experiencing at least one health problem, with those aged 51 and above being the most affected. This trend is likely attributable to a combination of age-related conditions and the cumulative impact of years spent working in agriculture, forestry, and animal husbandry. Participants frequently reported pain in their legs, joints, hips, and back, which they attributed to their involvement in animal husbandry and informal forestry work.

Significant rural migration occurred in the forest villages of Kastamonu Province during the 1980s, likely driven by the requirement for most agricultural and forestry workers to register with the Bağ-Kur system in order to access higher retirement benefits under the SSK/SGK system. The majority of participants reported an annual income between 24,001 and 36,000 TL (approximately \$1,600 to \$3,200, based on exchange rates from January to April 2021, when the survey was conducted).

Seventy-five percent of respondents indicated that they did not own any property, while 25% reported owning personal property. Among property owners, 50% had acquired their assets through inheritance, 36% through purchase, and 14% through a combination of both. These findings suggest that the social status of forest villagers has remained largely unchanged since the 1980s. It was also reported that, even when the state distributes inheritance, daughters are often expected to transfer their share to their male siblings. Most women surveyed believed that, upon leaving their father's household, their assets were no longer associated with it.

Sixty-four percent of participants stated that there was no cooperative in their village, and 1% were unsure. Among women living in villages with cooperatives, 32% reported that they were not members, while only 3% were members. Women who did not own property reported being excluded from important household decisions, whereas those who owned property indicated that the head of the family sought their opinion. Nevertheless, the head of household's opinion typically prevailed in decisions regarding the buying and selling of movable and immovable property, the area of cultivated land, the types of crops grown, and income management. However, men appeared to defer decisions regarding household finances to the women in the household. The limited involvement of women in significant decision-making may be explained by the fact that only 3% of those living in villages with cooperatives were actually members. Women tend to join cooperatives later in life, do not regularly attend meetings, and are unable to participate effectively in decision-making processes. This is further evidenced by the lack of clear responses from women regarding questions about agricultural land size and income, with the majority responding "I don't know" when asked about their income.

After my husband died, I lived with his brother and his wife. I was unable to take my children and return to my father's house. I worked hard so as not to be a burden to them, and I was unaware of how much I was earning. After my children grew up, they built this house, and we moved here.

Assistance from Husbands in Tasks Traditionally Assigned to Women

With respect to assistance from husbands in tasks traditionally assigned to women, 55.3% of participants reported receiving no help from male family members. Table 2 presents the Likert scale results regarding the level of support provided by men in these tasks.

There is an error in the definition associated with Table 2. It should be left as the explanation for the table containing the skewness and kurtosis values in Table 1. Table 2 should be associated with the explanation of the level of support men provide in tasks traditionally assigned to women.

According to the Likert scale results presented in Table 2, the average response from participants indicates that they "sometimes" receive assistance from male family members in the tasks for which they are responsible. The limited assistance provided by men stems from the prevailing perception that the listed tasks are primarily the responsibility of women. Many of the women interviewed expressed the belief that these jobs were their duty and that men did not fully understand their burdens.

Chi-Square Analysis Results Regarding Variables That Create Significant Differences in Participant Responses

Chi-square analysis was applied to reveal the relationships between the participants' responses and the variables addressed in the study. Through this analysis, the variables that created statistically significant differences in the participants' responses were determined. Thus, the factors according to which the participants' opinions differed and the significance level of these differences were revealed. The analysis's findings are presented in Table 3.

Values indicated as 0.001 in the table represent $p < 0.001$ and were evaluated within the significance level of $p < 0.05$.

Table 2 Level of support provided by men in tasks traditionally assigned to women

Likert scale means			
Level of support provided by men in tasks traditionally assigned to women	0.84 = 1	Kitchen work	0.67 = 1
		Childcare	0.66 = 1
		Animal grazing	0.95 = 1
		Chores	0.67 = 1
		Renovation	1.34 = 1
		Barn/poultry works	0.98 = 1
		Water transport	0.57 = 1
		Field/garden work	1.16 = 1
		Elderly/disabled care	0.42 = 0
		Collecting wood	0.97 = 1

0: Never, 1: Sometimes, 2: Usually, 3: Always

Table 3 Chi-square analysis results regarding variables that create significant differences in participant responses

Variables	χ^2 (chi-square)	df (degrees of freedom)	p (asymptotic significance)	
Age groups and educational status	420.707	24	0.001	<0.05
Age groups and annual income levels	111.281	20	0.001	
Annual income levels and working conditions	106.726	20	0.001	
Age groups and marital status	216.545	8	0.001	<0.05
Age groups and number of children	219.879	36	0.001	
Sources of income by period	454.263	15	0.001	
Age groups and sources of income from agriculture/horticulture (2016–present)	21.257	4	0.001	<0.05
Age groups and sources of income from live-stock farming (2016–present)	22.203	4	0.001	
Additional income sources by period	46.323	12	0.001	
Allocation of additional income by period	18.954	12	0.090	>0.05
Household structure by period	311.815	9	0.001	
Energy sources used by period	429.494	9	0.001	
Wood consumption by period	759.324	9	0.001	<0.05
Coal consumption by period	153.373	15	0.001	
Village problems by period	1.510.926	27	0.001	
Land area cultivated by period	0.353	3	0.950	>0.05
Types of crops grown by period	35.221	6	0.001	
Months of seed planting by period	728.610	27	0.001	
Rainfall adequacy by period	186.777	3	0.001	<0.05
Quality of drinking water by period	618.577	9	0.001	
Quality of agricultural products by period	1.077.406	6	0.001	
Yield from agricultural products by period	695.420	6	0.001	<0.05
Prevalence of weeds/insects by period	813.028	6	0.001	
Water availability by period	1.937.544	6	0.001	
Irrigation requirements by period	1.211.507	6	0.001	<0.05
Durability of agricultural products by period	1.563.096	6	0.001	
Agricultural damages from natural disasters by period	137.743	15	0.001	
Use of chemical fertilizers and pesticides in agriculture by period	351.684	6	0.001	<0.05
Methods of food acquisition by period	683.969	6	0.001	
Satisfaction with agricultural income by period	152.956	3	0.001	
Types of livestock owned by period	377.784	21	0.001	<0.05
Quality of animal feed by period	773.932	6	0.001	
Cattle height and weight developments by period	901.292	6	0.001	
Satisfaction with livestock income by period	6.339	3	0.096	>0.05

Table 3 (continued)

Variables	χ^2 (chi-square)	df (degrees of freedom)	p (asymptotic significance)	
Livestock damages from natural disasters by period	52.067	15	0.001	<0.05
Honey quality in beekeeping by period	49.321	6	0.001	
Honey production in beekeeping by period	175.437	6	0.001	
Bee mortality rate in beekeeping by period	223.163	6	0.001	
Satisfaction with beekeeping income by period	120.454	3	0.001	
Methods of benefiting from forests by period	149.106	18	0.001	
Types of income from forestry by period	42.855	6	0.001	
Women's participation in forestry work by period	16.468	3	0.001	
Satisfaction with income from forests by period	7.739	3	0.050	>0.05
Intensity of forestry work by period	996.490	6	0.001	<0.05
Forest coverage by period	354.854	6	0.001	
Frequency of encounters with wild animals by period	1.074.105	9	0.001	

As the age group becomes younger, the number of illiterate individuals decreases, while the proportion of primary school graduates increases. Annual income tends to increase with age, and conversely, decreases as the age group decreases. Women with average and above-average annual incomes are primarily in the housewife occupational group, while the income level of women who are forest and agricultural workers is generally lower. Single marital status is more prevalent among younger participants, and the number of children decreases as the age group decreases.

While agriculture and animal husbandry were the primary sources of livelihood between 1980 and 2000, pension income has become increasingly important in more recent times. Although migration rates were high between 1980 and 2000, the rate of permanent residence has increased closer to the present day. Women's contribution to the family economy has steadily increased from 1980 to 2000 to the present; however, there has been a notable decline in the sale of products such as mushrooms and rose hips collected from forests in recent years. Women consistently allocate their income to the needs of their children, education expenses, and household expenses across all periods.

The construction material of the buildings in which participants lived shifted from wood between 1980 and 2000 to reinforced concrete in more recent times. While participants noted the insufficient number of rooms in reinforced concrete buildings as a drawback, they also expressed concerns about the lack of durability, toilets, bathrooms, and heating in wooden structures. Although wood was the preferred source of energy and heating between 1980 and 2000, there has been a significant increase in the use of coal and solar energy, in addition to wood. The amount of wood used has generally decreased over the years, with the highest consumption occurring between 1980 and 2000. Conversely, coal usage has increased over time, with the highest levels coinciding with the 2016-present period. This increase is likely due to coal aid programs specifically targeting sick households, elderly individuals (over 65 years

of age), and households with no or very low income. The labor-intensive task of water transportation, primarily performed by women between 1980 and 2000, has significantly decreased in recent times. However, women's responsibilities in child-care, housework, animal grazing, and field and barn work have remained relatively consistent.

Changes in the Problems Faced by Forest Villages over Different Time Periods

The challenges experienced by participants in their villages have varied considerably across the periods studied. Food security, which was identified as a problem by only 0.2% of respondents during the 1980–2000 period, increased markedly to 15.3% in the 2016–present period. Similarly, concerns regarding water resources rose from 9.8% in the 1980–2000 period to 14.3% in the 2016–present period. Issues related to wild animals were reported by 4% of respondents in the earlier period, increasing to 14.4% in the most recent period. While village security was not cited as a problem in the initial period, 8.3% of respondents identified it as a concern in the most recent period.

In contrast, infrastructure problems in villages decreased from 17.6% in the first period to 12.7% in the most recent period. The prevalence of issues related to unemployment, education, health, and infrastructure remained relatively stable across all periods. Notably, traffic and communication problems have decreased by approximately 50% in recent years.

The bear ate my cows, so I gave up farming.

The bear destroyed my beehive and consumed my honey.

The majority of participants expressed concerns regarding infrastructure problems in their villages, citing frequent power outages, limited internet access, inadequate drainage, and poor road and water networks as factors contributing to the relatively low level of development in forest villages. In these villages, disasters such as floods and landslides caused by excessive rainfall, particularly in the spring and summer, frequently result in prolonged road closures. Similar issues arise after heavy snowfall in the winter, making it difficult for children in rural villages to access education. The transported education system, which serves high-altitude forest villages near the city center, is often disrupted following natural disasters.

The COVID-19 pandemic has exacerbated the fragility of these villages, as elderly residents who typically spend the winter months with their children in the city center have been forced to live alone in the villages. Most of the villages visited lacked medical facilities, and participants reported that family doctors visit their villages only once a month, providing the primary source of healthcare. If the male head of the family leaves home for work, women and elderly family members who remain in the village with their children rely on these monthly visits for healthcare. Additionally, participants with low levels of education often depend on the assistance of other villagers to access healthcare facilities.

Another critical issue that emerged was the problem of village security, which was not mentioned at all between 1980 and 2000 but was cited by 215 respondents in the present day, constituting 8.3% of the total problems identified. Participants who had previously migrated to metropolitan cities or abroad and had recently returned to their villages stated that they no longer felt safe. Security concerns in the village stem from a lack of trust among residents, frequent visits by non-native foreigners, wild animals restricting people's freedom of movement, and the presence of non-forest villager (foreign) forest workers. The perception that retired villagers returning to their villages are wealthy has also been associated with potential threats from outsiders.

Changes in Agriculture over Different Time Periods

The types of crops cultivated by participants have changed significantly across the periods studied. In the first period (1980–2000), 12.9% of participants reported cultivating crops primarily for income, whereas this figure declined to 6.6% in the most recent period (2016–present). The timing of crop planting has also shifted: while most crops were planted in September–October during the 1980–2000 period and subsequent years, planting now predominantly occurs in February and March of the following year.

Significant differences in rainfall sufficiency have been observed over time. There was no notable decline in rainfall adequacy between 1980 and 2000 or up to 2016; however, the proportion of respondents describing rainfall as “adequate” dropped sharply from 51.6% in the 2016–present period to just 16.6%. Perceptions of water availability in village sources have also changed dramatically. Between 1980 and 2000, only 1% of participants reported water scarcity, but this figure rose to 90.4% in the 2016–present period. The percentage of respondents who considered the water supply “abundant” was 98.3% in 1980–2000, decreased to 74.8% in 2001–2010, and fell further to just 1.4% in the most recent period. Regarding irrigation needs, 74.6% of respondents between 1980 and 2000 stated that only “rare irrigation with precipitation” was necessary. This percentage declined to 70.9% in 2001–2010 and dropped sharply to 7.8% in the 2016–present period. Conversely, in the most recent period, 74.8% reported a need for frequent irrigation. The proportion of respondents who described their drinking and utility water as clean also fell, from 55.6% in 1980–2000 to 33.3% in 2016–present.

Both the quality and yield of field and garden products have declined over time. The percentage of respondents reporting “low quality” products increased from 5.7% in 1980–2000 to 72.8% in 2016–present, while those reporting “high quality” products dropped from 79.1% to 9.9%. Similarly, the proportion indicating “low yield” rose from 12.1 to 81.2%, and those reporting “high efficiency” fell from 69.9 to 1.8%. Satisfaction with income from agricultural activities also declined, with 82% of respondents expressing satisfaction in 1980–2000, compared to only 38.6% in 2016–present.

There have also been notable changes in the prevalence of weeds and insects. In 1980–2000, 90.4% of respondents reported that weeds and insects were “less” prevalent, but this figure dropped to 24.2% in the current period. In contrast, 62.8%

now report that weeds and insects are “a lot,” compared to just 1.3% in the earlier period. The use of animal manure has decreased from 84.1 in 1980–2000 to 39.6% in 2016–present, while the use of fertilizers and pesticides has increased. Fertilizer use rose from 14.5 to 34.2%, and pesticide use increased from 1.4 to 26.2% over the same periods.

Product shelf life has also changed. In 1980–2000, 87.1% of respondents stated that products could remain “intact for a long time without spoilage, mold, or sprouting,” but this rate fell to 52.2% in 2001–2010. In the 2016–present period, 81.2% reported experiencing “short-term spoilage, mold, or sprouting.” The way respondents obtain food has shifted as well: while 91.7% grew their own food in 1980–2000, this rate dropped to 16.4% in the current period. Meanwhile, the proportion of those who both grow and purchase food increased from 3.9 to 58.6%.

Regarding natural disasters, 50% of respondents reported flood damage in 1980–2000, which rose to 52.2% in 2001–2010 but then decreased sharply to 4.4% in the 2016–present period. While floods were the most damaging natural disasters in the earlier period, droughts have become the most significant threat in recent years.

Participant quotations further illustrate these changes:

Recently, a potato beetle appeared and caused significant damage. Beans are also being damaged by insects that we have never seen before.

Before, the rains were enough to irrigate the fields and gardens; we rarely needed to water them. Now, even with daily irrigation, the plants need water.

Our crops were destroyed overnight. When we woke up, we saw that they were blackened and burnt. We had never seen anything like this before.

We can't find irrigation water anyway; now there is no water in our house.

We used to plant more land, but now we only plant enough to meet household needs. We have been buying the flour we need for two years.

Our wheat has turned black.

Only a third of what we sow in the fields is harvested. Wild animals destroy one-third. The rest was damaged by natural disasters, such as hail, drought, and floods.

Changes in Animal Husbandry over Different Time Periods

The types of animals owned by participants have changed noticeably over time. During the 1980–2000 period, ownership rates for sheep (12.9%), goats (8.2%), and Anatolian buffaloes (7.4%) were higher; however, these figures declined to 2.8%, 1.5%, and 0.4%, respectively, in the period from 2016 to the present. In contrast,

ownership of cows/cattle, chickens, geese, turkeys, and bees has increased over the same timeframe.

Participants' assessments of the quality of animal products have also shifted. In 1980–2000, 70.6% ($n=284$) reported that animal food was of “high” quality, but this rate dropped to just 9.2% ($n=43$) in the 2016–present period.

Observations regarding the growth and development of animals have varied as well. In 1980–2000, 85.1% of respondents described cattle development as “poor,” whereas this figure fell to 11.3% in the most recent period. Conversely, 78.6% and 72.9% of participants in the 2001–2010 and 2011–2015 periods, respectively, reported “good” development, but this rate decreased to 42.2% in 2016–present. Satisfaction with income from animal husbandry was 59.4% in 1980–2000 and 63.2% in 2001–2010, but has shown a downward trend in subsequent years.

Participants also reported increased losses in animal husbandry due to natural disasters, particularly in the 2016–present period. Drought has emerged as the most damaging natural disaster affecting livestock, with 59.5% of respondents identifying it as a major issue.

Table 4 presents the Likert scale averages for the problems encountered in animal husbandry over the past twenty years.

According to Table 4, when participants were asked to rate the problems they have encountered in animal husbandry over the last 20 years, the most significant issues identified were the rising cost of animal feed, declining water resources, deterioration of grass and pasture quality, a shortage of young people entering the field, and an increase in disease vectors. Participants indicated that they did not experience government restrictions on animal grazing. Notably, there was uncertainty among participants regarding whether disease outbreaks and animal deaths posed a significant problem for livestock.

Significant differences were observed in participants' evaluations of beekeeping activities across different periods. The proportion of participants reporting “high” honey quality declined steadily over time: from 100% in 1980–2000, to 95.9% in 2001–2010, 72.6% in 2011–2015, and just 44.4% in the 2016–present period. Similarly, the percentage of respondents indicating that they harvested a “plentiful” amount of honey was 89.6% in 1980–2000 and 75.5% in 2001–2010, while the highest proportion reporting “less” honey production occurred in the 2016–present period, at 50%.

Table 4 The problems in animal husbandry

Likert scale mean values		
Problems encountered in animal husbandry in the last 20 years	Increase in feed prices	3.9=4
	Decrease in water resources	3.9=4
	A decrease in grasses suitable for grazing	3.5=4
	Deterioration in pasture–pasture structure	3.6=4
	Government restrictions on grazing	0.8=1
	Shortage of young population	3.6=4
	Animal diseases/deaths	2.9=3
	Increase in disease-carrying vectors (flies, ticks, etc.)	3.5=4

1:minimum, 2:less, 3:medium, 4:more, 5:maximum

Bee mortality rates also changed markedly over time. “Low” mortality was predominantly reported in 1980–2000 and 2001–2010 (83.3%), whereas “medium” mortality was most common in 2011–2015 (67.7%). In the 2016–present period, “high” mortality was reported by 92.1% of respondents.

Participant satisfaction with income from beekeeping also declined significantly. While 95.5% of respondents were satisfied in 1980–2000, only 18.9% expressed satisfaction in the 2016–present period, with 81.1% reporting dissatisfaction.

Changes in Forestry over Different Time Periods

Participants’ responses regarding their utilization of forests have changed significantly over time. During the 1980–2000 period, activities such as mushroom collection (23.9%), wild fruit gathering (22.8%), and animal grazing (20.5%) were relatively common. However, these rates have declined in the 2016–present period, reaching 22.8%, 20.8%, and 16.0%, respectively. Notably, the use of forests for recreation increased from 2.2% in 1980–2000 to 9.7% in 2016–present, while hunting also saw a slight rise from 1.6% to 2.9% over the same periods.

The proportion of respondents earning income from forest labor was 67.5% in 1980–2000, 59.7% in 2001–2010, 57.3% in 2011–2015, and rose again to 73.1% in the 2016–present period. Income from the sale of non-wood forest products increased up to 2011–2015, but then dropped to 14% in the most recent period.

While most participants primarily assisted with forestry work, a notable 40.1% engaged in forestry work independently during 1980–2000. From 2011 onward, the proportion of those assisting with forestry work increased to 75.9%, while independent forestry work decreased to 24.1%. Regarding the intensity of forestry work, 55.4% of respondents described it as “rare” and 44% as “normal” in 1980–2000. However, from 2016 to the present, 76.4% reported that forestry activities are now “intensive.” Across all periods, participants generally expressed satisfaction with the income received from forest-related activities.

Perceptions of forest cover have also shifted. In 1980–2000, 62.8% of respondents reported an increase in forest cover, and 51.7% noted an increase in 2001–2010. However, in the 2016–present period, 36% (n=182) reported a decrease in forest cover.

Encounters with wild animals have become more frequent over time. While respondents in the 1980–2000 and 2001–2010 periods most often reported “sometimes” encountering wild animals, 71.7% of respondents in the 2016–present period reported “frequent” encounters.

Correlation Analysis of the Relationship Between Changes in Agriculture and Other Variables

To better understand the relationships among the key topics identified in the survey, Pearson’s correlation coefficient was calculated between the independent variables based on participants’ responses. The results of this analysis are presented in Table 5.

Table 5 Correlation between observed changes in agriculture and other variables

Variables		Severity level (2-ended)	Pearson correlation	Relationship's strength
Water re- sources from 2016 to the present	Agricultural productivity from 2016 to the present	0.002	0.136**	Positive—weak sig- nificant relationship
	Quality of agricultural products, 2016–2021	0.003	0.129**	Positive—weak sig- nificant relationship
	Prevalence of weeds and insects in agriculture, 2016 to the present	0.016	-0.106*	Negative—weak sig- nificant relationship
	Food safety issues, 2016 to the Present	0.001	-0.164**	Negative—weak sig- nificant relationship
Agricultural productivity from 2016 to the present	Quality of agricultural products, 2016 to the present	0.001	0.533**	Positive—strong, sig- nificant relationship
	Methods of acquiring basic food- stuffs, 2016 to the present	0.819	0.010	No relationship
	Pesticide use, 2016 to the present	0.001	0.145**	Positive—weak sig- nificant relationship
	Use of artificial fertilizers, 2016 to the present	0.001	0.158**	Positive—weak sig- nificant relationship
	Damages from natural disasters, 2016 to the present	0.001	0.149**	Positive—weak sig- nificant relationship
	Satisfaction with agricultural income, 2016 to the present	0.001	0.145**	Positive—weak sig- nificant relationship
	Methods of acquiring basic foodstuffs, 1980–2000	0.001	0.538**	Positive—strong, sig- nificant relationship
Prevalence of weeds and insects from 2016 to the present	Pesticide use, 1980–2020	0.001	0.450**	Positive—moderately significant relationship
Prevalence of weeds and insects from 1980 to 2020	Irrigation frequency, 2016 to the present	0.001	0.254**	Positive—moderately significant relationship
Drought conditions from 2016 to the present	Water resource issues, 2016 to the present	0.001	0.370*	Positive—moderately significant relationship
	Frequency of encounters with wild animals, 2016 to the present	0.001	0.319**	Positive—moderately significant relationship
Food safety issues from 2016 to 2021	Prevalence of weeds and insects, 2016 to the present	0.001	0.265**	Positive—moderately significant relationship
	Methods of acquiring basic foodstuffs, 1980–2000	0.001	0.168**	Positive—weak sig- nificant relationship
	Damages from natural disasters, 2016 to the present	0.001	0.298**	positive—moderately significant relationship

* $p < 0.05$ (statistically significant at 95% confidence level), ** $p < 0.01$ (statistically significant at 99% confidence level)

Changes in Livestock Farming and Its Perceived Impacts over Time

A significant positive relationship was found at the 99% confidence level between increases in agricultural productivity from 2016 to the present and the amount of water available in water resources during the same period. The pattern of participant responses linking low water availability to low productivity suggests a strong association between water resources and agricultural output. This positive and significant correlation confirms that agricultural productivity declines as water resources diminish.

There is also a significant negative relationship at the 99% confidence level between food security from 2016 to the present and the amount of water in water resources during the same period. Participants identified decreasing water resources and water scarcity as key factors threatening food security.

Additionally, a significant positive relationship was observed at the 99% confidence level between increases in agricultural productivity and improvements in product quality over the same period. The clustering of responses indicating both low productivity and low quality further supports the link between these variables. According to the correlation analysis, as agricultural productivity increases, so does the quality of agricultural products.

A significant positive relationship at the 99% confidence level was also found between increases in agricultural productivity and satisfaction with agricultural income during the same period. Participants' responses also indicated a relationship between low water quantity and low product quality. The analysis revealed a positive and significant relationship at the 99% confidence level between agricultural quality and the amount of water in water resources, indicating that higher water availability leads to better product quality.

At the 95% confidence level, a significant negative relationship was found between the prevalence of weeds and insects in agriculture from 2016 to the present and the amount of water in water resources. As water resources decrease, the presence of weeds and insects increases, with participants attributing this trend to drought conditions. Furthermore, there was a significant positive relationship at the 99.9% confidence level between the presence of weeds/insects and the use of pesticides in both the 2016–present and 1980–2000 periods. This suggests that increased weed and insect problems have led to greater pesticide use.

A significant positive relationship at the 99% confidence level was also found between methods of obtaining basic foodstuffs and agricultural productivity in the 1980–2000 period. High yields were associated with a greater reliance on farming for food, while low yields corresponded with a combination of growing and purchasing food. However, this significant relationship between agricultural productivity and food acquisition methods was not observed from 2016 to the present, possibly due to an increase in participants engaged in both farming and purchasing food.

There is also a significant positive relationship at the 99% confidence level between increases in agricultural productivity from 2016 to the present and the use of fertilizers and pesticides during the same period. Additionally, a positive and significant relationship was found between productivity increases and losses resulting

from natural disasters in agriculture, suggesting a connection between natural disaster damage and reduced productivity.

A significant positive relationship at the 99% confidence level was observed between drought from 2016 to the present and both the frequency of irrigation and water access problems. Participants attributed water shortages to the drought experienced during this period.

Furthermore, a significant positive relationship at the 99% confidence level was found between food security and losses from natural disasters in agriculture from 2016 to the present, indicating that participants view natural disaster damage as a major threat to food security. There is also a significant positive relationship at the 99% confidence level between food security and the frequency of wildlife encounters during the same period, suggesting that participants consider wildlife density to be another factor endangering food security.

The rainfall has become highly irregular. In the past, we could predict whether it would rain, but now heavy downpours occur suddenly, often accompanied by hail. Due to these unpredictable rains, I lost my bees.

As productivity in agricultural gardens declines and insect infestations increase, all villagers have resorted to using more artificial fertilizers and pesticides. The chemicals caused the death of all my bees. I once had 50 hives; now, only 5 remain.

In the past, animals primarily grazed on natural pastures. Now, with little grass left, the time animals spend grazing outdoors has decreased, and we are forced to feed them in the barn. The cost of animal feed is also quite high.

There used to be a breed of cattle we called 'black cattle' that never got sick. In recent years, our calves have started falling ill as soon as they are born. Previously, we never needed veterinarians, but now we are constantly calling them.

We make a living by selling milk, butter, eggs, yoghurt, wild rosehips, and mushrooms. In recent years, we have not been able to obtain animal milk as effectively. Chickens frequently become ill and die in large numbers. Rosehips and mushrooms are no longer as abundant or of the same quality. What we collect is now only enough for our own needs.

In the past, animals were not highly valued, but they were plentiful. I was able to educate my children, arrange their marriages, and build a house with the income from animal husbandry. Now, although animals are more valuable, if I sell five, the proceeds from two are spent just on expenses.

Factors Influencing Participants' Vulnerability and Awareness of Climate Change

Participants were asked to consider the hypothesis that women living in rural areas are more acutely aware of, and more affected by, climate change than men and other segments of society. The responses indicate agreement with the hypothetical sub-components presented in the table. According to participants, women in rural areas face limited access to education, resources, early information about weather conditions, and markets. They are also burdened with undervalued job responsibilities and are subject to patriarchal social structures that restrict their participation in decision-making processes. Additionally, women often lack economic independence, and both agricultural productivity and product quality have declined in recent years.

Participants believe that, as a result of increased workloads and growing challenges in animal husbandry, women have become more sensitive to the impacts of climate change. This has led some to adopt alternative lifestyles and to spend more time in nature. Table 6 presents the mean Likert scale scores reflecting women's vulnerability to climate change.

Table 6 Mean Likert scale scores on women's vulnerability to climate change

Average values of the Likert scale			
Do you think that the potential impact of climate change affects you more?	1.18=1	Access to education opportunities is more limited than for men	3.93=4
		Access to resources is more limited than that of men	3.66=4
		Being informed early about sudden weather events is more limited according to men	3.66=4
		Compared to men, women are more responsible for undervalued responsibilities such as housework, child-elderly—disabled care, fuel supply, and food supply	3.56=4
		Access to markets is more limited than men and income is collected in men	3.52=4
		Women are not included in decision-making processes due to the patriarchal social structure	3.71=4
		Women who do not have economic independence are dependent on adult male members of the family	3.61=4
		Women who become mothers often sacrifice their own needs and give priority to meeting their children's or household needs	3.67=4
		Due to the decrease in income sources, women's workload is increasing with alternative production, agricultural activities, etc	3.67=4
		Men are more skilled than women in natural life (swimming, driving tractors, cars etc., walking easily on rough terrain, running, etc.)	3.91=4

(1: Yes, 2: No); (1: Strongly disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly agree).

Participants' Perceptions and Awareness of Climate Change

Based on responses to questions analyzing participants' perceptions of climate change, the study found that most participants believe in climate change. According to the table listing some of the effects of climate change, participants attributed increasing temperatures, extreme weather events, and the decline in plant species and biodiversity (which have provided additional income in recent years) to climate change. However, it remains unclear whether the increase in animal diseases and deaths is directly linked to climate change, or whether climate change affects the living conditions of wild animals. Participants did not attribute the increase in diseases and epidemics in recent years to climate change. They generally agreed that the increasing frequency and duration of forest fires is due to rising temperatures caused by climate change.

The majority of respondents indicated that climate change negatively affects their quality of life, that declining agricultural productivity and rising food prices increase insecurity, and that they are worried about their children's future. Most participants agreed that climate change is a serious problem for their country. However, they expressed ambivalence regarding the claim that climate change is caused by industrial society and modern consumer psychology. Table 7 presents the average Likert scale scores regarding the impacts of climate change and the overall perceptions of the participants.

Based on participants' responses to questions evaluating climate change policies, the study found that participants generally supported less stringent approaches to the problem and agreed with the proposed policy recommendations. The majority of participants agreed that advancing climate action from a gender perspective would lead to more effective and beneficial outcomes. They also concurred that the active participation of women in decision-making mechanisms related to climate change mitigation and adaptation policies would result in more practical strategies. However, participants did not believe that the gender perspective is currently ignored in climate change policy.

It is generally believed that communities living in rural areas and relying on natural resources for their livelihoods are more sensitive to the effects of climate change and will be disproportionately affected compared to other segments of society. Participants expressed the need for new legal regulations to enhance the resilience of forest villagers against climate change. They also argued that rural development and climate change policies should be designed in a cohesive and integrated manner.

Although men tend to dominate decision-making in specialized fields such as energy, agriculture, and forestry, participants were hesitant to assert that women work harder behind the scenes. They also showed ambivalence toward the claim that incorporating traditional knowledge from women who live in close contact with nature could benefit climate change mitigation and adaptation efforts. Table 8 presents the average Likert scale scores reflecting participants' views on climate change policies.

The study found that individuals with limited literacy skills tended to exhibit ambivalent attitudes toward climate change, whereas those with at least a primary school education demonstrated greater awareness. Both married and single participants showed awareness of climate change, and higher annual income was associated

Table 7 Average Likert scale scores on the impacts of climate change and participants' overall perceptions

Average values of the Likert scale			
Do you believe in climate change?	1.13=1	The fact that the autumn and winter months of 2020 are warmer than in previous years is due to climate change	4.1=4
		Extreme weather events (hail, floods, drought, landslides) are caused by climate change	4.2=4
		With the increases in temperatures, animal diseases and deaths also increase	2.7=3
		Increasing diseases and epidemics in recent years are due to climate change	1.8=2
		Although forest fires are caused by human-induced factors, the increase in the number and duration of fires is due to climate change	3.5=4
		The decrease in biological diversity is one of the effects of climate change	4.1=4
		Climate change affects the living conditions of wild animals	3.3=3
		The decrease in plant species collected from forests, which are an additional source of income, is due to climate change	3.5=4
		I am concerned about the possible effects of climate change on my children's future	4.1=4
		Climate change negatively affects our quality of life	3.8=4
		The increase in food prices due to the decrease in natural resources and agricultural productivity increases my concerns	3.8=4
		Climate change is becoming a serious problem for our country	3.9=4
		Climate change is the result of societies with industrialization and modern consumption mentality	2.9=3
		Climate change increases the workload of forest villagers	3.5=4

(1: Yes, 2: No); (1: Strongly disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly agree).

with increased agreement with statements about climate change. An exception was observed among participants who declined to disclose their annual income, as they exhibited lower levels of awareness. The presence or absence of health problems did not appear to influence climate change awareness. Table 9 shows the variables affecting participants' awareness of climate change.

Participants whose fields and gardens had been damaged by natural disasters displayed higher levels of awareness, while those who reported no such damage were more likely to express uncertainty regarding climate change. Similarly, participants

Table 8 Average Likert scale reflecting participants' views on climate change policies

Average values of the Likert scale			
Evaluation of policies regarding climate change	3.52=4	Considering the gender perspective in climate change policies will provide more effective and beneficial results	3.5=4
		Ensuring the active participation of women in the decision-making processes of climate change combat and adaptation policies will provide more realistic approaches	3.5=4
		Gender perspective is ignored in our country's climate change policies	2.4=2
		Communities that live in rural areas and whose livelihoods depend on nature are more affected by climate change than other segments of society	3.5=4
		Rural development policies should be integrated with climate change combat and adaptation policies	3.8=4
		Legal regulations are necessary to strengthen the adaptation capacity of forest villagers to climate change	3.9=4
		Although decision-making mechanisms in sectors such as energy, agriculture, and forestry are generally made up of men, women work more labor-intensive in the background	3.1=3
		It would be beneficial to include women's traditional knowledge and experiences in climate change combat and adaptation policies	3.1=3

(1: Strongly disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly agree).

who acknowledged water resource problems in animal husbandry, as well as those who recognized both water resource issues and a decline in pasture grasses, demonstrated greater awareness. Respondents who reported that natural disasters had caused damage to livestock also scored higher on climate change awareness.

With respect to water quality, participants who described their water as dirty, cloudy, or clean tended to provide undecided responses, whereas those who reported calcareous drinking water scored higher on the section analyzing awareness of climate change impacts. Respondents who both grew and purchased food exhibited an ambivalent approach to climate change, although those engaged in both activities gave higher scores on the section concerning climate change impacts.

For the 2016–present period, respondents who identified food security and water resource problems demonstrated greater awareness of climate change, while those who reported no such problems tended to express uncertainty. Participants who benefited from non-wood forest products by collecting and selling them evaluated the impacts of climate change with higher scores, whereas those who did not earn income from these products were more likely to be undecided about climate change awareness. Respondents who reported a recent increase in forestry work were also more aware of climate change.

Table 9 Variables affecting participants' awareness of climate change

Dependent variable	Model	Sum of squares	df	Mean square	F	Significance level	
Do you believe in climate change?/ Education status	Anova Test Results	19.401	1	19.401	11.347	0.001^b	<0.05
/Age groups		5.073	1	5.073	2.920	0.088 ^b	
/Material status		12.584	1	12.584	7.304	0.007^b	<0.05
/Number of children		3.845	1	3.845	2.210	0.138 ^b	>0.05
/Job status		2.860	1	2.860	1.642	0.201 ^b	
/Annual income		16.703	1	16.703	9.739	0.002^b	<0.05
/Health problem		0.047	1	0.047	0.027	0.869 ^b	>0.05
/2016-Present drought		2.558	1	2.558	1.468	0.226 ^b	
/2016-Present agriculture natural disasters		1.698	1	1.698	0.974	0.324 ^b	
/2016-Present agriculture yield		0.523	1	0.523	0.299	0.585 ^b	
/Problem of water resources for animals		49.190	1	49.190	29.764	0.001^b	<0.05
/Problem of grass for disease		19.455	1	19.455	11.379	0.001^b	
/2016-Present livestock natural disasters		10.180	1	10.180	5.893	0.016^b	
/Quality of drinking water		16.479	1	16.479	9.606	0.002^b	
/2016-Present food acquisition		10.489	1	10.489	6.074	0.014^b	
/2016-present food safety problem		7.679	1	7.679	4.433	0.036^b	
/2016- Today's water resources problem		7.625	1	7.625	4.401	0.036^b	
/2016-Day's wild animals problem		0.005	1	0.005	0.003	0.957 ^b	>0.05
/Animal diseases and mortality		3.686	1	3.686	2.118	0.146 ^b	
/Disease carrier vectors		6.916	1	6.916	3.989	0.056 ^b	
/2016-Day's sales of non-wood forest products		16.465	1	16.465	9.598	0.002^b	<0.05
/2016-Day's forest fires		2.198	1	2.198	1.261	0.262 ^b	>0.05
/2016-Day's intensity of forestry work		2.357	1	2.357	1.352	0.245 ^b	
/2016-Day's forest quantity		7.115	1	7.115	4.105	0.043^b	<0.05
/Climate change—women's workload		98.962	1	98.962	63.555	0.001^b	
/Climate change affecting women more		101.165	1	101.165	65.146	0.001^b	

^b $p < 0.001$ indicates statistical significance. Results with $p < 0.05$ were considered significant

There was no significant difference in the ratings of participants who reported either an increase or decrease in forest cover regarding the effects of climate change; both groups were predominantly aware of climate change. However, respondents who reported no change in forest cover exhibited more ambivalent attitudes.

Finally, the study concluded that participants who reported an increase in women's workload and recognized women as a vulnerable group demonstrated greater awareness of climate change.

The Extent of Dependence on Forests and Forestry Activities

Participants' responses to questions evaluating climate change and forestry activities indicate general agreement with the less assertive options. Respondents expressed uncertainty about whether the recent increase in manufacturing activity across the country has been felt in their villages. Their focus was primarily on the benefits provided by forests, such as soil protection, water storage, erosion control, wildlife habitat, and biodiversity. They argued that these ecological benefits make forests an important tool in combating climate change. Consequently, participants agreed that forests should be managed with an emphasis on ecological rather than economic objectives, especially in light of climate change.

Participants noted that the recent trend of selling planted trees has strengthened forest production but has also had negative socio-economic impacts on forest villages. They assumed that peasants working in forestry are often excluded from social security and labor protection measures, leaving them unprotected by law. As a result, workers already living in poverty may be more vulnerable to the impacts of climate change and could lose their ability to continue forestry activities, especially given the risk of work-related accidents.

Additionally, participants appeared to be either unaware of or hesitant to express opinions on the potential impact of transitioning from fossil fuels to renewable energy sources on forests and forest-dependent communities. There was also a lack of awareness or willingness to comment on the claim that "there is a gap between forest laws and relevant legislation regarding the allocation of forests to non-forest activities."

Table 10 presents the average Likert scale scores reflecting participants' views on climate change and forestry activities.

Factors Influencing Participants' Responses to Questions related to Climate-Change

The analysis revealed that participants aged 30–40, 51–60, and 61 and above were more likely to agree that the impacts of climate change disproportionately affect women. This view was also supported by primary and secondary school graduates, whereas high school and university graduates were less likely to endorse the hypothesis. Marital status played a significant role: married and widowed respondents tended to agree that women are more intensely affected by climate change, while single respondents and women without children were less likely to support this perspective.

Occupational status also influenced responses. Participants who identified as housewives, retirees, or forestry workers were more likely to agree with the hypothesis. In contrast, those without social security did not support the idea that women are more affected by climate change, whereas participants with social security coverage through their spouses tended to agree. The hypothesis received greater support among participants with higher annual incomes, those who reported calcareous drinking water, and those experiencing health problems.

Perceptions of agricultural vulnerability further shaped responses. Respondents who believed that drought disasters harm agriculture were more likely to agree with

Table 10 Likert scale averages regarding climate change and forest activities

Average values of Likert scale			
Evaluation of climate change and forestry activities	3.55=4	The intensity of forest production, which has been experienced throughout the country in recent years, is also felt in our village	3.3=3
		Forests provide soil protection, carbon sequestration, water retention, erosion prevention, biodiversity, etc. It is an important tool in the fight against climate change with its benefits	4.4=4
		Forests should be managed by prioritizing conservation and sustainability (ecological) purposes rather than economic purposes	4.2=4
		The selling method of planted trees, which has become increasingly widespread in recent years, not only causes intense production in forests, but also negatively affects the socioeconomic structure of forest villagers	4.1=4
		Abandoning fossil fuels and choosing renewable energy sources within the scope of combating climate change causes deforestation	2.6=3
		Forest villagers are being displaced due to the construction (installation) of renewable energy resources within the scope of combating climate change	2.5=3
		There are gaps in the forest law and relevant legislation regarding the allocation of forests to non-forest activities	2.7=3
		The vulnerability of forest worker villagers in terms of social security and occupational health and safety, and the deaths and injuries that may occur due to possible accidents, will lead to loss of household labor and income, causing poverty to increase and thus the effects of climate change to be felt more intensely	4.2=4

(1: Strongly disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly agree)

the hypothesis. Conversely, participants who reported that natural disasters since 2016 had not damaged their fields or gardens were generally undecided. Those with low pesticide application requirements did not support the hypothesis, while those with high pesticide needs did. Participants who sowed seeds in September were less likely to agree, whereas those planting in February through June were more likely to support the hypothesis.

Agricultural productivity and resource quality were also influential. Respondents reporting low agricultural productivity, low quality and durability of agricultural products, frequent irrigation, scarce water resources, and a need for artificial fertilizers were more likely to agree that women are more affected by climate change. Similarly, participants who observed deteriorating pasture structures, low or medium quality of animal feed, increased animal diseases and deaths, declining water resources, and the presence of disease vectors in animal husbandry were more likely to support the hypothesis.

For the 2016–present period, the hypothesis was supported by participants who reported food security problems, those who purchase food, and those who both grow and purchase food. Additional support came from respondents who noted decreases in water resources, increased encounters with wild animals, security concerns in villages, unemployment, limited access to health services, and infrastructure problems. Participants who frequently or always encountered wild animals were also more likely to agree.

Finally, the hypothesis was supported by those who reported an increase in forestry work, a decrease or no change in forest cover, and by those who utilize forests for wood and wild fruit collection.

Discussion

According to the Turkish Statistical Institute (TSI) 2024 data, Türkiye ranks 66th out of 167 countries in terms of its elderly population. Kastamonu is the second largest province in Türkiye and, after Sinop, has the highest proportion of elderly residents, with a rate of 17.7% (URL-2 2024). The age distribution of participants interviewed in forest villages for this study aligns with TSI's findings. TSI's "Youth with Statistics 2024" (2020) reports that in 2019, a total of 231,477 individuals aged 18–24 migrated to another province for basic education (URL-3 2024). This internal migration for educational purposes is particularly prevalent in regions with limited educational opportunities, including the forest villages of Kastamonu. Migration trends by period reveal that the migration rate among participants was approximately 25% between 1980 and 2000, but declined to 8.8% in 2016. While the net migration rate in Kastamonu District was 4.46% in 2016, it fell to -3.05% in 2020 and -12.90% in 2024. Despite the declining net migration rate, there has been an increase in return migration. These findings regarding the age distribution of village residents are consistent with current TSI data (URL-4 2024).

The literacy rate among women in forest villages remains low. Girls are often not sent to school due to patriarchal norms, poverty, and household labor demands, resulting in a generation of vulnerable women in these communities. Heymann (2002) found that the health and education of children from poor families are often compromised by family responsibilities and workload. Globally, the literacy rate in 2019 was 86.4%, with adult women (aged 15 and over) at 83% (URL-5 2021). However, the literacy rate among women in Kastamonu's forest villages is below the global average, consistent with previous studies by Alkan (2007), Bulut (2018), and Korkmaz (2013).

The results also indicate that the age at first marriage in forest villages has increased in recent years. According to TSI's "Marriage and Divorce Statistics" (2024), the average age at first marriage in 2024 was 28.3 for men and 25.8 for women (URL-6 2021), which aligns with the findings of this study. Forest villages also have a high proportion of single-person households. TSI data show that the share of one-person households increased from 14.9% in 2016 to 20% in 2024. The average household size in Türkiye decreased from 4 persons in 2008 to 3.11 in 2024 (URL-7 2024). These results are consistent with those of Alkan (2007), Bulut (2018), Inanc (2011), Korkmaz (2013), and TSI (2024).

Women aged 51 and above in forest villages often experience a reduced quality of life due to joint pain, consistent with Eren Yalçın et al.'s (2016) findings on occupational diseases among agricultural workers. Regarding employment, Korkmaz (2013) found that women in forest villages are typically unpaid family workers without social security, primarily in agriculture and livestock. Alkan (2007) also noted their involvement in animal husbandry and paid forestry work. According to 2024 labor force statistics, women are most concentrated in the agricultural sector. The number of women over 15 not participating in the labor force is 21,047, compared to 9146 men, indicating a low female labor force participation rate and a high prevalence of informal work (URL-8).

Women in forest villages who have social security coverage—whether through their husbands, themselves, or their fathers—are included in the Bağ-Kur insurance scheme. This finding is consistent with Guresci and Yurtas (2008), who noted that inadequate social protection increases rural migration. Similarly, Inanc (2011) found that the pension receipt rate in the forest villages of Trabzon was 44%, rising to 63% in some areas, a trend also observed by Bulut (2018) in Kastamonu. The inclusion of agricultural workers in the social security system in Kastamonu's forest villages aligns with Social Insurance Institution data on compulsory and voluntary agricultural insurance (URL-9 2024). Participants reported annual incomes for 2021 ranging from TL 24,001 to 36,000. The average annual equivalent disposable income of Turkish households was TL 33,428 in 2020, and TL 28,369 in the Western Black Sea region. According to the World Bank, GDP per capita was \$10,925 in 2020, while TSI reported \$8,599. The TR82 region (Kastamonu, Çankırı, Sinop) had the second highest income-based relative poverty rate at 12.3% (URL-10 2024). Thus, annual incomes in Kastamonu's forest villages are significantly below the national GDP per capita, consistent with Alkan (2007) and Bulut (2018).

In forest villages, wooden houses have largely been replaced by reinforced concrete structures. Alongside wood, the use of coal and solar energy has increased. According to TSI, 55.5% of the total area of building permits issued in 2024 was for residential use (URL-12). Gün and Anıktar (2020) found that most construction permits issued between 2000 and 2019 were for reinforced concrete buildings, the most popular material in Türkiye. Bulut (2018) also observed a trend toward reinforced concrete in forest village construction. Tolunay and Korkmaz (2005) noted that changes made in 1983 to regulate villagers' access to forest resources for food and fuel imposed significant restrictions. This finding is consistent with their earlier study. Coal aid, especially for sick, elderly (over 65), and low-income households, is expected to increase coal use in villages. According to the Ministry of Family,

Labor and Social Services' 2024 activity report, 912 Social Assistance and Solidarity Foundations distributed 1,351,829 tons of coal to 1,587,728 households in 2024 (URL-11 2024).

It was found that women in forest villages have little say in important household decisions, although they do have authority over tasks traditionally assigned to them, such as kitchen management. Alkan (2007) reported that most forest villagers consult their husbands on household management decisions, even in areas where women are responsible.

The findings indicate that education level significantly influences climate change awareness: as education increases, so does awareness. This is supported by Korkmaz (2018), Lee et al. (2015), and Yayar et al. (2014). Age group did not significantly affect responses to climate change awareness questions, although those aged 61 and above showed more ambivalence, likely due to lower literacy rates. Korkmaz (2018) also found that age does not affect climate change awareness, while Shi et al. (2016) reported that young people are more concerned about climate change than adults. Marital status, however, does have a significant impact, with married respondents expressing greater concern about climate change, consistent with Korkmaz (2018). The number of children and employment status did not significantly affect responses. Retired participants and forest workers demonstrated greater knowledge, possibly due to their exposure to environmental issues and the structure of the SSK retirement system. Guloglu and Bulut (2016) argue that societal perceptions of climate change influence both those directly and indirectly affected.

Forest workers appear to have higher climate change awareness, likely due to their close observation of environmental changes such as reduced biodiversity and altered snowfall patterns. This aligns with the literature, which suggests that communities living in close contact with nature are more attuned to the effects of climate change (Nelson and Stathers 2009). Income status, however, does not significantly affect awareness, as confirmed by Korkmaz (2018).

Some participants believe that natural disasters do not harm livestock, attributing such events to chance rather than climate change. Others, however, acknowledge that while natural disasters can occur at any time, their frequency and severity have increased in recent years, affecting livestock and related sectors.

Participants' perceptions of drinking water quality from 2016 to the present are likely to influence their responses in the climate change awareness section of the survey. Interviews revealed that some participants' drinking water was found to be undrinkable, and most reported increased lime content in both drinking and industrial water. Some noted that the water was so hard that they could not drink it without a purification device. Drought-induced evaporation increases the concentration of dissolved ions, particularly calcium and magnesium, leading to harder water and more lime (Li et al. 2022; Müller and Schmidt 2024). Participants' observations are consistent with these findings.

Guler (1997) noted that drinking water quality can deteriorate due to environmental destruction from agricultural activities and the use of fertilizers and pesticides. Kucukkilavuz (2009) found that rainfall following prolonged drought increases chemical pollution in water. Ozturk (2002) also identified water quality deterioration as an environmental effect of drought. Albek (2007) stated that climate change exac-

erbrates water quality problems, with serious health and economic consequences due to increased water treatment needs.

Between 1980 and 2000, only 1.1% of people reported dissatisfaction with drinking water; from 2016 to the present, this rate has risen to 27.7%. Curriero et al. (2001) found that the incidence of waterborne diseases after rainfall increased from 51% before the 1990s to 68% in the 1990s, noting that floods contaminated drinking water and contributed to disease spread. Erdogan et al. (2008) reported that temperature changes, drought, and resulting excessive precipitation and floods increase the prevalence of waterborne diseases, including cholera, typhoid, and diarrhea, particularly among children. Varol et al. (2008) warned that excessive intake of water-hardening chemicals, such as calcium and magnesium, can cause serious health problems.

As climate change threatens food security, the workload and vulnerability of women—who are primarily responsible for food provision and nutrition—have increased (FAO 2023). Participants facing declining water resources expressed heightened concern about climate change, as water transportation has become more burdensome. In many villages, disputes over irrigation water have led to conflicts among residents. Women in forest villages face significant challenges regarding their rights to life, food security, hygiene, and access to water, making them particularly vulnerable to climate change (Wedo 2018).

The ability to collect and sell non-timber forest products significantly influences climate change awareness. Spending more time in the forest allows participants to observe environmental changes more closely, increasing their concern about climate change. Those who reported increased forest work also gave higher scores regarding the perceived effects of climate change. Interviews revealed that increased production activities in previously unexploited forests have raised concerns about flood risks. Women in villages with intensive production activities expressed greater concern about climate change. Some participants noted that while forest area may decrease, new growth could eventually compensate for these losses.

Participants who had witnessed forest fires, either directly or indirectly, demonstrated higher climate change awareness. Historically, large-scale forest fires were rare in Kastamonu, and villagers had little experience with such events. However, the 2020 fires in Taşköprü, Çatalzeytin, and Abana districts caused significant anxiety, with many expecting wildfires to become more frequent and severe due to drought. Thus, rising temperatures and their impact on forest fires are a growing concern.

The division of household responsibilities also affects perceptions of climate change. Women who receive only occasional help, both at home and outside, tend to be more aware of climate change, as they bear a greater workload. Many women who reported receiving no help were reluctant to participate in the study, likely due to patriarchal social constraints. Overall, women are more sensitive and vulnerable to the effects of climate change because they must manage all responsibilities without assistance.

A significant proportion of women who reported handling all household tasks were aged 61 and above and lived alone. Thus, educational status and patriarchal norms likely influence responses. The findings support the hypothesis that women in rural areas are more affected by climate change than men or other groups (FAO 2024). Participants also agreed with lower levels of this hypothesis, citing limited

access to education, resources, information, and markets, as well as exclusion from decision-making processes due to patriarchal structures. This gender-based inequality exacerbates women's vulnerability (Onwutuebe 2019).

Women in these communities lack economic independence, and agricultural productivity and quality have declined in recent years. They believe that increased workloads and challenges in animal husbandry make them more susceptible to the effects of climate change, and they are more likely than men to seek alternative livelihoods. Many participants reported that rising temperatures and drought have worsened these problems. For those dependent on agriculture and animal husbandry, climate change has led to shorter grazing periods, increased feed and water needs, and greater labor demands. Direct effects on livestock include reduced growth, milk production, reproduction, metabolic activity, and increased disease, while indirect effects include diminished water, pasture, and feed resources (Sejian et al. 2015).

Other challenges in livestock farming, such as deteriorating pasture quality, rising feed prices, and reduced offspring, further increase vulnerability to climate change. Many participants noted that limited capacity heightens their risk during natural disasters. Almost all reported that they could not swim and would be unable to survive a flood without assistance. Boys were allowed to swim in village streams from a young age, while girls faced restrictions due to cultural norms.

Finally, participants who frequently encountered wild animals expressed fear of attacks, particularly as they worked more intensively in agriculture, animal husbandry, and forestry. As one participant stated:

Protect yourself; you don't have the physical skills to run, climb, jump from high places, etc.

Participants reported feeling more vulnerable than men, as they were unable to fulfill the roles and responsibilities expected of them. Their sensitivity to these challenges increased as the problems intensified.

Hart and Risley (1995) conducted monthly observations over two years with children aged 1 to 3 in 42 affluent, educated, middle-class families. Their findings indicated that children from these families engaged in an average of 32 h of activity per week. The study also revealed that children in middle-class families heard, on average, 12 encouraging words and 7 prohibitive words per hour. In contrast, children from welfare-dependent families heard only 5 encouraging words and 11 prohibitive words per hour. The research demonstrated that, for disadvantaged children aged 1 to 3, a significant portion of parental interactions involved prohibitive language, often beginning with commands and becoming increasingly severe and negative as the children grew older.

Additionally, it was found that wild animals not only affect agriculture, animal husbandry, and forestry, but also restrict the mobility of participants, further contributing to their sense of vulnerability. As one participant explained:

I cannot find water to water the animals. In the past, even children herded animals in the mountains. Today, we are afraid of wild animals and cannot hunt them anymore. But I have to walk a long way from the village to find water.

As documented in the literature, women are disproportionately affected by climate change due to their work responsibilities and existing vulnerabilities. Participants in this study corroborated these findings, reporting that the effects of climate change are felt more acutely while performing essential tasks such as water collection, wood gathering, animal grazing, barn work, field and garden cultivation, and kitchen duties (Friedman et al. 2018).

A comparison of historical and current climate conditions reveals that women in forest villages in the Kastamonu district face a heightened risk of livelihood loss. Villages where agriculture and animal husbandry are the primary sources of income have been increasingly abandoned due to challenging land conditions and the adverse effects of climate change. Rural community members who have lost their livelihoods due to climatic disasters are adopting alternative production methods and cultivating larger areas of land, which, in turn, increases the demand for women's labor and intensifies their workload (Nelson and Stathers 2009; FAO 2023).

The most frequently cited problems in forest villages today include water resource scarcity, food insecurity, wildlife-related issues, unemployment, and inadequate infrastructure. Unemployment is a primary driver of the low young population in these villages, and this scarcity contributes to the decline of animal husbandry. In forest villages where men have migrated in search of income, the population predominantly consists of women, children, and the elderly.

The effects of climate change have been particularly pronounced in forest villages between 2010 and 2021. While younger residents may lack the historical perspective to fully analyze the long-term impact of climate change, they are aware of the broader societal awareness of the issue. Forest village women generally acknowledge the reality of climate change and agree that they are more susceptible to its negative consequences.

Participant observation indicates a decline in both productivity and quality in agriculture and horticulture within forest villages. Simultaneously, harvested products spoil more quickly and have a reduced shelf life. Once-abundant water resources are now at risk of depletion, and irregular rainfall patterns have been observed in the region for approximately 20 years. Since 2016, nearly all villagers have reported experiencing abnormal rainfall patterns.

Decreasing water resources create a negative feedback loop, increasing the demand for water in fields and gardens. In addition to irrigation and drinking water shortages, there is also a scarcity of potable water in the villages. Particularly during the summer months, many homes lack running water. Rising temperatures and water scarcity during the summer exacerbate the challenges of maintaining a suitable living environment in forest villages. Climate pressures on food security and agricultural productivity negatively impact women's labor force participation. Droughts, changes in rainfall regimes, and increasing problems in animal production increase women's responsibilities inside and outside the home, deepening gender-based inequalities (Mishra 2023).

New insects and weeds, previously unseen in the region, have emerged in fields and gardens. Consequently, the use of pesticides to control insects and weeds, as well as the application of artificial fertilizers to enhance productivity, is on the rise. Akbulut (2000) and Sahinler et al. (2008) have emphasized that increasing temperature and

humidity promote the growth, migration, and reproductive capacity of insects. Studies by Gioria and Pyšek (2016) and Bradley et al. (2018) have shown that invasive weeds spread rapidly and suppress native vegetation due to increasing temperature, decreasing soil moisture, and ecosystem degradation. This further threatens the food security of forest peasant women.

The results indicate that irregular rainfall and increased chemical use negatively impact beekeeping. This finding aligns with existing literature, which suggests that pesticides disrupt the behavior and physiological responses of bees, adversely affecting their overall health and endurance (Sahin 2015; Polat et al. 2020; Gadissa et al. 2022).

Efforts are underway to revitalize small livestock farming in forest villages through animal husbandry support programs. However, cattle breeding is declining, and chickens are primarily raised. The quality and productivity of animal feed are also decreasing. Existing literature supports these findings, indicating that insufficient water resources and reduced grazing time due to drought diminish milk production and animal quality. In recent years, there has been a notable increase in diseases and mortality, particularly in poultry. This is consistent with Attia et al.'s (2024) finding that climate change affects poultry farming, with extreme temperatures weakening poultry immune systems and increasing their susceptibility to diseases.

The presence of disease-carrying viruses has become more noticeable than in previous periods (Baumgardt et al. 2015). Cow size and weight have been decreasing, and animals are less resistant to diseases. The costs of caring for and feeding animals are rapidly increasing, leading to financial difficulties for villagers engaged in animal husbandry (Vitali et al. 2009; Bertocchi et al. 2014; Pasqui and Giuseppe 2019). The literature supports these results, showing that animal diseases and deaths increase during the hot summer months. The decrease in grass and water resources and the deterioration of pasture structure, which are identified as direct effects of climate change in the literature, are consistent with observations in forest villages. Although the full extent of climate change's impact on animals is not yet fully understood (Gaughan and Smith 2015), the findings support the conclusion that farmers engaged in animal husbandry face significant challenges.

Forest villagers maintain a close relationship with the forest. However, strict government controls and restrictions, coupled with the scarcity of non-wood forest products compared to previous years, have reduced additional income sources from forests. The decline in forest biodiversity has significantly decreased plant collection activities for nutritional and therapeutic purposes. Additionally, according to the 2022 statistics from the General Directorate of Forestry (GDoF) in Kastamonu, the province is one of the highest producers of unprocessed wood (industrial wood) in Türkiye. Participant observations align with GDoF data.

The sapling sales method preferred by the General Directorate of Forestry in recent years is not supported by forest villages. Intensive production activities by villagers have increased the fear of disasters such as floods and landslides. The villagers claim to understand the language of nature better than loggers and believe that deforestation is exacerbating climate change. They attribute the reduced productivity of trees such as hazelnuts and chestnuts to forest damage and the increase in natural disasters. This observation aligns with the finding that deforestation does not directly

cause climate change but contributes indirectly, along with other variables, in both the short and long term (Leon et al. 2022).

Women also assist their husbands as unpaid workers in forestry jobs, which are predominantly male-dominated. The number of forest villagers engaged in production has increased in recent years. However, women are often excluded from forestry jobs due to the specialized skills required. The exemption of forest villagers with professional qualifications employed in the forestry sector from labor laws, social security, and occupational safety measures increases poverty in cases of work accidents and potential occupational diseases. These conclusions align with the FAO's report, "The Status of Women in Agrifood Systems" (2023), which found that women are underrepresented in forest and agricultural policies, resulting in climate-based problems experienced by women not being adequately addressed.

Conclusion and Recommendations

This study identifies the limitations imposed by patriarchal social structures and the influence of maternal roles as significant factors affecting women's participation in initiatives aimed at ensuring their active involvement in climate change policy. The findings underscore the necessity of women's meaningful engagement in political processes, enabling them to utilize their skills and maternal perspectives effectively. It is essential to include women in climate change policies, particularly in light of their increasing workloads, rising food prices, and the reduction of supplementary income sources resulting from extreme temperatures, wildlife pressures, and other environmental changes associated with climate change. There is also growing concern for the well-being of future generations.

The study examined the impacts of climate change on women living in forest villages, considering demographic characteristics, agricultural and livestock activities, village challenges, forest production processes, biodiversity loss, fire risk, and extreme weather events. The results indicate that women's workloads have increased and their living conditions have become more precarious. Based on these findings, the following recommendations are proposed:

Policy Recommendations to Enhance Climate Change Adaptation and Reduce Vulnerability Gender-responsive forestry policies should be developed to reduce women's vulnerability to climate change. Such policies must enhance women's participation in decision-making processes and incorporate targeted support mechanisms. Additionally, climate-adaptive social protection programs—including income support, insurance schemes, and flexible working arrangements—should be established for women residing in rural areas. Regional action plans addressing climate-related threats such as forest fires, droughts, and extreme weather events should explicitly identify women as a priority vulnerable group and implement specific measures to address their needs.

Recommendations for Implementing Strategies to Reduce Vulnerability and Ensure Adaptation Training programs on climate change and disaster risk should be organized for women living in forest villages, and their access to early warning systems should be improved. Technical support should be provided by integrating

climate-resilient practices—such as drought-resistant crops and low-input production techniques—into women’s agricultural and livestock activities. Women engaged in forest production should have access to the necessary equipment, information, and training to ensure safe working conditions. Furthermore, given the significant workload borne by women, the distribution of tasks in forestry work should be reassessed to promote a more equitable allocation of responsibilities.

Recommendations for Future Research Traditional knowledge, adaptation strategies, and forms of resilience developed by women in forest villages in response to climate change should be thoroughly researched and integrated into forestry practices. Comparative studies that consider regional differences and socio-economic levels should be conducted to create climate-related vulnerability maps for women. Additionally, women’s experiences of climate change should be analyzed through inter-generational comparisons—including young, middle-aged, and elderly women—to inform and guide the development of effective social adaptation policies.

Recommendations for Improving Methodological and Technical Approaches in Future Studies Vulnerability analyses should encompass not only physical and economic factors, but also socio-cultural variables such as gender roles, time use, and decision-making power. Remote sensing and geographic information systems (GIS) should be employed to identify forest areas at high climatic risk, with priority given to support programs for women residing in these regions. Moreover, qualitative research methods—such as focus group discussions and life story narratives—should be expanded to provide a deeper understanding of women’s experiences and perceptions.

This study makes a significant contribution to the limited body of research examining the impacts of climate change on women in rural, nature-dependent communities. At the theoretical level, it addresses a critical gap in the literature by exploring the intersection of climate change and gender, particularly through the lived experiences of women in Türkiye’s forest villages. The study proposes a multi-layered vulnerability framework, demonstrating that women’s vulnerability is shaped not only by biophysical factors, but also by poverty, education level, gender roles, and livelihood strategies.

On a practical level, the study offers concrete recommendations for policymakers, local governments, and civil society organizations. Gender-sensitive climate adaptation policies should be developed to enhance the resilience of women in forest villages against the impacts of climate change. Within this framework, training, social support, and micro-finance programs for rural women should be expanded. Extension activities aimed at increasing women’s knowledge of drought, wildlife threats, and sudden weather events should be supported. Local leaders, including mukhtars (village heads) and provincial administrations, along with regional agriculture and forestry organizations, should develop local adaptation plans that increase women’s participation in these initiatives. Investments in transportation, water supply, and forest infrastructure should be prioritized to facilitate women’s access to agriculture and forestry activities. Civil society organizations should develop programs that encourage women in forest villages to participate actively in climate change adaptation processes. Their capacities can be enhanced through cooperatives and training programs

that support women's organizing, and CSOs can engage in advocacy activities to highlight women's unique needs from a climate justice perspective.

Overall, this study reveals that rural women are not only vulnerable to the impacts of climate change, but can also serve as essential actors in building resilient communities. Therefore, integrating climate policies with the principle of gender equality at the local level is critical for both sustainable development and climate justice.

Acknowledgements This study is based on the doctoral dissertation of the author, Ilknur Cesur. The authors would like to express sincere gratitude to Prof. Dr. Yusuf Güneş, Prof. Dr. Miraç Aydın, Assoc. Prof. Dr. Nur Belkayalı, Assoc. Prof. Dr. Mahmut Muhammet Bayramoğlu, and Assist. Prof. Dr. Alper Bulut for their valuable contributions and insightful feedback during the thesis defense process.

Author Contributions Conceptualization, I.C., Y.G.; methodology, I.C., Y.G.; survey design, I.C., Y.G.; analysis, I.C., Y.G.; writing, discussion and editing, I.C., Y.G. The authors jointly drafted and approved the final manuscript.

Declarations

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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