Research article

Farmers' Perceptions on Soil Degradation and their Criteria to Adopt Soil and Water Conservation Strategies in Ovche Pole Region in North Macedonia

OGNEN ONCHEVSKI
Graduate School of Agriculture, Tokyo University of Agriculture, Japan
E-mail: ognenoncevski@hotmail.com

MACHITO MIHARA*
Faculty of Regional Environmental Science, Tokyo University of Agriculture, Japan
E-mail: m-mihara@nodai.ac.jp

Received 22 January 2020 Accepted 11 September 2020 (*Corresponding Author)

Abstract Ovche Pole is a region in Macedonia where the main economic activity of people is agriculture. Moderate-continental-sub-Mediterranean climatic conditions are prevalent in the area. However, based on the data for average annual precipitations (P) and potential evapotranspiration (PET), the region has aridity index of 0.64, thus it is classified as dry sub-humid and vulnerable to desertification. The region is dominated by agriculture land which takes 62% of total area, followed by forests and pastures that takes 22.55% and 14% respectively. Vertisols are the dominant soil type, taking 51.24% of total area in the region. Climatic conditions, together with the unsustainable agricultural practices highly influence the process of land degradation, especially soil degradation in the region. The key for success of any land restoration activity is the involvement of local communities. Understanding the farmers' perceptions on this issue is crucial for development and implementation of sustainable resource management strategies. Therefore, the objectives of this study are to: (i) assess farmers' perceptions on different types of soil degradation and (ii) examine farmers' perception and motivation for adopting new SWC practices. A semi-structured questionnaire was developed and distributed to farmers to gather primary data. Out of total population of 375 registered farmers, following convenience sampling method, 102 farmers took a part in the questionnaire survey. Secondary data on climate/weather, land use, soils, demography was obtained from published or unpublished sources. The results of the study show that farmers could observe different soil degradation process on their land. Most of the farmers perceived decline in soil moisture retention as most intense and most significant problem. For majority of interviewed farmers, the main criteria to adopt SWC are the increased financial benefits and gains from the new measure and financial incentives provided by government institutions.

Keywords farmers' perceptions, questionnaire survey, soil degradation, soil and water conservation

INTRODUCTION

The Land Degradation Assessment in Drylands (LADA) project (2011) reported that "Soil degradation occurs as a result of adverse changes in the soil biological, chemical, physical and/or hydrological properties. Such changes can increase the vulnerability of the soil to further degradation". Although, soil degradation is influenced by local environmental conditions such as climate, topography, soil type etc., farmers with their land management practices can exacerbate degradation processes too. Therefore, adoption of SWC measure is required to prevent or revers degradation of natural resources. However, achieving success in SWC programs is difficult because many constrains play a role. Deciding to adopt SWC measures is complicated process influenced by many factors such as the agro- ecological conditions, socioeconomic and cultural characteristics of the farmers' population (Calatrava et al., 2011; Pulido and Bocco, 2014). Decision to adopt SWC measures driven

by intrinsic factors can promote long lasting behavioral change, while decisions made only because of extrinsic motivation factors, such as financial incentives provide less stable changes. Understanding the motivation factors that influence farmers to implement new SWC will help policymakers to design more effective SWC strategies and manage conservation programs more successfully. Top-down oriented projects in general are not so successful; Development organizations focus more on participatory methods emphasizing the importance of beneficiaries' commitment and engagement in activities (Kessler, 2006).

OBJECTIVE

The objectives of this research are (i) to assess farmers' perceptions of different types of soil degradation and (ii) to examine farmers' perception and motivation for adopting new SWC practices.

METHODOLOGY

Study Area Description

The region of Ovche Pole is a plain located in the east central part of Macedonia and takes an area of 649 km^2 (Fig. 1). Administratively, the region is divided into two municipal units, Sveti Nikole and Lozovo. According the last census municipalities together had population of 21.355 people (State Statistical Office, 2002). Highest point is on 856 m above sea level, however the average elevation of the region is between 200 and 400 meters. Three characteristically different landscape types can be distinguished in the region. Agricultural flatland landscape on saline ground takes the flat areas up to elevation of 350 m. specific for this area is the presence of halomorphic soils. Lowland rolling agricultural landscape, which are the areas found up to elevation of 500 m.a.s.l. represented by hills with mild slopes. The third specific landscape type is the lowland rolling agricultural landscape with wind hedges. Specific for this area is the presence of man-made corridors of trees and shrubs that protect the agriculture land from the prevailing winds (Melovski et al., 2015).

Fig. 1 Geographical position of the research area (in red borders of the right picture)

The climate in the region is modified warm continental with Mediterranean influence (Zikov, 1995; Filipovski et al., 1996). Specific for this region is the occurrence of strong winds coming from the north-west, north, south-east direction present most of the time of the year. Analysis of climatic data for the period between 1950 and 2000 showed that the average annual precipitation is 471.1 mm and the average annual evapotranspiration is 734.4 mm, with an aridity index of 0.64. According to the UNCCD this classifies the region as dry sub-humid and vulnerable of desertification (Blinkov et al., 2005; Miladinovc et al., 2006). The region is dominated by vast areas under arable fields and croplands. Although, agriculture land takes 40 183 ha (62 % of the total land), much of the arable land is not irrigated (Fig. 2). Forests cover 14 619 ha (22.5%) of which 2/3 are degraded, whereas 9134.38 ha (14%) are pastures (CORINE LC/LC, 2012). Vertisols are the dominant soil type in the

region, almost entirely distributed in areas where agriculture is intensively practiced. This soil type is distributed on 33 422 ha or 51.24 % of the land (MASIS). Farmers mainly produce grains such as wheat and barley, however there are areas where tobacco, alfalfa, melons, and vegetables are cultivated.

Fig. 2 Agriculture landscape in the research area

Data Collection and Analysis

The study was conducted from 7th of September to 7th of October 2019. Semi-structured questionnaire was developed and distributed to farmers to gather primary data. Using convenience sampling method, 102 farmers took a part in the questionnaire survey, out of a population of 375 registered farmers (MAFWM, 2019). The interviews with the farmers were done at any place they were met, usually in the field, local bars and shops in the villages or in their homes. Part of the questions were designed in a 5-point liker-type scale, ranging from "strongly not agree" to "strongly agree", however some information were gathered through ranking questions. The question statements were put in simple language, however in case when person could not understand some part additional explanation were given to them. The questionnaire was designed to have three sections. The first sections, contained questions related to socioeconomic characteristic of farmers as well as the land management practices. Second section, captured farmers' perceptions on soil degradation. Questions in the third section captured farmers' perceptions on SWC and their drivers of motivation to adopt new SWC measures. Simple descriptive statistics such us frequency distribution and percentage were used to interpret and present data. Secondary data on climate/weather, land use, soils, demography was obtained from published or unpublished sources. The number of registered farmers was provided by The Ministry of Agriculture, Forestry and Water Management (MAFWM). Data on land use/land cover was obtained from the CORINE Land Cover (CLC2012) data set from 2012, program coordinated by European Environmental Agency (EEA). Data from The Macedonian Soil Information System (MASIS) was used to analyze characteristics and distribution of the soil in the research area.

RESULTS AND DISCUSSION

Farmers' Perceptions on Soil Degradation Processes

Questionnaire results showed that 89% of the respondents noticed some negative changes related to soil quality. Table 1 outlines farmers' perceptions on the degree of intensity of soil degradation processes on their land. The farmers could choose one response on an intensity scale with five levels of degree ranging from no presence of soil degradation to extreme intensity of soil degradation. The results showed that water logging and salinization and/or alkalinisation were not present at all for

91% and 82% of the farmers, respectively. However, majority of farmers reported some degree of degradation, for the other investigated soil degradation processes. Decline of soil moisture retention was perceived as most insensitively present problem; 77% of the farmers reported strong and 6% extreme degree of this type of soil degradation. For loss of fertility and loss of soil structure, majority of the respondents' answers ranged between light, moderate and strong. Regarding, loss of topsoil and erosion 46% of the farmers reported light intensity, 31% reported no presence and 20% moderate intensity. However, for loss of life and biodiversity the results showed two tendencies in the response. A group of 39% of respondents that did not notice this problem and a group of 32% reports strong intensity of loss of soil life and biodiversity.

Regarding the perception for the time of beginning of these issues, 12% of respondents answered that the soil degradation issues started in the past 5 years, 35% said in the past 10 years, 25% in the past 15 years, 15% said in the past 20 years and 13% told they don't know. In addition, 69% of farmers said that now they use more fertilizers compared to the past 10 years. Farmers were asked to rank the soil degradation processes by the degree of significance for their farming activities. The results from the data analysis are visually presented in Fig. 3. The sample group gave consistent answers when ranked the 1st and 2nd most significant soil degradation issues. Decline in soil moisture retention capacity was ranked as the most significant problem by 89% of the respondents. The loss of soil fertility was ranked 2nd most significant issue by 75% of farmers. Loss of soil structure and loss of topsoil and erosion were ranked 3rd and 4th most significant issues, respectively. Loss of life and soil biodiversity was ranked 5th most significant issue. These results can be explained if we have in mind the climatic conditions and properties of Vertisols-the dominant soil type in the region.

Table 1 Farmers' perception on soil degradation intensity degree

Type of degradation	Intensity of soil degradation process				
	Not present	Light	Moderate	Strong	Extreme
Loss of topsoil and erosion.	31%	46%	20%	3%	0%
Loss of soil fertility	3%	17%	44%	34%	2%
Loss of soil structure	4%	24%	48%	24%	1%
Water logging of soil	91%	7%	1%	1%	0%
Loss of life and soil biodiversity	39%	14%	9%	32%	6%
Salinization and/or alkalinisation	82%	16%	2%	0%	0%
Decline in soil moisture retention	4%	4%	2%	77%	13%

Own Source: Data provided by questionnaire survey, 2019

The World Soil Resource Report (2015) notes that "the physical properties and the soil moisture regime of Vertisols represent serious management constraints. The heavy soil texture and domination of expanding clay minerals result in a narrow soil moisture range between moisture stress and water excess" (IUSS Working Group WRB, 2015). According to Alvaro-Fuentes et al. (2008) "Soil organic matter (SOM) is a key factor in semiarid agrosystem production" (Álvaro-Fuentes et al., 2008). In their study on effects of soil organic matter on soil productivity, Bauer and Black (1994) concluded that loss of fertility explained loss of productivity due to a depletion of soil organic matter.

Soil and Water Conservation Practices among Farmers

The results from the questionnaire showed that 77% of the farmers practice some measure for SWC conservation and 23% did not. Fig. 4 shows information on the different SWC practices implemented by farmers. Farmers practice only traditional conservation measure such as manuring, crop rotation and fallow. Except drip irrigation which is integrated by 5% of respondents, no other new technologies or practices are implemented. The involvement of government institutions or other

organization to support and encourage farmers in implementation of SWC is absent. The results of the survey showed that 96% of farmers are not familiar with government programs aimed to support SWC. In addition, 98% of farmers have never been contacted by any institution or organization on SWC and issues related with soil degradation.

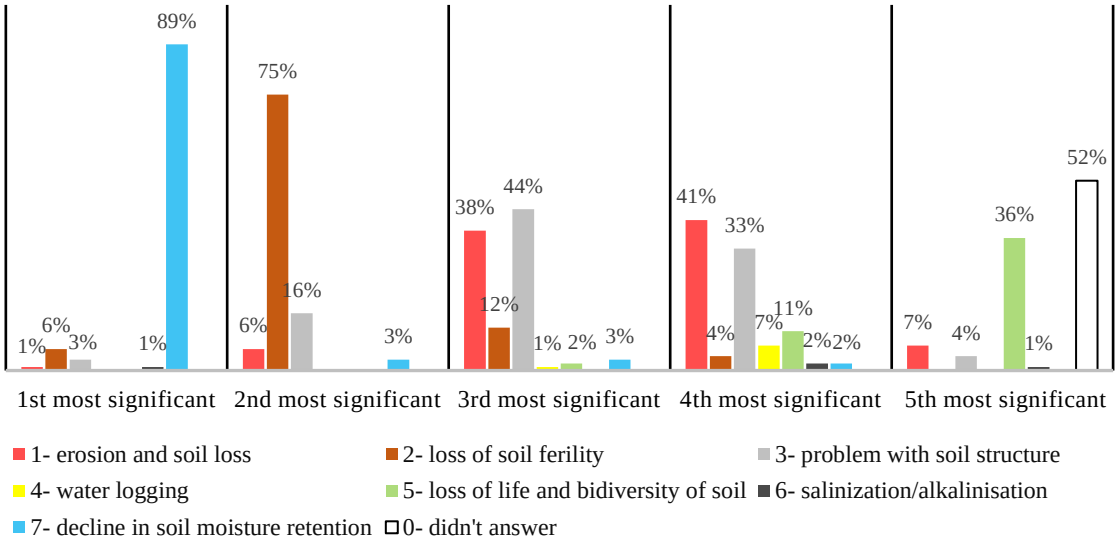

Fig. 3 Ranking of soil degradation issues by significance

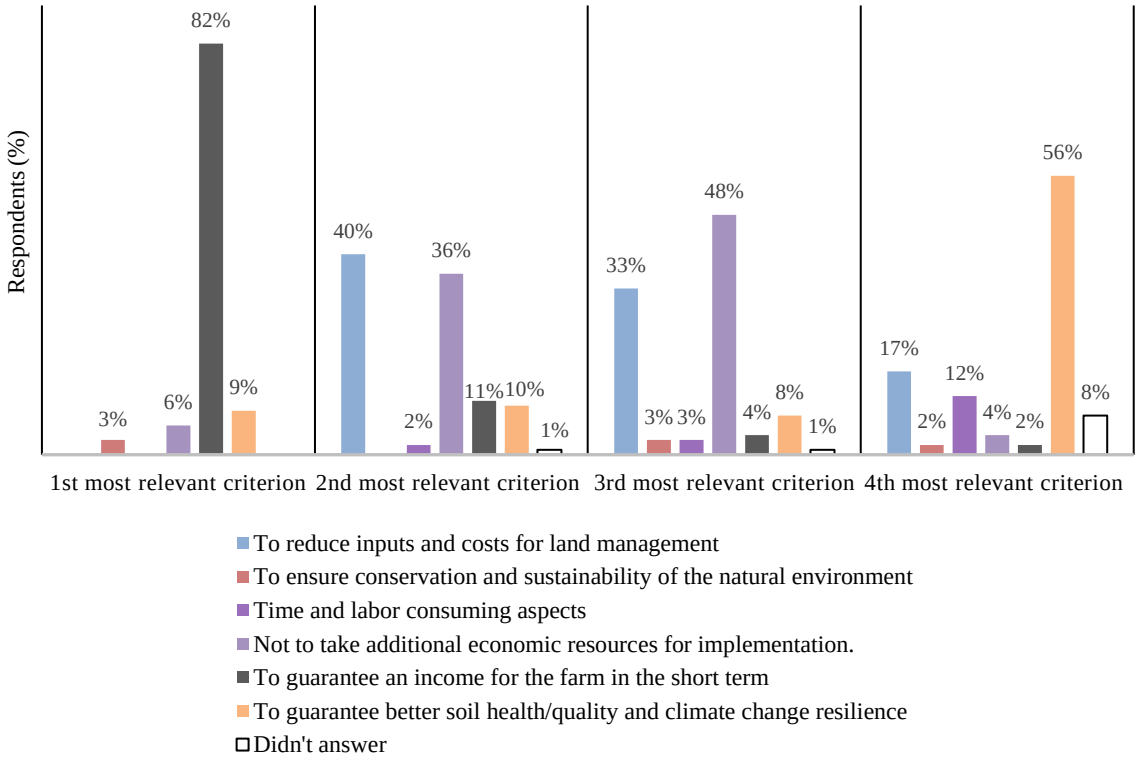

Fig. 4 Distribution of different soil and water conservation practices among farmers

Farmers' Motivation for Adopting New Soil and Water Conservation Practices

On the question if there is an interest in adoption of SWC measures among farmers, 61% answered affirmative, 19% said that there is no interest and 20% did not know how to answer. Perception of existing a future risk can be a driver for behavioral change, in this case adoption of SWC measure.

Therefore, farmers were asked if they believe that soil degradation issues would increase, stay same or decrease in future. Out of all, 95% answered that the soil degradation processes will increase in future and only 3% and 2% believed that issues will stay same and decrease, respectively. In this study respondents were asked to rank relevant criteria expected when adopting new SWC measure. The results presented in Fig. 5 show that the three most relevant criteria are related to the economic benefits of the farmers. Better soil quality and climate change resilience is on the fourth place of importance.

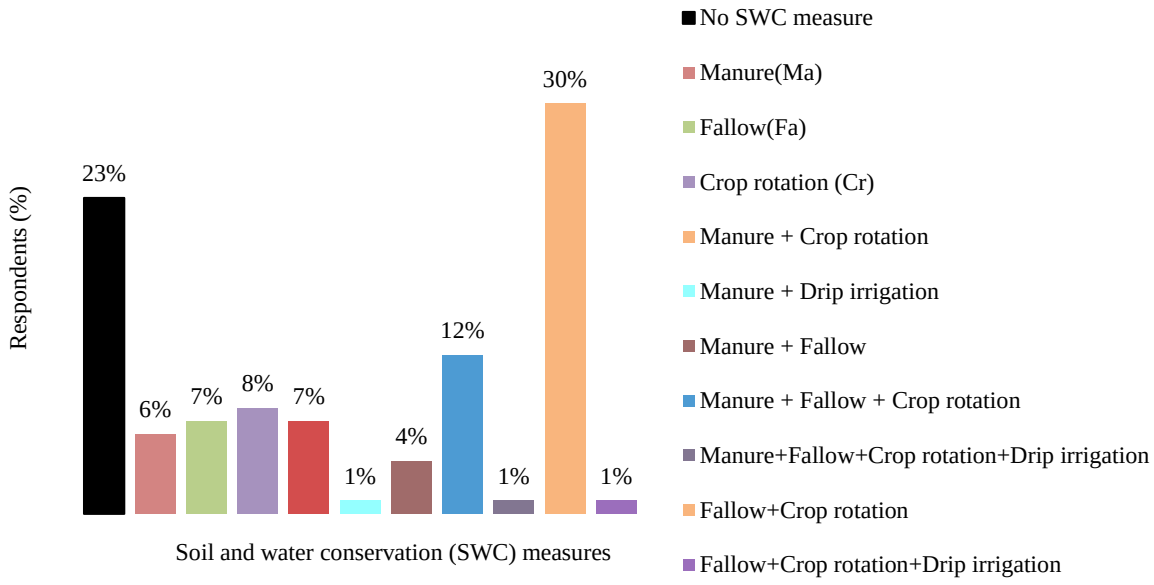

Fig. 5 Farmers' ranking of relevant criteria for adoption of SWC measure

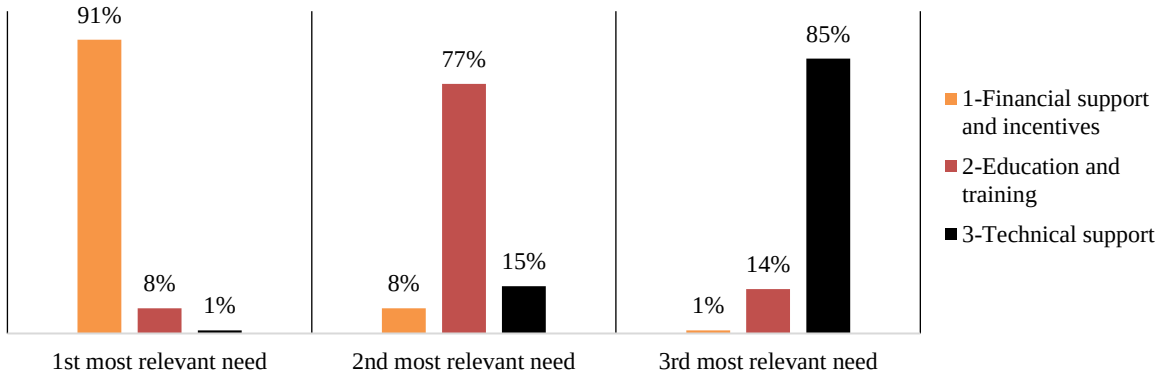

Fig. 6 Ranking of relevant need for adoption of SWC measure

To extract information on what farmers need to adopt new soil and water conservation measure they were asked to rank among: education and training, technical support and financial incentives. Participants in the survey ranked financial support and incentives as most relevant need for adoption of new SWC measure, technical support was ranked 2nd whereas education and training 3th most relevant need for adoption of new SWC measure. The results are presented in Fig. 6 of this manuscript. A study that compared results of independent research projects in five developing countries showed that factors that motivates farmers are always context-specific and generalization is not possible. However, in general profitability and financial benefits are common factors that influence farmers to adopt SWC measures (de Graaff et al, 2008). Other authors had similar conclusion that resource conservation should be accompanied by short-term economic benefits for farmers (Pulido and Bocco, 2014). However Calatrava et al. (2011) in their study on policy measures for agricultural soil conservation in semi-arid Mediterranean areas noted that “stakeholders stated

that the most important and effective measure is to provide technical education and information to farmers to convince them of the benefits of conservation practice."

CONCLUSION

General perception among the participants in the study is that biggest issues come from the decline in soil moisture retention, decline of soil fertility, soil structure and soil erosion. Soil degradation is induced as a result of combination of factors such as climatic conditions in the region and the properties of the dominant soil type, however problems are exaggerated by the land management practices. Although, 76% of the farmers of Ovche Pole region implement one or more SWC measure, most farmers execute only some traditional and very basic land management practices, new SWC practices have been rarely or not adopted at all. Extending of the traditional measures and introduction of new practices is needed, however this would require education, technical and financial support for farmers. Results of this study point out that SWC needs to be followed by short-term financial benefits through improved production and reduced costs, which are primary interest of farmers. Therefore, as a way to promote and encourage conservation agriculture, government must provide direct or indirect subsidies for farmers that implement SWC measures. In addition, institutions should provide financial support and incentives for farmers in the initial phase of implementation so they can overcome the initial investment constrains that they usually face. So far, the engagement of relevant government or non-governmental agencies to support farmers in adoption of new SWC strategies is very low. Therefore, development of capacity of institutions and organizations to conduct SWC programs and support farmers to implement measures on their land is needed. Commitment should be on a long term and project interventions need to have longer project cycle. Establishment of research and demonstration sites where farmers can directly see the benefits of SWC and be trained should be considered as appropriate strategy for long term results. Local solutions and innovations, as well as farmer-to farmer knowledge dissemination should be encouraged.

REFERENCES

Álvaro-Fuentes, J., López, M., Cantero-Martinez, C. and Arrúe, J. 2008. Tillage effects on soil organic carbon fractions in Mediterranean dryland agroecosystems. Soil Science Society of America Journal, 72 (2), 541-547.

Bauer, A. and Black, A. 1994. Quantification of the effect of soil organic matter content on soil productivity. Soil Science Society of America Journal, 58 (1), 185-193.

Blinkov, I., Vasilevski, K. and Miladinovic, M. 2005. An analyze of some particular conditions referred to lend degradation and desertification processes in the Republic of Macedonia (preliminary results), Scientific Conference Youndula 5-8.X 2005, Bulgaria.

Calatrava, J., Barberá, G. and Castillo, V. 2011. Farming practices and policy measures for agricultural soil conservation in semi-arid Mediterranean areas: The case of the Guadalentín basin in southeast Spain. Land Degradation & Development, 22 (1), 58-69.

FAO. 2011. Land degradation assessment in drylands: Manual for local level assessment of land degradation and sustainable land management. Part 1: Planning and methodological approach, analysis and reporting. Food and Agriculture Organization of the United Nations, Rome, Italy, 28.

Filipovski, G., Rizovski, R. and Ristevski, P. 1996. Characteristic of the climate–vegetation–soil zones (regions) in the Republic of Macedonia. Macedonian Academy of Sciences and Arts, Skopje.

Graaff, J. de., Amsalu, A., Bodnár, F., Kessler, A., Posthumus, H. and Tenge, A. 2008. Factors influencing adoption and continued use of long-term soil and water conservation measures in five developing countries. Applied Geography, 28 (4), 271-280.

IUSS Working Group WRB. 2015. World reference base for soil resources 2014, update 2015. International soil classification system for naming soils and creating legends for soil maps. World Soil Resources Reports No. 106. FAO, Rome, 18.

Kessler, C. 2006. Decisive key-factors influencing farm households' soil and water conservation investments. Applied Geography, 26 (1), 40-60.

Melovski, Lj., Jovanovska, D. and Avukatov, V. 2015. Landscape diversity in Bregalnica Watershed. Final report of the project "Ecological Data Gap Analysis and Ecological Sensitivity Map Development for the Bregalnica River Watershed", Book 3, Skopje, 18-21.

Mitkova, T. and Mitrikeski, J. 2005. Soils of the Republic of Macedonia: Present situation and future prospects. European Soil Bureau, 225-234.

Pulido, J. and Bocco, G. 2014. Local perception of land degradation in developing countries: A simplified analytical framework of driving forces, processes, indicators and coping strategies. Living Rev. Landscape Res, 8.

State Statistical Office. 2002. Census of population, households and dwellings in the Republic of Macedonia, 2002 - Book XIII.

Zikov, M. 1995. Climate and climate regionalization in Republic of Macedonia. Geographical consideration, Skopje 30, 13-21.