Factors Affecting Farmers' Range Environment Perception in Rehabilitated Rangelands: The example of Turkey's Central Anatolia Region

Islah Edilen Meralarda Çiftçilerin Mera-Çevre Algısını Etkileyen Faktörler: Türkiye İç Anadolu Bölgesi Örneği

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Abstract

This study aims to determine the socioeconomic factors affecting the rangeland-environment perceptions of farmers in improved rangelands. The study was carried out in the Central Anatolian Region of Turkey, where an arid and semi-arid climate prevails. Data were collected by conducting a face-to-face survey with 271 randomly selected farmers in the provinces where the studies were conducted. Data were analyzed using the chi-square test and Bonferroni corrected Z test. It has been determined that approximately 80% of the farmers do not have a sufficient level of awareness about the perception of range environment. A statistically significant difference was found between farmers' rangeland-environment perception levels and the farmers' age, education level, non-agricultural income, and the number of animals (AU). According to the study results, a low level of adaptation capacity was detected in farmers in terms of the holistic effect of climate change. It has been determined that if necessary, improvements are not made on the issue, unfortunately, 35.70% of farmers will abandon animal husbandry and migrate to city centers. It was concluded that if policymakers and extension organizations focus on the socioeconomic factors derived, farmers will be more successful in facilitating sustainable rangeland use.

Keywords: Characteristics of rangeland, farmer perception, socioeconomic factors, sustainable rangeland use, Central Anatolia Region

Özet

Bu çalışma, ıslah edilmiş meralarda çiftçilerin mera-çevre algılarını etkileyen sosyoekonomik faktörlerin belirlenmesini amaçlamaktadır. Çalışma, kurak ve yarı kurak iklimin hüküm sürdüğü Türkiye'nin İç Anadolu Bölgesi'nde gerçekleştirilmiştir. Veriler, araştırmanın yürütüldüğü illerde rastgele seçilen 271 çiftçiyle yüz yüze anket yapılarak toplanmıştır. Veriler ki-kare testi ve Bonferroni düzeltmeli Z testi kullanılarak analiz edilmiştir. Çiftçilerin yaklaşık %80'inin mera-çevre algısı konusunda yeterli düzeyde farkındalığa sahip olmadığı tespit edilmiştir. Çiftçilerin mera-çevre algı düzeyleri ile çiftçinin yaşı, eğitim düzeyi, tarım dışı geliri ve hayvan sayısı (AU) arasında istatistiksel olarak anlamlı farklılık bulunmuştur. Araştırma sonuçlarına göre iklim değişikliğinin bütünsel etkisi açısından çiftçilerde uyum kapasitesinin düşük düzeyde olduğu tespit edilmiştir. Konuyla ilgili gerekli iyileştirmelerin yapılmaması halinde çiftçilerin %35.70'nin hayvancılığı bırakıp şehir merkezlerine göç edeceği belirlenmiştir. Politika yapıcıların ve yayım kuruluşlarının türetilen sosyoekonomik faktörlere odaklanması durumunda çiftçilerin sürdürülebilir mera kullanımını kolaylaştırmada daha başarılı olacağı sonucuna varılmıştır.

Anahtar Kelimeler: Meraların özellikleri, çiftçi algısı, sosyoekonomik faktörler, sürdürülebilir mera kullanımı, İç Anadolu Bölgesi.

1. Introduction

Rangelands are vital for animal nutrition, increasing farm profits, and preventing erosion and ecosystems, especially in developing countries (Zimmer et al., 2021). Therefore, in many countries, ensuring the continuity of sustainable range management is important both ecologically and socio-economically (Sharifian et al., 2022). In addition, rangelands constitute approximately 50% of the world's land area, provide ecosystem services, and play an important role in rural tourism (Holechek, 2020). Rangelands areas in Turkey are an important natural resource as they constitute 16.86% of the total land area (Anonymous, 2024). The relationship between the agricultural economy and the environment, which is dependent on natural resources, is becoming more and more important in Turkey and the world (Cevher, 2019). Therefore, rangelands should be considered together regarding socio-ecological systems and environmental protection (Schulze et al., 2021). It is certainly predicted that global climate change will have major impacts on the world's rangelands and rangeland users in the coming years (Mensah et al., 2021). To avoid these negative effects, better communication, response strategies, socio-economic, and ecological objectives should be considered and developed together (Karimi et al., 2018). Therefore, since natural and social sciences have different effects in different environments, these sciences should be considered together to achieve more effective environmental policy (Sherren and Darnhofer, 2018).

In Turkey, small family businesses constitute a significant portion of livestock farmers (Aşkan and Dağdemir, 2015). Therefore, the effects of small-scale farmers' socio-economic factors on climate change need to be accurately defined (Vo et al., 2021). Determining this situation will contribute to sustainable animal production and reduce the negative effects on the environment (Chingala et al., 2017). Therefore, it requires the involvement of all stakeholders to develop sustainable use of rangelands in rural areas and sound management strategies (Diogo et al., 2021). This shows that socio-economic conditions and farm characteristics should be taken into account when analyzing the effects of climatic conditions on farm yield and income (Reidsma et al., 2007). Although there are studies on environmental issues in the world and in Turkey, researches involving the relations between the environment and rangelands is very limited. It is very important to examine the knowledge, attitudes, and behaviors of the farmers in Turkey towards this problem, and the policies and practices to be developed and/or implemented for the protection of rangeland and the reduction of environmental problems. For this purpose, the knowledge, attitudes,

and behaviors of farmers living in three provinces (Ankara, Kayseri, and Konya) towards the range environment relationship were examined at a descriptive level. Objective of the study is to determine the socioeconomic factors that affect the perception and behavior of the farmers on the rangeland-environment relationship.

In Turkey, there is no study investigating farmers' perception of the rangeland-environment at the farm level. This research will make an important contribution to the literature as it is a first in Turkey. Based on this background, this study will seek answers to the following three research questions: Is there any increase in farmers' knowledge about the importance of rangelands during the rangeland improvement work and the subsequent process? (2) How did socioeconomic factors affect farmers' rangeland-environment perceptions? (3) Which variables affecting the perception of rangeland-environment led to the development of agricultural policies? and What are farmer behaviors to ensure sustainable use of rangelands?

2. Materials and Methods

2.1. Study Area Information

The research area was carried out in the provinces of Ankara, Kayseri, and Konya in the Central Anatolia Region (CAR), where climate change is most common. Study areas [Ankara (0.46 mil ha), Kayseri (0.54 mil ha), and Konya (0.74 mil ha)] have a total of 2.85 mil ha rangeland area. CAR is one of the seven geographical regions and lies in the central part of Anatolia, covering 21% of Turkey's territory with a surface area of approximately 151,000 km² (Öner et al., 2016). This region is a place where a continental and arid/semi-arid climate dominates, away from the influence of the sea. Average annual precipitation is insufficient, varying between 250-500 mm, and varies widely from year to year (TSMS, 2024). As a result of overgrazing in most of the soils in CAR, the vegetation has been destroyed and the fertile topsoil has been carried away by erosion. These provinces are an important center of Turkey in terms of rangeland areas and animal production. The main agricultural economic activities of the Central Anatolia Region (CAR) are grain products (wheat, corn for silage, barley, lentils, chickpeas, beans), commercial products (rapeseed, beet, beetroot, potatoes, vegetables, watermelon); livestock (sheep, goats, cattle, chickens and other domestic animals). In the CAR region, the decrease in the amount of forage in rangelands cause a decrease in livestock capacity, which indirectly leads to a decrease in the

income level of livestock farmers (Cevher, 2019). The study area and climate characteristics of the study area are shown in Figure 1.
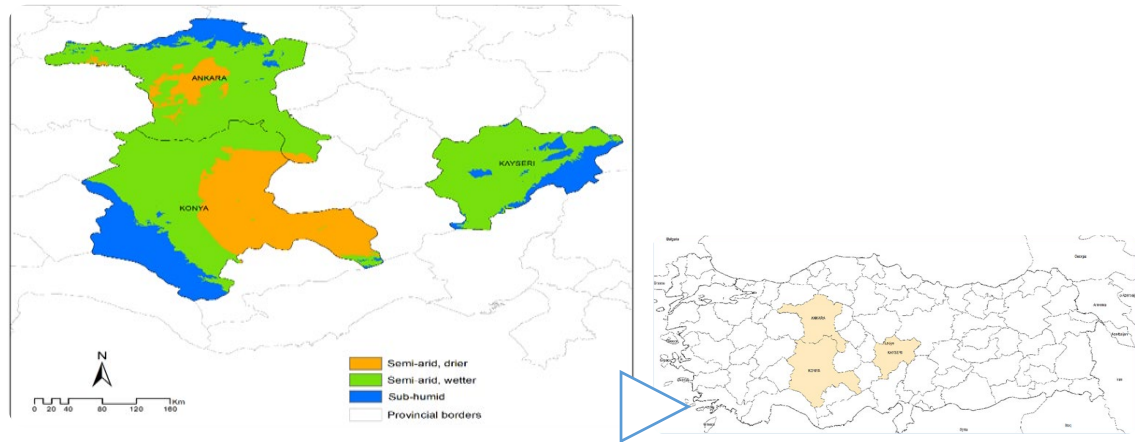

Figure 1. Study area and climate characteristics of the study area.

2.2. Methodology

Due to the degradation of rangelands in Turkey, livestock production is negatively affected. Despite this situation, the place of rangelands in animal production still maintains its importance. For this reason, rangeland improvement works were started in the study area between 2001 and 2011, in cooperation between the Ministry of Agriculture and Forestry and the relevant departments of the Universities. Within the scope of rangeland rehabilitated, irrigation, fertilization and seed planting were carried out in the rangelands. This study was conducted to evaluate farmers' perceptions and adaptation strategies regarding climate change and its effects on range lands. We aim to evaluate the socioeconomic factors affecting the adoption and dissemination of rangeland improvement technologies and farmers' perceptions of climate change and adaptation options. For this reason, it was tried to determine how rangeland improvement activities were perceived by rangeland users. Because these perceptions are also affected by various external factors, including individual and household characteristics, institutions, socioeconomic conditions and environmental conditions. However, farmers' perceptions are influenced by the farmer's various past behaviors, experiences and observations, as well as future aspirations.

We used 2011 survey data based on farmers' rangeland-environment perception of rehabilitated rangeland. Survey questions were prepared regarding the farmer's socioeconomic characteristics, rangeland-environment relationship, and rangeland-environment perception. We aim to answer the following questions through the questions in

the survey: (1) Have farmers' rangeland-environment perception levels about the characteristics of rangelands changed during and after the rangeland improvement work? (2) Do socioeconomic factors affect farmers' rangeland-environment perceptions? (3) What agricultural policies need to be developed regarding the variables affecting the perception of rangeland-environment? (4) What are farmer behaviors to ensure sustainable use of rangelands?

The answers to the questions given above are important in terms of creating new projects and policies regarding the subject under study and solving the problems. Understanding farmers' socioeconomic and demographic characteristics is crucial to drawing conclusion about how they perceive and respond to changing climatic conditions and their impact on rangelands (Ayal and Filho, 2017)

2.3. Data collection techniques

In the study, the "Purposeful Sampling Method" was used in the selection of the districts surveyed. In Ankara, Kayseri, and Konya provinces, 18 villages where rangeland improvement and management studies have been completed constituted the scope of the research. The sample size was determined by taking into account the registered farmers in the villages where the Provincial Directorates of Agriculture and Forestry carried out Rangeland Improvement and Management studies. The number of questionnaires was determined by the Simple Random Sampling Method (Yamane, 1967).

$$n = \frac{N t^2 \, pq}{d^2 \, (N-1) + \, t^2 \, pq}$$

N = number of individuals in the mass

n = number of individuals to be sampled

p = frequency (probability) of the event under consideration

q = frequency (probability) of the event being examined

t = theoretical value found from t table

d = ± deviation based on the frequency of occurrence of the event

The sample size was calculated with a 95% confidence limit and an error margin of 5% of the population mean. As a result of the calculation, 271 farmers (Ankara 42 farmers, Kayseri 154 and Konya 75) formed the sample volume of the study. Livestock farming in Turkey is generally based on rangeland, and the primary feed source of the animals is met from rangelands For this reason, a survey was conducted with 154 farmers who engage in

animal husbandry and 117 farmers who do not engage in animal husbandry in the research area.

The survey forms were completed by meeting the farmers face to face. Interviews were conducted with the heads of households on the farm. because the head of the household is usually the primary decision-maker in traditional agricultural enterprises (Bryceson 2002; Solomon et al., 2007). In the questionnaire form, questions about the demographic characteristics of the farmers, the characteristics of the rangeland areas and the relationship of the rangeland areas with the environment were asked. Closed and open-ended questions were included in the survey. The surveys were conducted between April 1, 2011, and July 30, 2011. The variables included in the survey and used in the analysis are given in Table 1.

Table 1. Description of variables used to determine farmers' perception of rangeland and climate change.

Explanatory Variables	Explanation of Variables
Age group	Age of the head of the household in years; Categorically, 1 if younger than 30 years, 2 if between 31-45 years of age, 3 if between 46-60 years of age, 4 if older than 61 years of age.
Level of education	Attendance at school; Categorical, Primary is 1, Secondary is 2, Tertiary is 3
Residence	Place of residence of the head of the household, Categorical, 1 if Rural, 2 if Urban
Non-Farm Income	Non-agricultural income, Categorical, 1 if None, 2 if Yes
Agricultural crop insurance	Categorical, 1 if None, 2 if Yes
Annual income from farm **Annual farm income in Turkish Lira***	Annual income per household, categorical, 1 for Low, 2 for Middle, 3 for High.
Animal husbandry	Categorical, 1 if None, 2 if Yes
Livestock number (Herd size on the farm) (AU)**	Categorical, 1 if not engaged in livestock farming, 2 if between 1-10 AU, 3 if between 11-20 AU, 4 if between 21-30 AU, 5 if 31 AU is more
Type of animal on the farm	Categorical, 1 if there is no animal, 2 if cattle, 3 if sheep and goats, 4 if mixed livestock farming
Household head's (HH)*** perception of climate change in rangelands (n=271)	Categorical, 1 if there is a change, 2 if there is no change, 3 if I have no idea.
The head of the household's change in the number of animals due to climate change (n=154)	Categorical, 1 if there is no change, 2 if the number of animals decreased, 3 if the number of animals increased.
Impact of climate change on Livestock type (n=154)	Categorical, 1 for Cattle, 2 for Sheep and Goats, 3 for Mixed Livestock.
Is there any thought to changing the number of animals in case the amount of forage in the rangeland decreases? (n=154)	Categorical, 1 if the number of animals will decrease, 2 if the number of animals will not decrease, 3 if rangeland livestock farming will decrease, 4 if there will be no change.
Decrease in the amount of roughage in the rangeland due to climate change (n=154)	Categorical, 1 If I will continue to live in the village, 2 I'm undecided for now, 3 If I'm going to quit farming and go to the city

*1 US Dollar = 29.08 Turkish Lira in December 2023; **AU= Number of Livestock; ***HH = Household

2.4. Data analysis

The survey data were coded and transferred to the computer environment and analyzed with the SPSS V24 software program. Descriptive statistical tools such as percentages,

tables, and graphs were used to interpret the analysis results. Also, empirical data from farm household surveys conducted on 271 farm households were used and the chi-square test was used to understand farmers' knowledge and perceptions. In case significant relationships were detected as a result of the chi-square test, the Bonferroni corrected Z test was applied to compare the rates. The upper limit for significance was taken as 0.05.

3. Results and Discussion

In this study, we can say that climate change affects the socio-economic characteristics of farmers and, as a direct result, determines the behavior of farmers. Perceptions of climate change and its impacts are influenced by psychological and socioeconomic differences, limiting their responses to climate change (Evans et al., 2016). The results showing the relationship between the rangeland-environment perceptions and age education level, residence status, agricultural insurance status, annual income level, non-agricultural income, stockbreeding status, and number of animals the farmers in the sample are shown (Table 2).

3.1. Socio-economic characteristics of farmers and their rangeland-environment perception levels

Farmers' socio-economic attributes and perceptions of rangelands are presented in Table 2. When the knowledge levels of the farmers on rangeland and the environment are examined, it is seen that the rate of the farmers who perceive the rangeland areas as an area where only animals are grazed is 78.2%. The rate of perception of the farmers that the rangelands protect the soil and water resources was determined as 13.3%. The percentage of farmers who expressed the other characteristics of rangelands (providing natural beauty, contributing to animal health, non-agricultural areas, plant diversity, flora, and fauna) differently was determined as 8.5%. According to these results, It is seen that the level of knowledge of the farmers about rangeland areas and the environment is not sufficient. Therefore, in the field of research, rangeland and environmental problems should be handled together and new policies should be created in this regard.

All questionnaires were conducted with male farmers due to the rural family structure. Although the ages of the farmers varied between 21 and 84 years, the average age was determined as 48.8. The largest age group consists of farmers between the ages of 46-60. It has been determined that farmers have been doing agriculture traditionally and for a long time. Therefore, it is possible to say that the target audience has been reached in terms of research. All of the agricultural enterprises surveyed consisted of male individuals and the majority of them were primary school graduates (72.0%). The fact that this rate is high makes

it difficult for the farmer to understand the climate information and to reach the information about the rangeland-climate relationship. 58.7% of the male individuals in these agricultural enterprises had no non-agricultural income and only animal and plant production income. The rate of farmers living in rural areas was determined as 88.2%. The rate of subjects residing in the city and also farming in the village is 11.8%. Farmers have between 5 and 120 dairy animals, with an average of 6.03 animals per farm. The number of livestock is between 4 and 64, with an average of 12.9 animals per farm. The average number of small cattle per holding is 25 and varies between 80 and 550. 79.1% of farmers engaged in animal husbandry produce for market purposes. It was determined that 11.9% of farmers did not have land. It was determined that farmers gave priority to the production of forage crops (alfalfa, silage corn, sainfoin, and vetch) in the crop production pattern and this rate was 64.8%.

Table 2. Socio-economic features of respondents and rangeland-environment perceptions (n=271).

Variables and Category		Rangeland						Total	p-value
		Rangelands are grazing areas		Rangelands prevent erosion		Other features of the rangelands			
Variables	Category	Freq.	(%)	Freq.	(%)	Freq.	(%)	n	
Age group	≤ 30 years	10	43.5	9	39.1	4	17.4	23	0.001**
	31-45	57	72.2	17	21.5	5	6.3	79	
	46-60	106	84.8	8	6.4	11	8.8	125	
	≥ 61 years	39	88.6	2	4.5	3	6.8	44	
Level of education	Primary	182	93.3	7	3.6	6	3.1	195	0.001**
	Secondary	14	58.3	7	29.2	3	12.5	24	
	Tertiary	16	30.8	22	42.3	14	26.9	52	
Residence	Rural	192	80.3	29	12.1	18	7.5	239	0.069ns
	Urban	20	62.5	7	21.9	5	15.6	32	
Non-Farm Income	None	137	86.2	18	11.3	4	2.5	159	0.001**
	Yes	75	67.0	18	16.1	19	17.0	112	
Agricultural crop insurance	None	196	78.4	31	12.4	23	9.2	250	0.146ns
	Yes	16	76.2	5	23.8	0	0.0	21	
Annual income from farm	Low	49	89.1	5	9.1	1	1.8	55	0.215ns
	Middle	144	75.4	28	14.7	19	9.9	191	
	High	19	76.0	3	12.0	3	12.0	25	
Animal husbandry	None	83	71.6	15	12.9	18	15.5	116	0.002*
	Yes	129	83.2	21	13.5	5	3.2	155	
Livestock number (AU)*	No livestock farming	83	71.8	15	12.8	18	15.4	117	0.023*
	1-10 AU	49	86.0	7	12.3	1	1.8	57	
	11-20 AU	42	82.4	8	15.7	1	2.0	51	
	21-30 AU	12	75.0	4	25.0	0	0.0	16	
	>31 AU	25	83.3	2	6.7	3	10.0	30	
Total		**212**	**78.2**	**36**	**13.3**	**23**	**8.5**	**271**	

Significance level, $*p < 0.05$; $**p < 0.01$; ns, not significant
*__Definition of Animal Unit (AU):__ A cultured dairy cow is calculated one Animal Unit; 1 – A purebred dairy cow is 1 Animal Unit, 2 – A crossbreed is 0.75 Animal Unit, 3 – A domestic cow is 0.50 Animal Unit, 4 – A sheep is 0.10 Animal Unit, 5 – A goat is 0.08 Animal Unit, 6 – A buffalo (male) is 0.90 Animal Unit, 7 – A buffalo (female) is 0.75 Animal Unit (Anonymous 2023).

In terms of farmers' socioeconomic characteristics, a significant relationship was found between age, education, non-agricultural income ($p<0.01$), livestock farming and animal number variables ($p<0.05$) and the farmer's rangeland-environment perception. On the other hand, no significant relationship was found between the farmer's place of residence, insurance for the products produced on the farm and the annual income obtained on the farm and the farmer's rangeland-environment perception ($p>0.05$). According to these results, we can say that the variables that most affect the perception of rangeland-environment are education, age, livestock farming and non-agricultural income.

Farmers' age and farm experience are thought to be associated with environmental information, including changes in climatic conditions. Therefore, it was thought that the age of the farmers would be a variable that could affect the perception of the rangeland-environment and it was discussed in the study. Adeola and Adetunbi (2015) determined that farmer age has an impact on producers' perception of sustainable agriculture. Likewise, many researchers have reported that the age and socio-economic characteristics of farmers should be taken into account in order to improve the environment and land productivity (Mango et al., 2017; Chingala et al., 2017). In our study, as the age of the farmer's increases, the number of farmers who think that rangelands are important for the environment decreases. While the rate of knowing the rangeland-environment relationship of the farmers under the age of thirty was 56.50%, the rate of the farmers over the age of sixty-one was 11.30%. Therefore, extension services are recommended to increase the awareness of middle and old farmers about rangeland-environmental awareness (Koç and Uzmay, 2021). According to our study and previous study results, we can say that it is necessary to raise awareness of young farmers and ranchers about their rangeland-environment perception. On the other hand, training studies on rangeland-environment perception for elderly farmers need to be increased.

It was determined that 69.20% of the farmers who stated that rangelands protect plant genetic resources and contribute to the protection of soil and water resources were high school and university graduates. This result shows that the perception of rangeland-environment will increase in parallel with the increase in the education level of the farmer, and this will lead to a positive increase in the perception of the farmer against climate change. However, the reason why well-educated farmers are more sensitive to climate change can be explained by their scientific and technological follow-up of climate change and their high awareness on this issue.

Our results are in line with the studies of many researchers on environmental perception (Maddison, 2006, Fahad et al. 2020 and Xie et al. 2022). Likewise, a statistical difference was detected between the climate change awareness level and risk perception level between education groups. It was observed that there were statistically significant differences (Özdemir et al. 2022). They determined that the level of education had a positive impact on farmers' perceptions of climate-related agricultural risks (Kawadia and Tiwari, 2017). On the other hand, Mango et al. (2017), Al-Amin et al. (2020) and Cevher and Altunkaynak (2020) reported in their studies that the increase in education level has a positive effect on rangeland-environment awareness. They stated that farmers perceive that the deterioration of rangeland quality also affects environmental degradation, and therefore, increasing the education level of farmers and extension services will contribute to the prevention of environmental degradation (Adusumilli and Wang, 2018; Vo et al., 2021). For this reason, by providing training to the farmers on rangelands, it will contribute positively to the effective use of the range law, to increase the perceptions against the rangeland-climate change, and to the adoption of sustainable rangeland and livestock activities.

Farmers need non-agricultural incomes both to increase their social welfare and to increase farm productivity. Income level is one of the main socio-economic factors affecting farmers' perceptions of climate change (Cevher, 2019). Therefore, it is emphasized that it is important to include income level in studies when designing strategies to adapt to climate change and reduce adaptation vulnerability (Radolf et al., 2022). In this context, the variable of non-agricultural income has been discussed in our study and it is seen that this variable has a positive effect on the perception of rangeland-environment. There are some studies reporting that one of the most important factors affecting the farmer's perceptions of climate change and the adaptation of rangelands is annual non-agricultural income (Vo et al., 2021; Radolf et al., 2022).

Most of the farmers engaged in animal husbandry in Turkey are small-scale enterprises (Aşkan and Dağdemir, 2015). Small-scale holdings constitute the farmer group that will be most affected by climate change because of their low adaptation capacity (Gökgöz and Kayahan, 2021). Therefore, the effects of small-scale farmers' socio-economic factors on climate change need to be accurately defined. Since most of the livestock enterprises in Türkiye are small-scale enterprises and the roughage supply area of a large part of these enterprises is rangelands, the perception of rangeland-farmer needs to be increased. One of the other important findings of our study is that these enterprises have insufficient information about animal production and rangeland areas. For this reason, it is necessary to

educating and support more farmers on the subject of rangeland-environment, especially those who have a small number of animals and keep domestic animals.

Although the concept of rural and urban may differ, the farmers in this area are complementary to each other. It is known that the place of residence has an impact on environmental awareness, and that there is an important relationship between the place of residence and the interest in the environment (Karimi et al., 2018). According to Freudenburg (1991), people living in urban areas are more environmentally conscious than people living in rural areas. However, environmental awareness should be evaluated from a city or rural perspective rather than local, national and international conditions (Blake, 2001). Rangeland areas can be protected or improved with modern rangeland improvement methods (restorative agricultural practices, etc.) by encouraging the right rural policies and the organization of producers (associations, unions, etc.) in order to ensure the sustainability of rural traditions.

3.2. The effects of rangelands and climate change on farmers' preferences in terms of livestock

It requires the determination of farmers' perceptions of the impact of climate change on rangeland lands and the changes that these perceptions may cause on animal production. Because a significant part of the roughage need for animal production in Turkey is provided from rangeland areas (Meşe et al., 2019). For this reason, in Table 3, the impact of climate change on rangelands and the effects on farmers whose livelihoods depend entirely on animal husbandry are examined in detail. Approximately 18.50% of the farmers stated that climate change has a negative impact (reduction in the amount of forage) on their rangelands. However, this rate varies according to the livestock type.

In this study, almost all of the farmers engaged in ovine livestock and 18.80% of farmers engaged in cattle breeding reported that climate change has an effect on rangeland areas. When studies on this subject are evaluated, farmers have reported that grazing patterns in rangelands have changed in the last two decades (Sejian et al., 2015). Climate change is putting more pressure on livestock types that depend on rangeland ecosystems globally (Holechek et al., 2020). In our study, it can be said that the inclusion of farmers in this group in training and extension studies will have a positive effect on sustainable rangeland use since the perception of the rangeland environment of non-animal farmers is very low. Due to the negative impact of climate change on rangelands, the number of animals in the farm has decreased. This decrease was determined as approximately 90.90% in sheep and goat

farming and 13.30% in cattle livestock type. In the light of these remarkable results, it can be stated that further support of rangeland-based livestock farmers will contribute to the reduction of grazing pressure on rangeland areas and increase the number of animals.

The livestock sector in Turkey is an important production area because it reduces the unemployment rate by creating job opportunities in rural areas and preventing migration from rural areas to cities. In our study, the decrease in the amount of forage in rangeland areas due to climate change has caused remarkable changes in the behavior of livestock farmers. They stated that 37.70% of the farmers will abandon animal husbandry and continue to live in the countryside, 26.60% of the farmers cannot yet decide what to do after leaving animal husbandry, and 35.70% of the farmers will migrate from rural areas to the city center after leaving animal husbandry. Farmers who engage in rangeland-based animal husbandry need to be supported more by the state in order to prevent their migration from rural areas to the city center. Additionally, there is a need to develop agricultural policies to diversify the income sources of rural households. If these situations occur, we can say that it will contribute to sustainable animal husbandry in rural areas and the prevention of rural migration. Ermetin and Abacı (2022) stated in their study that dairy farming should be supported in order to increase the income level of dairy farmers, reduce unemployment and prevent migration from rural areas. Some researchers have stated that climate change affects farmers' limited livelihoods, such as livestock, both directly and indirectly, and therefore affects the migration decision of farmers (Sagynbekova, 2017; Zhou et al., 2020; Mounirou, 2022). Although economic migration has been the most intense migration flow between urban and rural settlements to date, they have stated that climate change has recently become a determining factor for migration in many parts of the world (Dehcheshmeh and Ghaedi, 2020). If the amount of roughage in the rangelands decrease as a result of climate change, the farmers engaged in rangeland-based livestock will be adversely affected. These negative effects will cause the abandonment of livestock and a decrease in the number of animals. Tadesse and Dereje (2018) and Radolf et al. (2022) stated in their study that farmers' livelihoods are becoming increasingly difficult due to environmental changes. Therefore, it has been concluded that more support should be given to farmers (especially small farmers) engaged in rangeland-based livestock production in order to prevent the decrease in animal production. Our study results show that climate change does not have one size fits all business. For this reason, we can say that the development of the policies to be developed according to the farm size will contribute more to the reduction of the effects of climate change. Therefore, climate change plans and support programs must be tailored to individual

farm needs. Studying individual differences will be important to help tailor policies on climate change and rangelands to local needs. It was emphasized that it is necessary to include socio-economic factors when designing strategies for adaptation to climate change and reducing vulnerability of small farmers (Chingala et al., 2017). It has also been reported that the implementation of good rangeland management will contribute to increasing farm income, mitigating climate change and improving farmers' livelihoods (Mekuriaw et al., 2019). Adapting to climate change is possible by understanding social-ecological systems and adapting these systems to the known vulnerabilities of agricultural holdings. This requires the development of policies and management to increase the capacity of farms against possible environmental impacts. A potentially effective and important way to support the resilience of farmers, rangelands and livestock production to climate change would be to build trusting relationships between public and agricultural support organizations.

Table 3. Impacts of climate change on rangeland and livestock production (n=271).

Farmer Attribute	Category	Frequency	Percentage (%)
Livestock type* (n=271)	No livestock farming	117	43.20
	Cattle	125	46.10
	Sheep and goats	24	8,90
	Mixed livestock	5	1.80
Household head's perception of climate change in rangelands (n=271)	There was a change	50	18.40
	There was no change	23	8.50
	No idea	198	73.10
The head of the household's change in the number of animals due to climate change (n=154)**	There was no change	114	74.03
	The number of animals decreases	40	25.97
	The number of animals increased	0	0.00
Decrease in the amount of roughage in the rangeland due to climate change (n=154)[a]	I will continue living in the village	57	37.70
	I'm undecided for now	41	26.60
	I'll quit farming and go to the city	56	35.70
Which type of livestock has been affected the most by climate change? (n=154)	Cattle	14	9.09
	Sheep and goats	25	16.23
	It affected all livestock types	115	74.68
Does decreasing the amount of roughage in rangelands affect the number of animals? (n=154)	The number of animals will decrease	29	18.83
	The number of animals will not decrease	30	19.48
	Range animal husbandry will decrease	18	11.69
	There will be no change	77	50.00

*All farmers who raise cattle and sheep are engaged in rangeland farming; **Number of livestock farmers

In our study, variables such as age, educational status, non-agricultural income, livestock farming and number of animals were identified as the main socio-economic factors affecting farmers' perception of rangeland-climate change. According to these results, it can be said that it is important to include socio-economic factors when designing climate change adaptation and vulnerability reduction strategies for farmers in areas where range improvement works are carried out. Our results will help to promote or adopt awareness of the perception of rangeland and environmental protection practices. Considering together the knowledge and perceptions of rangeland and environment that will affect the behavior

of farmers in these areas, in short, requires a holistic rangeland policy approach in the formation of policies for these areas. Therefore, policy makers can indirectly influence the direction of producers' behavior by setting some basic laws and rules (Debela et al., 2015; Tesfahunegn et al., 2016; Chingala et al., 2017; Amamou et al., 2018).

This study suggests that educational status strongly affects and increases farmers' perceptions of rangeland perception and climate change. A higher level of education may lead to greater awareness of rangeland perception, climate change, and animal production, which may increase the likelihood of changes in animal production practices and greater conservation of rangelands. Farmers with a high level of education are aware of the impact of climate change on rangelands, which is parallel to their ability to apply this situation to their lives. This will help protect rangelands and contribute more to animal production, as well as reduce the negative effects of climate change. Tarfa et al. (2019) and Ayal and Filho (2017) emphasized the importance of taking into account the socioeconomic characteristics of farmers and improving institutions in increasing governments' perception of rangeland-environment.

Income (non-agricultural) significantly changes farmers' perception levels of rangeland and climate change and its impact on agriculture (Cevher, 2019). We can say that on average, approximately half (41.32%) of the annual income of farm households in our study is obtained from non-agricultural sources, and therefore income dependency is related to external conditions affecting non-agricultural income-generating activities or employment, and ultimately this situation directs the perception of rangeland and climate change. Non-farm income will also increase input purchasing opportunities on the farm and therefore contribute to reducing income losses and increasing animal production income. This will also contribute to reducing the negative effects on farm income. For this reason, governments need to provide incentives to farmers to provide income in non-agricultural areas and to create income-generating investment opportunities.

The information in this study is critical for policy makers in defining strategies for an effective conservation policy of rangeland and the environment. Also similar to this work in the future; It is important to carry out studies on a larger scale in other basins, both for the formation of more accurate and producer-oriented regional policies, and for the evaluation of regional differences in terms of agricultural production. For this reason, it is very important to carry out studies to determine the impact on the basis of climate change on a regional or national scale, in terms of adaptation studies to be carried out in the name of a solution.

Governments should provide adequate training, communication and support to farmers, taking into account the results of this research. However, public and private farmer organizations should regularly organize training programs and raise awareness for farmers. Farmers should be educated not only on climate change, but also on what to do to minimize the effects of climate change. The most important results of this study are that it is necessary to raise awareness about the impact of climate change on the rangeland in order to adopt or improve climate change strategies, to eliminate the farmer's living standard and poverty.

Livestock farming contributes greatly to the income sources and social lives of rural farmers in Turkey. Therefore, developing policies to eliminate the negative effects of climate change on rangelands will increase the sustainability of animal husbandry. 35.70% of the farmers who will be negatively affected stated that they will abandon current livestock farming and migrate to city centers. This negative impact will cause livestock farming in rural areas and therefore in Turkey to remain inadequate, as well as a decrease in farmers in rural areas and a decrease in animal food supply. Although the studies that deal with the environment, rangeland and agricultural activities together are limited in Turkey, the number of studies that deal with and evaluate the issue from the perspective of farmers is very few. There are no studies examining farmers' perceptions of environmental rangeland. This study is important in terms of revealing the farmers' perception of rangeland-environment and its relationship with the socioeconomic structure of the farmer. The results of the research are quite remarkable in terms of contributing to scientists working on climate, ministries making policy in rangeland areas, public institutions operating on climate change, private sector organizations operating in the agricultural sector and rangeland management associations. The results obtained in our study contain important data on rangeland improvement work, the importance of rangeland, reducing the negative effects on rangeland areas and the effect of rangelands on farm income. However, these results obtained at the local level will help to create changes in agricultural policy (for rangelands) practices and make range policies more consistent and stable.

4. Conclusions

In developing countries such as Turkey, rangelands are important in terms of economic growth, food supply, and farmer residence in rural areas. In the study area, the relationship between the farmers' socio-economic structure and rangeland-environment perception was tried to be determined and the findings were evaluated. The main variables that significantly affect farmers' rangeland-environment perception are age, education level, non-agricultural

income, and number of animals. A statistically significant relationship was found between these variables and rangeland-environment perception. It has been concluded that farmers do not have sufficient information about the importance of rangelands and the negative impact of climate change on rangelands, according to their socio-economic characteristics. The fact that farmers largely (78.2%) see rangeland areas as sources of nutrition for animals and do not have sufficient awareness of other features of rangelands has had a negative impact on the protection and sustainability of these areas. Considering that the majority of farmers are primary and secondary school graduates (80.81%), basic training programs and agricultural extension studies on the importance of rangeland-environment relationship and sustainability of rangelands need to be carried out at the farmer level. Rangeland-climate change education policies developed by taking into account farmers' knowledge and perceptions will contribute to the effective protection and sustainability of rangelands against the effects of climate change. At the same time, awareness can be strengthened by making public service announcements and making print/visual media more effective on this issue. Therefore, an effective and important way to increase the resilience of rangelands and animal production against climate change will be to establish reliable relations between public institutions and agricultural support organizations.

References

Adeola, R.G., & Adetunbi, S.I. (2015). Farmers' perception of sustainable agriculture in SouthWestern Nigeria: implications for rural economy. *International Journal of Applied Agriculture and Apiculture Research*, 11(1-2), 86-92.

Adusumilli, N., & Wang, H. (2018). Analysis of soil management and water conservation practices adoption among crop and pasture farmers in humid-south of the United States. *International Soil and Water Conservation Research*, 6(2), 79–86. https://doi.org/10.1016/j.iswcr.2017.12.005.

Al-Amin, A.Q., Masud, M.M., Sarkar, M.S.S., Filho, W.L., & Doberstein, B. (2020). Analysing the socioeconomic and motivational factors affecting the willingness to pay for climate change adaptation in Malaysia. *International Journal of Disaster Risk Reduction,* 50, 101708. https://doi.org/10.1016/j.ijdrr.2020.101708.

Amamou, H., Sassi, M.B., Aouadi, H., Khemiri, H., Mahouachi, M., Beckers, Y., & Hammami, H. (2018). Climate change-related risks and adaptation strategies as perceived in dairy cattle farming systems in Tunisia. *Climate Risk Management,* 20, 38–49. https://doi.org/10.1016/j.crm.2018.03.004.

Anonymous (2024). Republic of Türkiye Ministry of Agriculture and Forestry General Directorate of Plant Production. Available at: https://www.tarimorman.gov.tr/(Accessed: 17 April 2024).

Aşkan, E., & Dağdemir, V. (2015). Analysis of the Factors Affecting the Production Rates of Dairy Livestock Facilities Benefitting from Governmental Financial Supports and Incentives: The Sample of Erzurum, Erzincan, Bayburt Provinces. *Turkish Journal of Agricultural Economics*, 21(2), 69-76.

Ayal, D.Y., & Filho, W.L. (2017). Farmers' perceptions of climate variability and its adverse impacts on crop and livestock production in Ethiopia. *Journal of Arid Environments*, 140, 20-28.

Blake, D.E. (2001). Contextual Effects on Environmental Attitudes and Behavior. *Environment & Behavior*, 33(5), 708–725. doi:10.1177/00139160121973205.

Bohensky, E.L., Kirono, D.G.C., Butler, J.R.A., Rochester, W., Habibi, P., Handayani, T., & Yanuartati, Y. (2016). Climate knowledge cultures: stakeholder perspectives on change and adaptation in Nusa Tenggara Barat, Indonesia. *Climate Risk Management*, 12, 17–31. doi:10.1016/j.crm.2015.11.004.

Bryceson, D.F. (2002). The scramble in Africa: reorienting rural livelihoods. *World Development,* 30, 725–739. doi: 10.1016/S0305-750X(02)00006-2.

Cevher, C. (2019). Determination of the Main Socio-economic Factors of the Sustainable Production of Forage Crops: Research of Kayseri Province. *Journal of Agricultural Sciences,* 25(4), 474–480.

Cevher, C., & Altunkaynak, B. (2020). Socioeconomic Factors and Sustainable Forage Crops Production in Turkey Aegean Region: A Multivariate Modeling. *Sustainability*, 12(19), 8061. https://doi.org/10.3390/su12198061.

Chingala, G., Mapiye, C., Raffrenato, E., Hoffman, L., & Dzama, K. (2017). Determinants of smallholder farmers' perceptions of impact of climate change on beef production in Malawi. *Climatic Change*, 142, 129–141. https://doi.org/10.1007/s10584-017-1924-1.

Debela, N., Mohammed, C., Bridle, K., Corkrey, R., & McNeil, D. (2015). Perception of climate change and its impact by smallholders in pastoral/agropastoral systems of Borana, South Ethiopia. *Springer Plus*, 4, 236. https://doi.org/10.1186/s40064-015-1012-9.

Dehcheshmeh, M.M., & Ghaedi, S. (2020). Climate Change and Ecological Migration: A Study of Villages in the Province of Khuzestan, Iran. *Environmental Research, Engineering and Management*, 76, 6-19.

Diogo, R.V.C., Dossa, L.H., Vanvanhossou, S.F.U., Abdoulaye, B.D., Dosseh, K.H., Houinato, M., Schlecht, E., & Buerkert, A. (2021). Farmers' and Herders' Perceptions on Rangeland Management in Two Agroecological Zones of Benin. *Land,* 10, 425. https://doi.org/10.3390/land10040425.

Ermetin, O., & Abacı, N.İ. (2022). Current Situation of Dairy Cattle Activity in Yozgat Province and Future Expectations of Producers. *Gaziosmanpasa Journal of Scientific Research*, 11(1), 14-26.

Evans LS, Hicks CC, Adger WN, Barnett J, Perry AL, Fidelman P, et al. (2016) Structural and Psycho-Social Limits to Climate Change Adaptation in the Great Barrier Reef Region. PLoS ONE 11(3): e0150575. https://doi.org/10.1371/journal.pone.0150575.

Tobin, R. (2016). Structural and Psycho-Social Limits to Climate Change Adaptation in the Great Barrier Reef Region. *PLoS ONE* 11(3), e0150575. https://doi.org/10.1371/journal.pone.0150575.

Fahad, S., Tahira, I., Jianling, W., Li, D., Guangyin, H., Sufyanullah, K., & Aaqil, K. (2020). Farmers' awareness level and their perceptions of climate change: A case of Khyber Pakhtunkhwa province. Pakistan. *Land Use Policy*, 96, 104669. https://doi.org/10.1016/j.landusepol.2020.104669 (2020).

Freudenburg, W.H. (1991). Rural-Urban Differences in Environmental Concern: A Closer Look. *Sociological Inquiry*, 61(2), 139–279. https://doi.org/10.1111/j.1475-682X.1991.tb00274.x.

Gökgöz, H., & Kayahan, C. (2021). Risk perception and behavior ın livestock sector: Case in the city of Afyonkarahisar. *Research of Financial Economic and Social Studies*, 6(2), 279–295.

Holechek, J.L., Geli, H.M.E., Cibils, A.F., & Sawalhah, M.N. (2020). Climate Change, Rangelands, and Sustainability of Ranching in the Western United States. *Sustainability,* 12(12), 4942. https://doi.org/10.3390/su12124942.

Karimi, V., Karami, E., & Keshavarz, M. (2018). Vulnerability and adaptation of livestock producers to climate variability and change. *Rangeland Ecology & Management,* 71(2), 175–184. https://doi.org/10.1016/j.rama.2017.09.006.

Koç, G., & Uzmay, A. (2021). Determinants of dairy farmers' likelihood of climate change adaptation in the Thrace Region of Turkey. *Environment, Development and Sustainability*, 24, 9907–9928 https://doi.org/10.1007/s10668-021-01850-x.

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239–260.

Maddison, D. (2006). The perception of and adaptation to climate change in Africa. CEEPA Discussion Paper No. 10, Centre for Environmental Economics and Policy in Africa, University of Pretoria.

Mango, N., Makate, C., Tamene, L., Mponela, P., & Gift-Ndengu, G. (2017). Awareness and adoption of land, soil and water conservation practices in the Chinyanja Triangle, Southern Africa. *International Soil and Water Conservation Research*, 5(2), 122–129. https://doi.org/10.1016/j.iswcr.2017.04.003.

Mekuriaw, S., Mengistu, A., & Tegegne, F. (2019). Livestock Technologies and Grazing Land Management Options for Climate Change Adaption and Mitigation as a Contribution for Food Security in Ethiopia: A Brief Overview. In: Castro, P., Azul, A., Leal Filho, W., Azeiteiro, U. (eds) Climate Change-Resilient Agriculture and Agroforestry. Climate Change Management. *Springer, Cham*. https://doi.org/10.1007/978-3-319-75004-0_22

Mensah, M., Villamor, G.B., Fosu-Mensah, B.Y., & Vlek, P.L.G. (2021). Exploring the Gender-Specific Adaptive Responses to Climate Variability: Application of Grazing Game in the Semi-Arid Region of Ghana. *Agriculture,* 11(11), 1048. https://doi.org/10.3390/agriculture 11111048.

Meşe, A., Gülümser, E., & Mut, M. (2019). Current Status of Forage Crops in Bilecik Province. *BSEU Journal of Science*, 6(2), 336–343. https://doi:10.35193/bseufbd.619342.

Mounirou, I. (2022). Do climatic factors induce rural migration? Empirical evidence from cotton farmers in Benin. *Natural Resources Forum, a United Nations Sustainable Development Journal,* 46(4), 393-409.

Nguyen, T.P.L., Seddaiu, G., & Roggero, P.P. (2019). Declarative or procedural knowledge? Knowledge for enhancing farmers' mitigation and adaptation behavior to climate change. *Journal of Rural Studies*, 67, 46–56. https://doi.org/10.1016/j.jrurstud.2019.02.005.

Öner, N., Erşahin, S., Ayan, S., & Özel, H.B. (2016). Rehabilitation of Semi-Arid Areas in Central Anatolia. *Anatolian Journal of Forest Research*, 2(1-2), 32–44.

Özdemir, B., Özdamar, A., Kıymaz, S., & Akıllı, A. (2022). *Turkish Journal of Agriculture -Food Science and Technology*, 10(9): 1732-1740.

Radolf, M., Wurzinger, M., & Gutiérrez, G. (2022). Livelihood and production strategies of livestock keepers and their perceptions on climate change in the Central Peruvian Andes. *Small Ruminant Research,* 215, 106763. https://doi.org/10.1016/j.smallrumres.2022. 106763.

Reidsma, P., Ewert, F., & Oude-Lansink, A. (2007). Analysis of farm performance in Europe under different climatic and management conditions to improve understanding of adaptive capacity. *Climatic Change, 84, 403–422*. https://doi.org/10.1007/s10584-007-9242-7.

Sagynbekova, L. (2017). Environment, Rural Livelihoods, and Labor Migration: A Case Study in Central Kyrgyzstan. *Mountain Research and Development,* 37(4), 456-463. https://doi.org/10.1659/MRD-JOURNAL-D-17-00029.1

Schulze, M., Spiller, A., & Risius, A. (2021). Do consumers prefer pasture-raised dual-purpose cattle when considering meat products? A hypothetical discrete choice experiment for the case of minced beef. *Meat Science*, 177, 108494. https://doi.org/10.1016/j.meatsci.2021. 108494.

Sejian, V., Bhatta, R., Soren, N.M., Malik, P.K., Ravindra, J.P., Prasad, C.S., & Lal, R. (2015). Introduction to Concepts of Climate Change Impact on Livestock and Its Adaptation and Mitigation. Climate Change Impact on Livestock: *Adaptation and Mitigation*, 1–23. https://doi.org/10.1007/978-81-322-2265-1_1.

Sharifian, A., Fernandez-Llamazares, A., Wario, H.T., Molnar, Z., & Cabeza, M. (2022). Dynamics of pastoral traditional ecological knowledge: A global state-of-the-art review. *Ecology and Society*, 27(1), 14. https://doi.org/10.5751/ES-12918-270114.

Sherren, K., & Darnhofer, I. (2018). Precondition for Integration: In Support of Stand-alone Social Science in Rangeland and Silvopastoral Research. *Rangeland Ecology & Management,* 71(5), 545–548. https://doi.org/10.1016/j.rama.2017.08.003.

Solomon, T.B., Snyman, H.A., & Smit, G.N. (2007). Cattle-rangeland management practices and perceptions of pastoralists towards rangeland degradation in the Borana zone of Southern Ethiopia. *Journal of Environmental Management,* 82, 481–494.

Tadesse, G., & Dereje, M. (2018). Impact of Climate Change on Smallholder Dairy Production and Coping Mechanism in Sub-Saharan Africa-Review. *Advances in Life Science and Technology,* 65, 41–54.

Tarfa, P.Y., Ayuba, H.K., Onyeneke, R.U., Idris, N., Nwajiuba, C.A., & Igberi, C.O. (2019). Climate change perception and adaptation in Nigeria's guinea Savanna: empirical evidence from farmers in Nasarawa State, Nigeria. *Applied Ecology and Environmental Research,* 17(3), 7085-7112.

Tesfahunegn, G.B., Mekonen, K., & Tekle, A. (2016). Farmers' perception on causes, indicators and determinants of climate change in northern Ethiopia: Implication for developing adaptation strategies. *Applied Geography,* 73, 1-12. https://doi.org/10.1016/j.apgeog.2016.05.009.

TSMS (Turkish State Meteorological Service). (2024). https://www.mgm.gov.tr/eng/forecast-cities.aspx/ (Accessed: 17 April 2024).

Vo, H.H., Mizunoya, T., & Nguyen, C.D. (2021). Determinants of farmers' adaptation decisions to climate change in the central coastal region of Vietnam. *Asia-Pacific Journal of Regional Science,* 5, 327–349. https://doi.org/10.1007/s41685-020-00181-5.

Xie, S., Ding, W., Ye, W., & Deng, Z. (2022). Agro-pastoralists' perception of climate change and adaptation in the Qilian Mountains of northwest *China. Scientific Reports,* 12, 12689 (2022). https://doi.org/10.1038/s41598-022-17040-2

Yamane, T. (1967). Elemantary Sampling Theory, Printice Hall Inc, Englewood Cliffs, N.T.

Zhou, H., Yan, J., Lei, K., Wu, Y., & Sun, L. (2020). Labor migration and the decoupling of the crop-livestock system in a rural mountainous area: Evidence from Chongqing, China. *Land Use Policy,* 99, 105088, https://doi.org/10.1016/j.landusepol.2020.105088.

Zimmer, S.N., Schupp, E.W., Boettinger, J.L., Reeves, M.C., & Thacher, E.T. (2021). Considering Spatiotemporal Forage Variability in Rangeland Inventory and Monitoring. *Rangeland Ecology & Management,* 79, 53–63. https://doi.org/10.1016/j.rama.2021. 07.008.