

UNIVERZA V MARIBORU • FILOZOFSKA FAKULTETA



ODDELEK ZA GEOGRAFIJO

REVIJA ZA GEOGRAFIJO

JOURNAL FOR GEOGRAPHY

11 – 1 2016

MARIBOR
2016

REVIJA ZA GEOGRAFIJO JOURNAL FOR GEOGRAPHY

11-1, 2016

ISSN 1854-665X

UDK 91

Izdajatelj / Published by

Oddelek za geografijo, Filozofska fakulteta, Univerza v Mariboru
Department of Geography, Faculty of Arts, University of Maribor

Mednarodni uredniški odbor / International Editorial Board

Ana Maria de Souza Mallo Bicalho (Brazil), Dragutin Feletar (Croatia), Lisa Harrington (USA), Uroš Horvat (Slovenia), Roy Jones (Australia), Peter Jordan (Austria), Doo-Chul Kim (Japan), Marijan Klemenčič (Slovenia), Karmen Kolnik (Slovenia), Lučka Lorber (Slovenia), Jörg Maier (Germany), Pavel Ptaček (Czech Republic), Igor Žiberna (Slovenia)

Glavni in odgovorni urednik / Chief and Responsible Editor

Igor Žiberna

Oddelek za geografijo

Filozofska fakulteta

Univerza v Mariboru

Koroška cesta 160, SI – 2000 Maribor, Slovenija

e-pošta / e-mail: igor.ziberna@um.si

Tehnični urednik / Technical Editor

Igor Žiberna

Za vsebinsko in jezikovno podobo prispevkov so odgovorni avtorji. Ponatis člankov je mogoč samo z dovoljenjem uredništva in navedbo vira.

The authors are responsible for the content of their articles. No part of this publication may be reproduced without the publisher's prior consent and a full mention of the source.

<http://www.ff.um.si/>

Publikacija je indeksirana v naslednjih bibliografskih bazah / Indexed in:
CGP (Current Geographical Publications), EBSCOhost, IBSS (International Bibliography of the Social Sciences), Ulrich's, DOAJ.

Publikacija je izšla s finančno pomočjo Javne agencije za raziskovalno dejavnost Republike Slovenije

Tisk / Printed by

Tisk Žnidarič. d. o. o.

Naklada / Number of copies 100

KAZALO - CONTENTS

MOHAMMAD AFSAR ALAM

Depleting State of Stratospheric Ozone_A Challenging Conservation for Global Community with special Reference to Eritrea	7
Summary	24

ANDRÁS BALOGH

Villages of Porabje: Individual elements of the Hungarian settlement network	25
Summary	39

ALMA KADUŠIĆ, ALIJA SULJIĆ, NEDIMA SMAJIĆ

The demographic ageing of population in Bosnia and Herzegovina: causes and consequences	41
Summary	52

ALIJA SULJIĆ, ALMA KADUŠIĆ, DŽEVAD MEŠANOVIĆ, SABAHUDIN
SMAJIĆ

Change in the status of internally displaced Bosniaks of the Srebrenica municipality in the Tuzla canton during the period 2005- 2015	53
Summary	64

MARTIN MARIČ

Temperaturni obrat in termalni pas v Slovenskih goricah med Muro in Pesnico	65
Summary	77

TATJANA KIKEC

Primerjava stanja vodne bilance in potreb izbranih kmetijskih kulturnih rastlin po vodi v Pomurju	79
Summary	98

ANA VOVK KORŽE, MANUELA ŠTEFANE

Climate changes in North Africa and the possibilities of adapting to it with ecosystem approaches	101
Summary	117

RANKO MIRIĆ, NUSRET DREŠKOVIĆ, BORIS AVDIĆ

Diversification of Tourism Offer as a Means of Socio-economic Development of Peripheral Regions – Case Study of Kupres	121
Summary	132

Navodila za pripravo člankov v Reviji za geografijo	133
---	-----

DEPLETING STATE OF STRATOSPHERIC OZONE: A CHALLENGING CONSERVATION FOR GLOBAL COMMUNITY WITH SPECIAL REFERENCE TO ERITREA

Mohammad Afsar Alam

PhD., Assistant Professor and Ex-Head

Department of Geography

Adi-Keih College of Arts and Social Science, P.O.Box 59,

Eritrea, N.E. Africa,

e-mail: drmaalam92@gmail.com

UDK: 504.05:916

COBISS: 1.02

Abstract

Depleting State of Stratospheric Ozone: A Challenging Conservation for Global Community with special Reference to Eritrea

Though the basic needs of the humans are prioritized first, health and quality of environment are also equally important. Environmental issues are based on many and different things. One of these is the depleting state of Stratospheric Ozone in the atmosphere. The ozone layer is vital to life on earth because it acts as a filter for UV radiation, which can have severe impacts on human health and the earth's environment. As estimated, every one per cent decrease in the ozone layer results in the increase of ultraviolet light intensity at the earth's surface by two per cent. Known effects of ultraviolet exposure include greater incidence of skin cancer and eye cataracts among humans and diminished crop yields for foods such as peas, beans, and squash and soya beans. Phytoplankton, the tiny one celled Ocean plants that are staple food for squid, fish, seals, and whales also are vulnerable to Ultra violet radiations. Depletion of ozone layer is one of the main issues of the world today. Concerning to these issue two important meetings had been hold i.e. known by the Montreal Protocol and Vienna Convention. Most of the world countries are part of this Montreal Protocol and Vienna Convention. Eritrea is also part of Montreal Protocol and Vienna Convention. In the present paper basically an attempt has been made to show the world's concern in general and the Eritrea's in particular about the conservation measures taken on mitigation of Ozone layer. This research paper also emphasizes on the global problem of Ozone Depleting Substances (ODSs) releasing from different industries and specific sources. Besides, the study further includes the existence of naturally created Ozone hole on the Polar Regions.

Key words

Ozone layer, Depletion, Chlorofluorocarbons (CFCs), Environment

1. Introduction

The term ozone layer describes the zone of the highest concentration of ozone molecules in the stratosphere. The layer, which is 10–20 km thick, envelopes the entire globe like a bubble and acts as a filter for the harmful ultraviolet (UV-B) radiation produced by the sun. The stratosphere is the part of atmosphere above the troposphere. It starts at 15–30 km above ground level and continues up to 40–50 km.

Stratospheric ozone differs from ground-level ozone. Ground-level ozone is created both by natural process of percolating of broken ozone molecules from the stratosphere and also, from industrial and traffic emissions. It is part of photochemical smog, and, as an irritant gas, it may cause human respiratory problems, especially in older people and young children, as well as damages plants. The ozone layer is vital to life on earth because it acts as a filter for UV radiation, which can have severe impacts on human health and the earth's environment.

Stratospheric ozone filters out dangerous ultraviolet radiation by means of a continuous cycle in which oxygen and ozone, break down and reform, absorbing ultraviolet light and releasing less damaging kinds of energy. Without enough ozone, the effectiveness of the filtering capacity of ozone decreases and more ultraviolet radiation reaches the earth. The main destroying causes for the stratospheric ozone are a group of chemicals known as chlorofluorocarbons (CFCs) and halogens, which are produced by humans and released into the atmosphere. These substances are very stable and remain unchanged in the lower layer for as long as a century. During their long lifetime, the CFCs and halogens drift up to the stratosphere where they are exposed to high-intensity ultraviolet radiation and breaks apart. CFCs release highly reactive atoms of chlorine, halogens and bromine atoms. The chlorine and bromine atoms are very reactive in breaking up ozone and tying up oxygen atoms that might form new ozone.

According to the Scientists, a single chlorine atom can destroy up to 100,000 ozone molecules before the chlorine is finally captured by a reaction with hydrogen. One bromine atom can destroy nearly ten times as chlorine atom. Even if production of CFCs and halogens ceased tomorrow, the full destructive effect on the ozone shield would still be felt for years into the future. Even now, releases over the past several decades of the long-lived chemicals are making their way up toward the stratosphere. Other threats to the upper ozone come from chemicals found in certain degreasers, adhesives, dyes, pesticide, aerosols and fungicides.

2. Objectives of the study

The present study has manifold objectives. One of the objectives of this study is to have better knowledge and understanding about the structure of ozone in the atmosphere, phasing out the depleting chemical substances and ozone protection processes. Besides the above objective, the other important objectives of the study are given as follows:

- To provide knowledge and understanding of the structure of ozone molecules and their distribution in the atmosphere.
- To review the processes of how Ozone hole is created, the effects of the ozone depletion on ecology including human beings; and measures of mitigating the problem.

- To assess the role of Eritrea in the mitigation of the Ozone depletion or evaluating Eritrea on the process of Ozone layer protection.
- To identify the role of inspection of the projects that has been used to reduce Ozone depleting substances (ODSs), and finally
- To foresee the future trends of progress.

3. Methodology

The study has been accomplished through both the primary and secondary data which have been collected from various sources. The primary data are collected from government offices of Ministry of Land, Water and Environment; Department of Environment and also from refrigerant workshops. For the acquisition of primary data two methodologies have been employed i.e. discussions and interviews, discussions with the Head office of the Department and interviews with the refrigerator technicians.

The secondary data are collected from published books and unpublished softcopies which are sourced from internet and software. These sources of data include reports and proceedings from the Ministry of Land, Water and Environment (MoLWE). The information are gathered from various respective sources; they are compiled, processed, analyzed, illustrated and presented in figures, charts, graphs and tabular forms. Computation of data is followed by cartographic representation and analytical notes. Apart from these a number of articles published in various National and International journals have also been consulted for the purpose.

4. Background Literature

Eritrea is one of the east African countries located in the horn of Africa. It sprawls between 12° to 18° north and 36° to 44° east, is bounded by Red Sea in the northeast and east, by Djibouti in the southeast, by Sudan in the north and northwest and Ethiopia in the south. Review made on documents indicates that no doubt, Eritrea is one of the highly backward countries of the world, even though she is aware of the significance of ozone layer and its depletion. The present study reveals that Eritrea ratified the Vienna Convention and the Montreal Protocol on the 2nd of March 2005 and all four amendments on 27th June in the same year. However, Eritrea had already realized the problems associated with Ozone Depleting Substances (ODSs) on Human health and other life forms well before it ratifies the convention. As first step to address the concern, Eritrea through the Department of Environment of the Ministry of Land, Water and Environment (MoLWE) has undertaken nationwide inventory of ODSs and ODSs based equipment in 2002 (Albritton, Daniel 1998).

Although Eritrea produces and consumes minor amount of any of the substances controlled by the Montreal Protocol, it is very vulnerable to the effect of ozone layer depletion and climate change (Some ODSs are also greenhouse gases). Eritrea's consumption is mainly on refrigeration and air conditioning.

The review further shows that the ratification of the Montreal Protocol on Substances that Deplete the Ozone Layer, Eritrea has accomplished several tasks to ensure effective implementation of the Convention and Protocol by adopting the following measures:

- Establishment of the Ozone Unit office to facilitate the works

- Promulgation of the legal notice for issuance of licensing system for the importation and exportation of ODS and ODS based equipment
- ODS and ODS-based Equipment Survey (2005-2010)
- Phased-out all CFCs
- Undertakes annual assessment to determine the annual Prepares.

Distributed several Refrigeration and Air-conditioning equipment to Private and Public institutions. This will assist technicians and refrigeration sectors perform safer maintenance for effective recovery of ODS and ultimately eliminates the release into the atmosphere. Based on these literatures, we are going to assess Eritrea's role in terms of its adopted strategies, regulations and promulgations as well as awareness rising actions.

5. Global Distribution of Ozone

Ozone is not uniformly found across the globe. The total ozone varies with latitudes, longitudes and seasons. High amount of Ozone concentrations is found in high latitudes, and the lower latitudes have lowest amount of Ozone concentrations. This is caused by winds that move from tropical region toward the poles. Moreover, high latitudes have large amount of ODSs gases concentrated due to the characteristics of the gases that move and condensed in the cooler area of high latitudes. These ODSs gas make chemical reactions with clouds in winter season. This chemical reaction affects the ozone molecules which result in low amount of concentration of ozone in high latitudes. Total ozone concentration is measured by Dobson unit (DU) through local and remote techniques. Local measurement requires light weight ozone measuring modules suitable for launching on small balloons (Environmental Science and Technology, Vol 28, no. 13 1994). It also uses optical detection or research aircrafts. In remote measurement ozone abundance is measured by detecting the presence of ozone at distances away from the place by using instruments in satellites.

6. Formation of Ozone Hole

The severe depletion of the Antarctic ozone layer known as the "ozone hole" occurs because of the special weather conditions that exist only there and nowhere else on the globe. The very low temperatures of the Antarctic stratosphere create ice clouds called polar stratospheric clouds (PSCs). Polar stratospheric clouds cause changes in the relative abundances of reactive chlorine (D. H. Stedman 1981). Reactions occur on the surfaces of PSC particles during wind turbulences in winter. This disintegrates the reactive chlorine compounds, ClONO₂ and HCl, to the most reactive form (Washington, DC: National Academy Press 2008). ClO become active in the chemical destruction of ozone when sunlight is available. As a result of this, the ozone layer gets thinner and creates ozone hole.

According to an estimate, every 1 per cent decline in stratospheric ozone concentration translates into a 2 per cent increase in the intensity of biologically active ultraviolet rays that passes through the ozone layer (Washington, DC. 1989). Increased propagation and overexposure of ultraviolet rays may cause not only serious human health problems but it will affect the other mammals too. Its harmful effects may include a greater risk of skin cancer in human and animals, eye damage including cataracts, immune deficiencies, and reduction of crop yields and destruction of certain forms of aquatic life. Higher dosage of ultraviolet rays lead to reproductive failure also particularly in birds and lizards and hence threaten the ecosystem.

Since 1967, the amount of ozone in the stratosphere has decreased by about two per cent. Ozone hole is in fact not a hole, but it is a dark patch in the ozonosphere over the Antarctica. For this dark patch the use of Chlorofluorocarbons (CFCs) is exclusively responsible. The first indication of a thinning of the ozone shield above Antarctica was discovered by Joe Farman, Jonathan Shanklin and Brian Gardiner in the mid-1980s. Ozone hole is created as well as recovered by natural phenomena. During the southern hemisphere Spring (mainly September and October) every year the ozone layer in the Antarctica thins drastically. But by November or December at the latest, the ozone level recovers naturally (Monthly Weather Review vol. 101 2005, 426–443). The area of ozone depletion over the Antarctica is known as 'Antarctic ozone hole', is as big as the size of United States of America. It is estimated that up to eight per cent of the protective ozone layer over the United States, Canada and Europe has disappeared. Researchers report that the seasonal "hole" over Antarctica and some populated regions of the Southern Hemisphere thins the ozone layer at times by as much as 60 to 70 per cent. This seasonal hole is created by summer and winter season. So, we care about Ozone because of the importance of its presence and the negative consequence as it gets depleted. Among the countries affected by ultraviolet radiation, United States of America is the worst victimized. According to a survey more than 400,000 new cases of skin cancers are diagnosed each year; about one in seven Americans will develop this disease during their life time.

Initially, the chlorofluorocarbons (CFCs) was synthesized around 1928, later, in 1970 scientists found that the Ozone depleting substances (ODSs) deplete the ozone layer. Consequently in 1977, the United Nations for Environmental Programme established a coordinating committee on the ozone layer, comprising the world's leading experts, to study the problem and suggest solutions. So, Diplomatic discussions started on the major global environmental issues. The first Convention, known as the Vienna Convention held in 1985 drew up a framework for studying ozone depletion in more detail. But the Convention was not successful due to some drawbacks in controlling the production and consumption of ODSs. Especially on the part of industrial sectors there was unwillingness as they produce and consume too much amount of ODSs. As a result, Vienna Convention and the Montreal Protocol came into existence just after two years, on 16th September 1987. This protocol strengthened progressively by a number of adjustments and amendments (Andelin and John 1988).

In recognition of the protocol's unique accomplishments, the UN General Assembly announced the September 16, as the international day for the preservation of the ozone layer. All members of the protocol celebrated the international ozone day. Scientists, Paul Crutzen, Mario Molina, and Sherwood Rowland received the Nobel Prize in 1995 for their contribution on the chemistry of ozone layer.

A number of institutions and procedures have been established to assist the smooth working of the Montreal Protocol and Vienna Convention. As mentioned above, the mitigation strategies are not a matter for developed states only as it also involves developing states because it requires the aggregate work of states for better achievement of the objectives of the protocol (Washington, DC 1995).

Eritrea is part of Vienna Convention for protection of the Ozone layer and the Montreal Protocol which aims at phasing-out the ODSs that deplete the ozone layer. It plays a vital role. Eritrea ratifies Vienna Convention and Montreal Protocol on 2nd march 2005 under the responsibility of Ministry of Land, Water and Environment. For this purpose,

Eritrea established separate departments who care about the Ozone affairs. Even before, Eritrea had been playing a considerable role in such issues.

7. Common Ozone Depleting substances (ODSs)

The common Ozone-depleting substances (ODS) are chemical substances like chlorinated fluorinated or brominated hydrocarbons have the potential to react with ozone molecules in the stratosphere. If a substance is only fluorinated (does not contain chlorine and/or bromine), it is not an ozone-depleting substance. ODS include:

- Chlorofluorocarbons (CFCs)
- Hydrochlorofluorocarbons (HCFCs)
- Halons
- Hydrobromofluorocarbons (HBFCs)
- Bromochloromethane
- 1, 1, 1-trichloroethane (methyl chloroform)
- Carbon tetrachloride
- Methyl bromide.

According to reports, in most developing countries like Eritrea, most of the ODS are still used in refrigeration and air-conditioning. CFCs and HCFCs are used as refrigerants for the cooling circuits. ODS are also used as blowing agents for foam applications, as cleaning solvents in the electronics industry and in dry-cleaning, as propellant in aerosol applications. As sterilants in hospitals Metered-dose inhalers (MDIs) used for treating pulmonary diseases and fire-fighting agents. Moreover, use as fumigants for controlling pests. ODS can be applied in laboratory as analytical reagents.

Tab. 1: Shows ODSs occurrences in percentage across the world.

Occurrences of CFCs and HCFC from different sources	Percentage of Occurrences
Refrigerant and Air Conditioning	30%
Foam Products	14%
Solvent Cleaning Products	36%
Aerosols	5%
Sterilization	3%
Others	12%

Source: Ministry of Land, Water and Environment, Department of Environment.

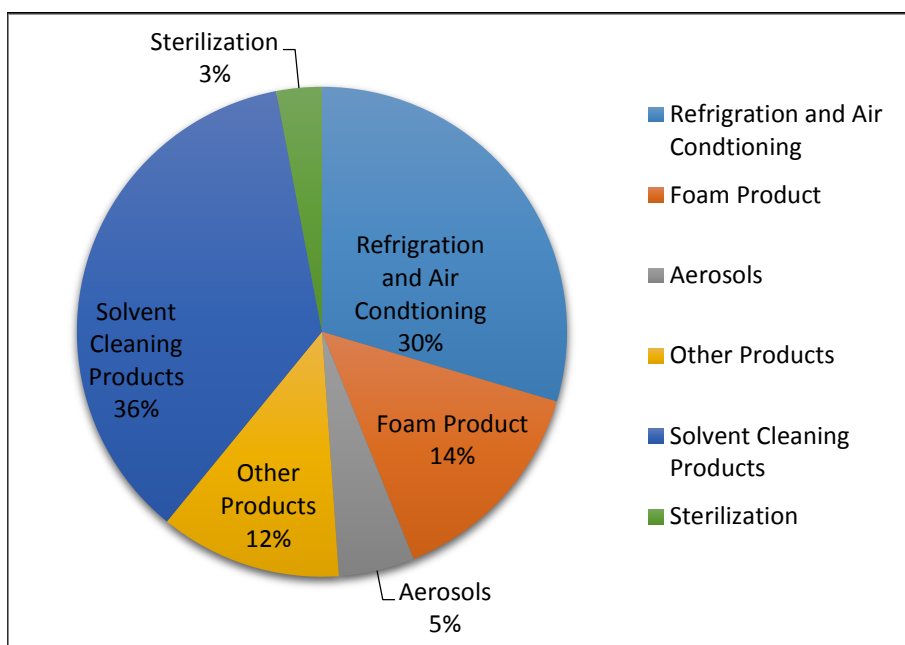


Fig. 1: ODSs occurrences in percentage across the world.

Source: Ministry of Land, Water and Environment, Department of Environment.

The above table and pie chart shows the occurrences of ODSs in different products. Solvent cleaning products produced a great deal of ODSs comprises almost 36 per cent of the total ODSs produced. Refrigerant and air conditioning, Foam products, Aerosols, sterilization and others sources comprises 30, 14, 5, 3 and 12 per cent respectively.

8. Impact of Ozone Depletion on Human Health

Ozone's unique physical properties make the ozone layer to act as our planet's sunscreen, providing an invisible filter to help protect all life forms from the Sun's damaging UV rays. Most incoming UV radiation is absorbed by ozone and prevented from reaching the Earth's surface. Without the protective effect of ozone, life on Earth would not have evolved the way it has. The ozone layer protects us from the harmful effects of wavelengths of ultraviolet UV light from the Sun. The danger to human health from ultraviolet radiation comes mainly from the UV range of the spectrum. Any significant decrease of ozone in the stratosphere would result in an increase of UV radiation reaching the Earth's surface, and cause health problems. Some of the possible harmful effects of increased UV light on human health include:

- Skin cancer
- Immune inhibition
- Cataracts

8.1 Skin cancer

The most well-known effect of UV radiation is the slight reddening or burning of the skin when exposed to sunshine. This change of colour is caused by an expansion of the skin's blood vessels. For most people burning is followed by tanning within a

couple of days. A permanent tan will occur when the UV radiation causes a pigment called melanin to form in the pigment cells of the skin. Over a period of years, exposure to radiation originating from the sun cause damages in the skin's connective tissues, so-called photo-ageing. This manifests itself as a thickening of the skin, as wrinkles, and reducing of elasticity. Elastin and collagen fibres determining the firmness and elasticity of the skin are damaged. UV radiation thus increases the risk of getting skin cancer.

Research has shown that even small amounts of UV radiation can cause considerable harm. UV damages the genetic material of DNA and is related to some types of skin cancer. It is important to note, that UV radiation has always had this effect on humans. In recent years non-melanoma skin cancer has become more prevalent in many parts of the world because people are spending more time in the Sun and are exposing more of their skin in the process.

The relationship between the occurrence of milder non-melanoma skin cancers and time spent in the sun is well documented. Such cancers generally occur in people in their 70s and 80s on areas of the skin usually exposed to sunlight (such as the face or hands). Malignant melanoma (another form of skin cancer), however, usually occurs in younger people and in skin areas not necessarily exposed to sunlight. It tends to occur most commonly among groups of people less likely to have spent significant amounts of time outdoors.

The risk of developing malignant melanoma is directly related to the sensitivity of an individual's skin to the sun. Fair-skinned is more susceptible than darker skinned individuals. The victims are almost exclusively Caucasians, particularly fair-skinned Caucasians. The incidence of malignant melanoma has been increasing among light-skinned populations around the world for decades. An increase in the levels of UV reaching the Earth as a result of ozone depletion may compound the effects of spending more time in the sun. According to some estimates, a sustained 10 per cent global loss of ozone may lead to a 26% increase in the incidence of skin cancers among fair skinned people. Australia, with high sunshine levels, has very high skin cancer rates. Estimates show every two of three people in most parts of the country develops some form of skin cancer. In Queensland, where UV radiation is the highest, the probability jumps to three in every four people.

The evidence for UV being a causative factor in skin cancers are as follows:

- The cancers are most often found on areas of the body exposed to the sun.
- The incidence is higher in people with outdoor occupations.
- The incidence increases with age.
- Conclusions are supported by studies on mammals.

8.2 Immunological Effect

Skin is an important immunological organ; the immune system is vulnerable to modification by environmental agents, including UV radiation. Demonstrations that immunity can be disturbed by exposing skin to UV radiation raise the concern that ozone depletion might adversely influence immunity to infectious diseases.

8.3 Cataracts

UV radiation can damage the cornea leading to snow blindness. Symptoms of this kind of an infection include the eyes becoming reddish, a sensitivity to light, enhanced excretion of tears, the feeling of having some dirt in one's eye, and pain. A long-term

exposure to UV radiation increases the dimming of the eye's lens, which means that potential cataracts begin to evolve at earlier ages. A cataract is a partial or complete opacity (not allowing light to pass through) of the lens of the eye and is the main cause of blindness in the world. Part of the UV radiation reaches the back of the eye, causing cells in the retina to slowly begin to deteriorate. Damage will in time particularly occur to near vision. If not operated upon blindness can occur. Radiation is partly absorbed in the lens of an adult eye, but will go right through the lens of a child, reaching the back of the eye. For this reason, children's eyes in particular should be protected against strong sunlight.

Other common eye diseases associated with increased UV radiation are eye cancer, conjunctivitis and pterygium. Conjunctivitis is an inflammation of the membrane covering the anterior portion of the eyeball. Pterygium is a thickening of the membrane that covers the eyeball. Increased exposure to UV radiation from ozone depletion is expected to increase the number of people experiencing cataracts. A 1 per cent decrease in stratospheric ozone may result in 100,000 to 150,000 additional cases of blindness due to eye cataracts world-wide.

9. Impact of Ozone Depletion on Environment

Other than effects to human health there are other impacts which could result from prolonged destruction of ozone in the stratosphere. Our environment and all living things within it are affected by this harmful radiation. UV rays also brings damage to polymers used in buildings, paints and packaging, and changes in biogeochemical cycles affecting ground-level pollution (smog), acid rain and even climate change. Animals and plants life, the land vegetation and aquatic life is highly damaged by a prolonged exposure to UV radiation.

10. Government Strategies and Regulations to Phase out ODSs in some countries

The Norwegian government adopted an action plan early in 1988 to reduce the use of CFCs by 50 per cent by 1991 and 90-100 per cent by January 1, 1995. This early action plan served as planning guideline for the industry, particularly because it later proved to be in good accord with international agreements to phase out CFCs. Its existence made it possible for industry to make the transition from CFC technology relatively easily and efficiently (Norway; government strategies; UNEP 1997, 19).

The legal methodology chosen was a regulation banning almost immediately all imports, production and exports of CFCs and halons unless a special exemption was issued by the Norwegian state pollution control Authority (STF). This regulation, dated January 1991, also prohibits imports, sale and sometimes use of CFC and halon related products without an exemption from the SFT, with scope and dates specified for each application sector.

In addition, Norway provided substantial financial support to the trade associations so that they could provide information and technical assistance to contractor's and equipment owners, as described below.

10.1 Regulations on CFC and HCFC supply

The SFT implemented the ban on CFC imports by estimating the requirement for each chemical, and then assessing the costs, available alternatives and technical

competence needed to phase out its use. Import permits for CFC-12 and CFC-115, the main CFC refrigerants, were therefore reduced more slowly than for other CFCs. Since 1995, no import permits have been issued for CFCs (Norway; government strategies; UNEP 1997, 20).

10.2 Regulations on new equipment using CFC refrigerants

The 1991 regulation also prohibits the production, import, export, installation and sale of refrigeration, air-conditioning and heat pump equipment with CFC refrigerants. The SFT based the implementation of this ban on discussions with industry and experts regarding available alternatives and competence, as well as the costs of phasing out CFCs and introducing alternatives. Exemptions for new equipment have been progressively refused, with the largest units being phased out first. Imports of units containing less than 1 kg of refrigerants (such as domestic refrigerators) - the last category to be allowed- have been refused since 1 July 1993.

The SFT received a total of 400-500 applications for exemptions during 1991-1992. During this period 3-4 persons worked on ODSs issues, reviewing applications for exemption, preparing additional ODSs regulations included consequence analysis, attending meetings, reporting to the ozone secretariat and providing information services (Norway; government strategies; UNEP, 1997, pp.20).

10.3 Regulations on HCFCs in new equipment

In 1997, restrictions on HCFCs in new equipment were under preparation, closely following those applicable in European Union countries.

10.4 Regulations on installed equipment using CFC and HCFC refrigerants

The 1991 regulations contained a general clause compelling anyone who handles CFCs to acquire the knowledge needed to reduce unnecessary emissions. Technicians installing or servicing equipment containing CFCs must therefore ensure that CFCs are not emitted to the atmosphere. The compliance is controlled within the framework of the SFT's general pollution control, supported by some information from the public. The 1991 regulation empowers the SFT to select a deadline for phasing out the use of CFCs in existing refrigeration; air- conditioning and heat pump equipment, taking into account the costs and technical alternatives available. Due to the high cost and lack of technical capacity in replacing existing refrigeration equipment with CFCs and HCFCs, STF has not yet decided any date for prohibiting the use of CFCs and HCFCs in existing equipment.

The regulation also empowers the SFT to requires that a code of practice is followed and that all servicing of equipment using CFC refrigerants, including recharge and recovery, is carried out only by authorized enterprises or certified people. The SFT has decided not to put these restrictions into operation and to rely, at least for the time being, on market forces to phase out the use of CFCs refrigerants in existing equipment, in line with the declining supply of virgin and recovered CFCs which is resulting from the ban on import of virgin substances. The main reasons for this decision were:

- The SFT considered it impossible to ensure that authorized companies really followed the authorized procedures.
- Allowing the trade association to administer an authorization scheme would imply transferring powers to the private sector that would normally rest with government authorities; in any case, the possibility of appeal would be necessary.

11. Awareness Raising Activities

The Norwegian government has tried to raise awareness among refrigeration technicians and equipment owners of the actions needed to phase-out the use of CFCs, with financial support from the government (NOKI 1.45 Million). This includes a country wide inventory of existing refrigeration equipment, a manual for conversion from CFC-12 to HFC-134a, seminars and brochures for equipment owners-particularly in the retail sector. Those brochures highlight the risks involved for owners of CFC equipment when the CFC supply vanishes. They also contain detailed recommendations on how owners should make an inventory and evaluation for their equipment, prevent leakage and plan for conversion to other refrigerants.

12. Institutional Framework and National Policies

12.1 National Level Institutions

The Government of the State of Eritrea had outlined the ozone related Policies, institutional and legal frameworks. In addition practical measures to conserve and mitigates ozone layer supported by various programs and projects. These legal and institutional instruments are briefly described below.

In general term, relevant Ministries directly lead environment conservation, development and management aspects. Their primary roles contain regulatory function, monitoring and evaluation, research and training.

The Ministry of Land, Water and Environment is the main player for environmental and natural resource management in Eritrea. The Department of Environment (DoE) of the Ministry of Land, Water and Environment (MoLWE) has responsibility for monitoring the state of the environment.

The Ministry of Trade and Industries has a mandate to regulate and control the importation of ODSs with close cooperation with the Ministry of Land, Water and Environment.

The Ministry of Energy and Mines (MoEM) has a development policy and strategies that promotes economically and environmentally sound energy sector development. The Ministry of Energy and Mines has the responsibility to collaborate with Ministry of Land, Water and Environment to present annual uses of ODSs in their sector in all mine sites such as Bisha mine site, Zara mine site etc.

The Ministry of Health (MoH) has responsibility to cooperate with Ministry of Land, Water and Environment for importation substitutes of HCFCs gases, as most of the hospitals use cooling equipment.

The Ministry of Information (MoI) has the role to propagate and to broadcast information that aims to raise the awareness on equipment that contains ODSs.

Industries: All industries use high amount of refrigerants for their cooling systems. Some of those sectors include Red Sea Bottlers, Dairy factories, Asmara Brewery Factory, Massawa ice chillers factory and all mining private sectors. These sectors cooperate with Ministry of Land, Water and Environment at the time of preparing inventories.

Refrigeration Technicians: Refrigeration technicians are the main users of ozone depleting substances (ODSs) in their work area. As a result, these people need the know-how with regard to safety recovery of ODSs. They are assisted by the Department Of Environment on ozone unit.

12.2 International Level Institutions

United Nations Industrial Development Program (UNIDP)

This organization gives investment components and equipment to the Ministry of Land, Water and Environment. This aids the Ministry in ozone mitigation processes.

12.3 United Nations Environmental Program (UNEP)

The United Nations Environment Programme (UNEP) coordinates United Nations environmental activities. It assists Ministry of Land, Water and Environment in implementing environmental policies and practices. UNEP has financial aid and training courses in the development of guidelines and treaties on issues related to ozone mitigation (UNEP, Vol.1, refrigerants 2001).

12.4 National policies

The national policy and legislations on ozone depleting substances is pointed out by the Ministry of Land, Water and Environment. The law stated- Regulation for the issuance of permit for the importation or exportation of ODS and ODS- based equipment or products (legal notice No. 117/2010): The objectives of the legal notice are to:

- Control and limit the ODS, imported to Eritrea.
- Ensure that ODS are imported through formal import permits.
- Promote the use of ozone friendly substances, products, equipment and technology.
- Phase out the use or consumption of ODS and products. Articles in this notice include scope of application, restrictions, permits, powers of the Ministry of Land, Water and Environment, obligation of importers and exporters and list of controlled ODS and their mixtures.

13. Eritrea's Mitigation Measures and Implementation Strategies

13.1 Eritrea for confirmation of Convention and Protocol

Eritrea ratified the Vienna Convention and the Montreal Protocol on of March 2, 2005 with all four amendments in 27th June the same year. However, Eritrea had already realized the problems associated with Depleting Substances (ODSs) on Human health and other life, well before it ratifies the convention. As first step to address the concern, Eritrea through the Department of Environment of the Ministry of Land, Water and Environment has undertaken nationwide inventory of ODSs and ODSs based equipment in 2002.

Although Eritrea produces and consumes minor amount of any of the substances controlled by the Montreal Protocol, it is very vulnerable to the effect of ozone layer depletion and climate impacts (Some ODSs are also greenhouse gases). Eritrea's consumption is mainly on refrigeration and air conditioning.

13.2 Eritrea's mitigation and implementation to lessen ODSs

Since the ratification of the Montreal Protocol on Substances that Deplete the Ozone Layer, Eritrea has accomplished several tasks to ensure effective implementation of the Convention and Protocol. These tasks include the following activities:

13.3 Establishment of the Ozone Unit office to facilitate the works

Establishing the Ozone unit under the responsibility of the Department of Environment is the first crucial step. This makes the work for better identifying the ODS and ODS containing equipment with the help of Refrigerant Identifier tool. The Department of Environment operates without any cost. The aim for making free charge is for the sake of public encouragement ((Kebrom Asmelash (head officer of ozone unit), 2nd May, 2016).

13.4 Declaration of legal notice for the issuance of licensing system for the importation and exportation of ODS and ODS based equipment

The Eritrean government lay-out the gazette which has been published on 23rd August 2010 under declaration article 177/2010. The gazette was printed under the volume number 18/2010. The gazette has certain rules and regulations on the exportation, especially in importation of OD and ODS containing equipment.

13.5 Phased-out all CFCs and Halons

Eritrea, as part of the Montreal Protocol has phased out Halons and CFCs in 2007 and 2010 respectively. As is shown in the given table and chart; Eritrea as a small nation did phase-out these ODSs containing chemical elements at the required time.

Tab. 2: Phased-out all CFCs and Halons.

Year	Substance
2010	CFC-12
2010	CFC-11
2010	CFC-113
2010	CFC-115
2007	Halons

Source: Ministry of Land Water and Environment, Department of Environment.

Tab. 2 shows the total phase out of both Halons and Chlorofluorocarbons (CFCs). The phase out schedule was given by the Montreal Protocol to each party. So every party should have follow the schedule for phase out the highly ODS at the required time. The need to phase out these chemical elements is due to their highly Ozone Depleting potentials (ODP). Eritrea did phase out in 2010 CFCs chemical elements like CFC-12, CFC-11, CFC-113, CFC-115 and Halons in 2007. Even though these chemical elements are phased out, it does mean that they are totally eradicated because some equipment works with the support of CFC and Halons. But the production and consumption is much lesser nowadays.

13.6 ODS and ODS-based Equipment Survey (HCFC 2005-2010)

Being the member of the Montreal Protocol Eritrea has taken responsibilities of controlling, surveying these ODS and ODS based equipment. As the above table 2 shows the CFC and Halons has been phase-out in 2010. Seeking an alternative is the main concern. Hydro chlorofluorocarbons (HCFCs) came in to existence as an alternative. The given table 3 shows that the annual HCFC-22 Consumption in 2010 was high (20,31 tones) as HCFC is an alternative for CFC. Later on, in 2011 a fall in consumption is shown and in the coming year in 2012 it raised-up again due to emergence of some equipment supported with HCFC. Finally a fall is seen in 2013 and 2014 by 18,3 and 18,1 respectively. Even though the consumption of HCFC has been changing since the year 2011, the mitigation strategies of Eritrea adopted some measures for complete phasing-out the HCFC and replace by HFC by 2040.

Tab. 3: Annual HCFC-22 consumption in tones.

Year	Annual HCFC-22 Consumption in tones
2010	20,31
2011	17,5
2012	18,6
2013	18,3
2014	18,1

Source: Ministry of Land Water and Environment, Department of Environment.

Training to about 150 National Refrigeration and Air-Conditioning technicians (RAC) This training comprises of Private and Public sectors. Out of the RAC-technicians, 24 are certified with European Standard Certification system. These would enable Eritrea to effectively address the issue of safe and legal work of refrigeration systems (Tesfalem, Hagos, Kahesai, Mogos and Halisslassie, April, 2015). Importantly this will enhance capacity towards ensuring efficient and timely implementation of the Phase out of HCFCs at scheduled time and replacement by alternative HFCs.

13.7 Establishment of Refrigeration and Air Condition Training Centres

The Department of Environment in collaboration with the United Nations Industrial Development Organization (UNIDO) and United Nations Environmental Program (UNEP) decided to establish two regional refrigeration training centres (UNEP, Vol.6 Methyl bromide) with the objectives stated as follows:

- To provide service of recovery to refrigeration technicians
- To provide training to newly recruited/ licensed technicians so as to make them certified in the refrigeration practices, and
- To introduce students with new available technologies and train them in good refrigeration practices.

13.8 Distributed several Refrigeration and Air-conditioning equipment to Private and Public institutions

This will assist technicians and refrigeration sectors perform safer maintenance for effective recovery of ODS and ultimately eliminates the release into the air. Accordingly, tools and equipment for the two training centres were acquired and delivered to the Department of Environment of the Ministry of Land, Water and Environment.

The Department of Environment has already established two training centres at:

- College of Marine Science and Technology in the Port City of Massawa.
- At the Ministry of Energy and Mines, Renewable Energy Centre at Asmara.

14. Findings and Analysis of the Study

All the activities carried out by Ministry of Land, Water and Environment (MoLWE) has been described above. Eritrean policies and adoptive measures to mitigate ozone depletion are further analyzed in this study. The results found from the policies of Eritrea for regulating of importation of ozone depleting substances (ODSs) are implemented in the ground. Offering training courses to 150 refrigerant technicians throughout the country was a helpful platform to conserve ozone depleting substances (ODSs) from being discharge to the atmosphere. The first method includes, transferring the refrigeration gases to a small cylinder (temporal container). Once the refrigeration takes its services, the previously taken-out gases should be returned for

reuse. This whole process is called gas recovery process and is carried out by a device named gas recovery machine. In this gas recovery system, refrigeration is fully safe from out flow of ozone depleting substances (ODSs) like HCFCs -R22 to atmosphere. This means there is no out flow of gas to atmosphere.

In this research the survey done consisting of interviews and discussions to investigate how much the given training courses has been traced and followed in the ground. We have managed to choose interview survey techniques in order to acquire the necessary data through intimate interviews with the refrigerant technicians.

In this survey, five refrigeration and air conditioning technicians' shops have been taken into consideration to find out the efficient use of the recovery gas machine. According to the survey only one refrigeration and air conditioning technicians shop follows all the necessary steps in the gas recovery system. Thus, technicians who have not followed the proper recovery machine have given the following reasons:

- The processing of transferring gases into a temporal cylinder then replacing it, is time consuming process, and
- Some of them do not have the recovery machine.

Among the five selected refrigeration technicians shops, only one shop is following the necessarily techniques certified by Ministry of Land, Water and Environment. This is known by Hagos Keleta refrigeration and air conditioning repair and sales work shop located along Tegadelti Street near Freselam junior school. One of the technicians who is responsible to run the shop is Tesfalem. He is a highly skilled and possesses a good English language skill. From this observation, the rest of four shops do not acquire the same level of education and skills. This is a reason why we have found only one shop that follow up and utilize the recovery gas machine properly, carefully and neatly.

15. Conclusion

Ozone layer protects the earth surface from harmful ultraviolet radiations. It is formed by composition of three oxygen atoms. This layer is found in the stratosphere which is far from the earth's surface about 10-50 km. Moreover, this layer has a thickness of 10-20 km. Ozone molecule has a reaction of dynamic equilibrium character, meaning the number of ozone molecules breaking down are equal to that of being created. The use of this stratospheric layer is to filters out the harmful ultraviolet radiation (UVB). As a result, it has a great significance in protecting life on earth. However if ozone layer is damaged by anthropogenic activities the harmful radiation began to descent toward troposphere. In return, a great deal of damages has been experienced up on the environment and human health. Most of the time, the effect of falling ultraviolet radiation (UVB) felt across high latitudes than in low latitudes. Because of the polar stratospheric clouds that catalysis the chemical reactions over high latitudes and the movement and concentration of ozone depleting substances (ODSs) from the entire world toward cold regions.

Generally speaking, the effect of ultraviolet radiation (UVB) is not much felt in Eritrea. This is due to its location within tropics. Saving ozone layer from depletion is not the mission of few, but it needs a collective activity among countries, that ratify Montreal and Vienna Conventions. Eritrea has adopted several polices and measures to mitigate ozone layer since 2005. Established ozone unit office as well as ratifies the legal notice for issuance of licensing system for the importation of ODS and ODS based equipment.

The role further being played by Eritrea through Ministry Of Land, Water and Environment also include, offering training of custom officers and refrigeration Technicians. The training mainly covers the technical aspect of recovering Ozone depleted substances (ODSs) from air conditioning and refrigeration. However, the findings and discussions of the study shows that only one shop follows proper gas recover out of five refrigeration technician shops (RTS). Therefore, it is concluded that only few technicians uses and follows the measures that formulated by Ministry of Land, Water and Environment and the others are not able to follow the measures given by the Ministry of Land, Water and Environment because of some problems stated above.

16. Recommendations

This research paper finally concludes the work with the following recommendations that may help in mitigating ozone processes in Eritrea.

1. The Ministry of Land, Water and Environment should give to refrigeration technicians, a continuous training on gas recovery processing and increasing their understanding on environmental awareness.
2. The Ministry of Land, Water and Environment should solve the problem of lack of recovery machines to all repairing refrigeration workshops.
3. Ministry of Land, Water and Environment, Department of Environment in particular, should provide the disposal area for the previously used impure ozone depleting substances (ODSs), specially CFCs and HCFCs gases.
4. And it is also recommended to Refrigeration technicians to use the recovery machines as well as its necessary steps in processing.

References

- Albritton, D. 1998: What Should Be Done in a Science Assessment In Protecting the Ozone Layer: Lessons, Models, and Prospects.
- Allied Signal Corporation. "Remarks," International CFC and Halon Alternatives Conference. Washington, DC. 1989.
- Alternative Fluorocarbons Environmental Acceptability Study (AFEAS), Washington, DC, 1995.
- Andelin, D., John, V. 1988: Analysis of the Montreal Protocol, Staff report, U.S. Congress, Office of Technology Assessment, Jan. 13, 1988.
- Angell, J. K., Korshover, J. 2005: Quasi-biennial and Long-term Fluctuations in Total Ozone, Monthly Weather Review vol. 101, pp.426–43.
- Anderson, J. G. 2008: The Measurement of Trace Reactive Species in the Stratosphere: An Overview. In Causes and Effects of Stratospheric Ozone Depletion: An Update, Washington, DC: National Academy Press.
- Stedman, D. H. 1981: Atomic Chlorine and the Chlorine Monoxide Radical in the Stratosphere: Three in Situ Observations. Science, vol.198.
- Interviews with refrigeration technicians: Tesfalem, Hagos, Kahesai, Mogos and Halisslassie, April 2015.
- Open interviews with Mr. Kebrom Asmelash (head officer of ozone unit), 2nd May, 2016.
- Stephen, O., Morehouse, E. T. Jr., Miller, A. 1994: The Military's Role in Protection of the Ozone Layer. Environmental Science and Technology, vol 28, no. 13.
- United Nations Environment Programme (UNEP): strategies and policies for the implementation of the Montreal protocol in Norway. In: Environmental Management in developed countries, pp. 19-22, 1997.

United Nations Environment Programme (UNEP): Protecting the Ozone layer Vol.1
refrigerants 2001.

United Nations Environment Programme (UNEP): Protecting the Ozone layer Vol.6
Methyl bromide.

DEPLETING STATE OF STRATOSPHERIC OZONE: A CHALLENGING CONSERVATION FOR GLOBAL COMMUNITY WITH SPECIAL REFERENCE TO ERITREA

Summary

No doubt, the ozone layer acts as a shield against the harmful ultraviolet radiation on earth. The absorption of ultraviolet radiation in the upper stratosphere prevents potentially lethal levels of ultraviolet rays from reaching the earth's surface. The formation and destruction of ozone led to the absorption of ultraviolet rays. In the absence of this shield, life could not exist on earth.

Depletion of ozone layer is today's major environmental concern. A group of chemicals, known as CFCs (chlorofluorocarbons) is the main culprit for thinning out the ozone layer. These CFCs were widely used for decades as fluids in air conditioners and refrigerators, propellants in aerosol sprays, and blowing agents for foam insulation and cosmetic goods. CFCs emissions are also produced by supersonic jet aero planes, nuclear explosions and volcanic dust erupted from the earth's surface. Possessing strong oxidizing power, ozone is usually used in medicine, as a disinfectant for drinking water and beverages. It is also very effective as a reagent in purifying industrial effluents and treating contaminated river water. In ship cabins, underground mines and tunnels where sunshine is absent all the year round, ozone is often utilized for purifying the air. It kills organic matter without producing disgusting dump stinks.

Within the troposphere, CFCs are chemically non-reactive, but in the stratosphere it is highly reactive as the intense ultraviolet radiation breaks them down and liberates chlorine atoms. Chlorine acts as a catalyst (A catalyst accelerates a chemical reaction without itself being altered by that reaction) in chemical reactions that convert ozone to oxygen. In this way, each chlorine atom can destroy tens of thousands of ozone molecules.

Increased propagation and overexposure of ultraviolet rays may cause not only serious human health problems but it will affect the other mammals too. Its harmful effects may include a greater risk of skin cancer in human and animals, eye damage including cataracts, immune deficiencies, and reduction of crop yields and destruction of certain forms of aquatic life. Higher dosage of ultraviolet rays lead to reproductive failure also particularly in birds and lizards and hence threaten the ecosystem. According to an estimate, every 1 per cent decline in stratospheric ozone concentration translates into a 2 per cent increase in the intensity of biologically active ultraviolet rays that passes through the ozone layer. The actual amount that reaches the earth's surface hinges on cloudiness and air quality. Various studies suggest that a 2.5 per cent thinning of the ozone layer could boost the incidence of human skin cancer by 10 per cent. As whole, reaching of ultraviolet rays on earth is hazardous. It is mainly caused due to overexposure to the ultraviolet radiation i.e., UVB. What measures could be adopted to protect ourselves from this dangerous radiation?

As we know that our body has natural self-defensive mechanism to protect against any kind of attack and so is the case with the ultraviolet radiation. Besides, we must adopt some strategy which can provide adequate protection. We should avoid such places where UVB is maximum. Such places include Sea beaches because sand reflects up 50 per cent of the incident UVB. In the same way water transmits UVB to a depth of a meter or so, and a wet T-shirt allows 20 per cent to 30 per cent of incident

UVB to reach the skin. The beach is not the only place where a person is likely to be exposed to high levels of UVB. Skiing at high mountain elevations, where UVB is more intense than at Sea level, results in significant exposure. In addition, snow is even more reflective of UVB than the beach sand. As whole two remedial measures can be adopted to protect against UVB. First of all we should avoid the sun at its greatest intensity, which is between 10 A.M to 3 P.M. Secondly, we should apply a 'Sunscreen' on most commonly exposed surfaces such as the forearms, face, neck and wearing protective clothing is a wise strategy. Experts have recommended a broad spectrum Sunscreen that provides protection from both UVB and UVA. In the Sunscreen we should see the degree of protection offered i.e., Sun protection factor (SPF). Higher the SPF value, the longer the protection lasts. Experts recommended a minimum SPF of 15.

VILLAGES OF PORABJE: INDIVIDUAL ELEMENTS OF THE HUNGARIAN SETTLEMENT NETWORK

András Balogh

PhD., Associate Professor
University of West Hungary
Institute of Geography and Environmental Sciences
Department of Human Geography
Károlyi Gáspár sq. 4
Szombathely – 9700 Hungary
e-mail: baloghandras@nyme.hu

UDK: 911.37

COBISS: 1.01

Abstract

Villages of Porabje: Individual elements of the Hungarian settlement network

Special feature of Porabje settlements can be detected on some geographical aspects within the national settlement network. Unique features of these settlements even these features are not exclusive in themselves regarding all the administratively independent settlements form such a specific region of Hungary on the base of that the following can be stated. The Vend-region occupies prominent place among the regions of Hungary. These special features are studied in this study on the base of the following aspects: spatial location, history, ethnic composition, ethnographic aspects, small village and sporadic settlement characteristic and development possibilities. However Szentgotthárd (Monošter) played important role in life of the Slovenians in Hungary too the essay focuses on the analysis of the settlements in the Porabje region.

Key words

Porabje, Slovenians in Hungary, ethnographical region, small villages, sporadic settlements, development possibilities

1. Introduction

The Slovenians count indigenous national minority in Hungary who belong ethnically to the Slovenians living mainly in Slovenia, Carinthia and Styria in Austria and in the Italian border provinces. The majority of the Slovenians live in the surroundings of Szentgotthárd (Monošter) in county Vas in the Western corner of the country (Kozár 2007). This area is called the Vend-region and its Slovenian name is Porabje. The naming 'Vend' became dominant from the end of the 19th century until then Hungarians named 'Tót' the population living here and talking Slavic (Beluszky 2005). Name of the folk occurred first in our area today Rábatótfalu (in Slovenian: Slovenska vas, part of Monošter) mentioned as 'villa Sclavorum' that means 'Slavic village' in a charter of the year 1221. Latin version of the phrase 'vend' appeared in the title of a Slovenian ritual book 'Agenda Vandalica' (Kozár 1999) first in 1587.

Porabje is a specific ethnic-related region of Hungary that preserves its culture till today. Settlements of the region are not ethnically homogeneous Slovenian villages but cohabitation is realized with the Hungarians and other minorities in several villages (eg. Germans, Slovaks). The unique ethnic composition, small size of the villages in Porabje, sporadic feature, and the traditional farming methods and the construction modes in a protected natural environment in the Western border area of Hungary in relative isolation make this region extremely interesting research theme. We try to analyze these features in our study.

2. Schematic history of Porabje's Slovenians

The ancestors of the Slovenians as the most western nation of the southern Slavs arrived and settled down in the area of the Rába, Dráva, Mura and Száva in the 6th century. In other words the arriving Hungarians found them in this area during the conquest. When establishing counties and bishoprics the western border zone was missed so the Slovenian villages between the Rába and Mura got administratively to Vas and Zala counties and Zagreb and Győr dioceses in the 11th century (Kozár 1998, 2007). Number of the Slovenians rose due to introduction and further moving into the area and the Cistercian abbey founded by Béla III in 1183 also played a key role in this. Monastic majors so called 'Grangias' formed on the cleared lands conquered from the forest in the area. A manor is a double concept: it means a piece of land that is the management and administrative centre of a large estate, and in addition, it is a form of settlement, where the farming workers or even the owner of the estate live (Balogh, Bajmócy, 2011, 2014). Villages of Porabje developed from these manors and the sporadic feature of these settlements can be account to this partly. Although majority of the settlements are first mentioned in the charters mainly in the second part of the 14th century settling of the Slovenians happened later in the 16th century (Kozár 1998).

Slovenian-majority villages were found in Porabje in the census in 1910. After the 1st World War the newly organized South-Slavic state so called Serbian-Croatian-Slovenian Kingdom established on 1st December 1918 laid claim to this area. As a result of the Treaty of Trianon the language borders and the borderline of the county were not coincided with each other, so nine villages could stay in Hungary (Benczik 1998). The historic Porabje was much larger than today and included the area of Prekmurje that is part of Slovenia nowadays. Six administratively independent villages formed out of the nine Slovenian-majority municipalities around Monošter remained in Hungary as a result of coupling and merging of villages: Alsószölnök (Slovenian

name: Dolnji Senik), Felsőszölnök (Gornji Senik), Orfalu (Andovci), Szakonyfalu (Sakalovci), Apátistvánfalva or Števanovci (the formerly independent Újbalázsfalva in other words Otkovci was connected here). Kétvölgy (Verica-Ritkarovci) was born due to its name by merging two former villages (Vashegyalja – Verica and Ritkaháza – Ritkarovci) in 1951. The 9th formerly independent village was Rábatótfalu (Slovenska ves) that was connected to Monošter in 1983.

3. Spatial location

The area of Porabje today is less than 100 km² and the number of inhabitants is under 3000. It is located in the western corner of Vas County and Gornji Senik is the westernmost settlement of Hungary (Fig. 1). The triangle border stone (Tromejnik) can be found 4 km far from the centre of the village at the meeting point of the three countries Slovenia, Austria and Hungary.

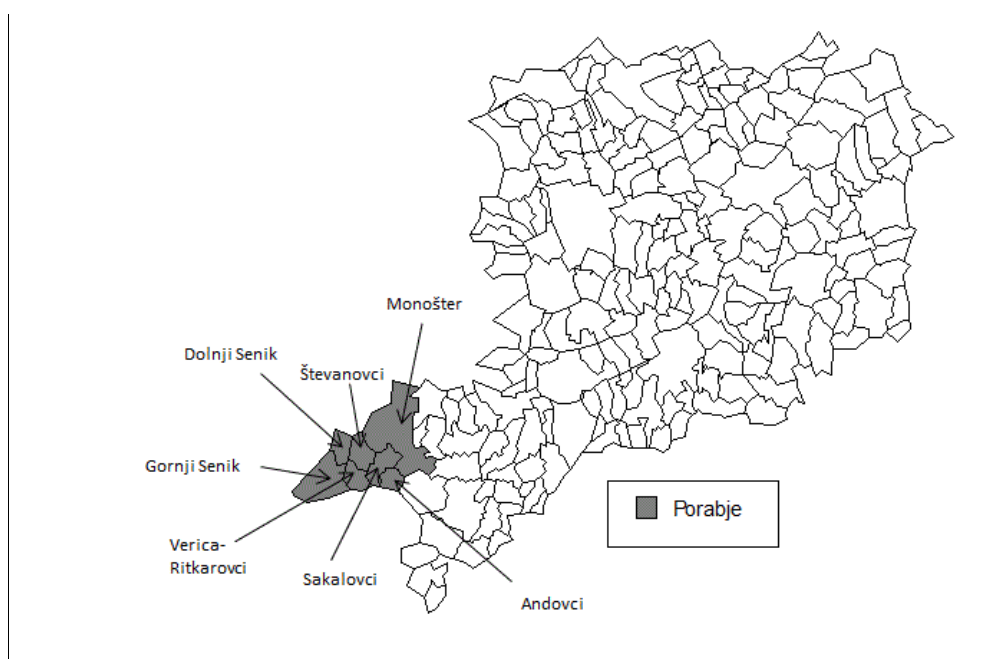


Fig.1: Spatial location of Porabje in Vas county.

Source: own construction.

Porabje is divided into two parts on the base of its accessibility. Gornji Senik, Dolnji Senik and Sakalovci can be reached only through Monošter but Andovci, Števanovci and Verica-Ritkarovci are located in the other corner of the area. The area was closed as border stripe during the period of socialism and was avoided by nationalization and collectivization of agriculture. Today this area is under nature protection as part of Órség Natural Park and began to develop after opening the borders. The name of Porabje physical geographically is different: this area is 'Vas Mountain Ridge' according to the small land cadaster. This name is quite strange for the local inhabitants because the Hungarian-inhabited settlements with prefix 'Hegyhát' (Hegyhátszentjakab, Hegyhátszentpéter, Hegyhátsál and Hegyháthodász) are located in the East.

4. Population changes and ethnic minorities

We can get information about the exact number of inhabitants of the Slovenian nationality people in Hungary only at the census in every 10 year. The data prove that number of Slovenians in Hungary decreased continuously in the 20th century as population of the Slovenian settlements. The rate varied over the centuries moreover there were growth phases mainly between the periods of the two world wars but altogether everywhere exceeded 50% it means that all of the Slovenian villages lost more than half of the inhabitants. The loss was quite drastic in some municipalities e.g.: while 431 people lived in Verica-Ritkarovci in 1900 then only 97 people lived in 2015. The situation is similar in case of Andovci number of inhabitants was 364 in 1900 and 71 in 2015. Thus these two settlements lost around 80% of the inhabitants in the examined period. If we examine only the situation after 1990 it can be stated that Andovci could stop the negative tendency during the past more than quarter century. Of course it is not enough to balance the decrease of the previous decades. Andovci is the smallest Slovenian village in Hungary. Reduction of Verica-Ritkarovci is very spectacular since 1990 and number of the inhabitants decreased fewer than 100 by nowadays (Tab. 1).

Tab. 1: Changes in the number of population between 1991-2015 in Porabje's villages.

Villages	Population					Population change 1991-2015 (%)
	1991	1997	2003	2009	2015	
Gornji Senik	736	733	659	584	584	-20,7
Števanovci	435	415	400	369	377	-13,3
Dolnji Senik	438	427	418	363	368	-16,0
Sakalovci	367	377	369	354	351	-4,4
Verica-Ritkarovci	159	151	138	127	97	-39,0
Andovci	69	72	65	60	71	+2,9

Source: Gazetteer of Hungary.

Concerning the Slovenian minority, they live in different number and rate in the villages of Porabje. The official census data help in measuring but some problems are also raised. The ethnic affiliation was asked in every case after the 2nd World War in Hungary except the year of 1970. Response became voluntary since 2001 at the same time the ethnic affiliation is judged on the base of several criteria (more questions). Today there are two questions to clear the ethnic affiliation (in order to estimate exactly who has double identity) one regarding the mother tongue and the other regarding the language used with family or friends. Since everyone could mark more nationalities one person is listed repeatedly for those ethnic affiliations what he/she marked at the question (Kovács 2013). This is the reason why the total rate of those who declare themselves as Hungarian and Slovenian exceeds 100% in the villages of Porabje (Fig. 2).

Three-fourth of the inhabitants declared themselves Slovenian too in Gornji Senik. This is the highest rate among the villages of Porabje. Dolnji Senik is at the other end of the list with the rate of 17,6 % of Slovenian population. Significant difference can be between the data of census and the reality. Number of the Slovenians is around five thousand in Hungary according to the advocacy of minority boards instead of three thousand given by statistics. Besides Hungarians and Slovenians other minorities also live in the most villages in Porabje, primarily Germans and Slovaks.

Germans live in the highest rate (26,8%) in Dolnji Senik and Slovaks (6,6%) in Andovci.

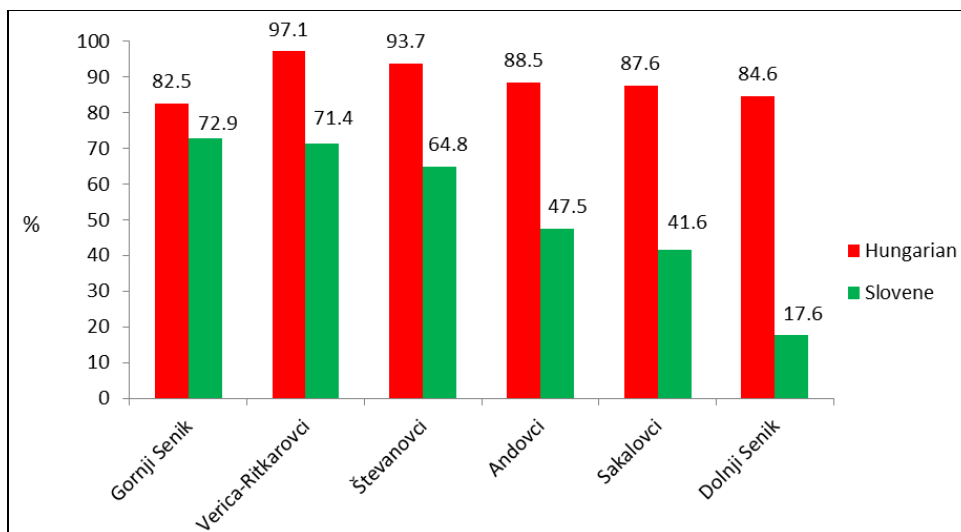


Fig. 2: The share of Hungarian and Slovenian population in villages of Porabje.

Source: Hungarian Central Statistical Office, Census of 2011.

Ten Slovenian nationality local governments were elected as the result of the election held on 12th October 2014 in Hungary. The local governments were established by Slovenians in six villages of Porabje and in Monošter, Szombathely, Budapest and Mosonmagyaróvár. Center of the National Slovenian Local Government (Državna slovenska samouprava) operates in Gornji Senik and there is only a representation in Budapest. Bilingual primary school and a kindergarten operate in Gornji Senik and Števanovci, a kindergarten in Dolnji Senik and Monošter and an associated kindergarten in Sakalovci. Professionals having Slovenian pedagogue diploma and Slovenian-speaking teachers work in every institution. There is possibility to learn ethnic Slovenian language in two secondary grammar schools in Monošter and the high-degree Slovenian language teaching takes place in Savaria University Centre of the University of West Hungary (www.slovenci.hu).

5. Settlement patterns

Settlement means an administratively independent unit in every case on the base of the most frequently applied criterion when standardization the Hungarian settlements. According to this on the base of spatial position of the houses the certain types diverse from each other.

Houses can be located in groups and sporadically (and between these two types in transition as well). The settlement consists of one single bigger group unit in the first case. These are the classic villages and towns. In the second case the settlements are built up by single houses so we cannot talk about closed core of settlement. The buildings are located sporadically in space and these form an administratively independent settlement. Villages of Porabje belong to this type (Fig. 3).

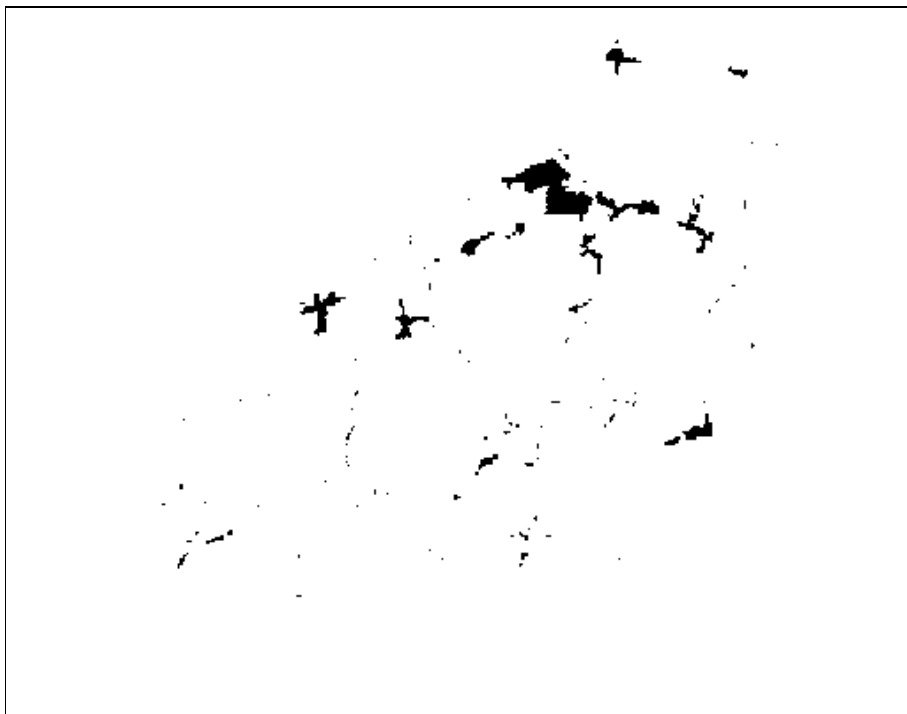


Fig. 3: Settlement patterns of Slovenian villages and Monošter.

Notation: The lines indicate borders of the settlements and the black spots indicate the interarea.

Source: Zentai, Kercksmár, Veress 2016.

Villages of Porabje are mainly sporadic settlements that were developed from granges where single homes are on the hillsides and combs originally. Every single house was surrounded by the pasture belonging directly to the property the kitchen garden and the orchard. Then the forest was the next. Raspberry plantations are found on the fringe of the forest. Lands without vegetation almost can be seen. The original landscape in case of many villages changed in the course of time by increasing the number of inhabitants of the settlement. The houses started to thicken and became such the so-called 'szeres' villages in Órség that means that no single houses but groups of houses built on the hilltops and combs. Lines of streets developed from the separately built homes and the lands in crop separated from the living area. Sporadic settlements remained only in Gornji Senik, Števanovci, Verica-Ritkarovci and Andovci nowadays (Fig. 4).

The most beautiful, most spectacular sporadic settlement Verica-Ritkarovci is located above 300-360 meters above sea level (www.ketvolgy.hu). The administrative area is 6,28 km² out of that the inner area is 13 hectares. The village with 15,5 persons / km² population density is one of the least densely populated settlement in Hungary. Huge green hills, forests and meadows are located among the sporadic houses (Fig. 5).

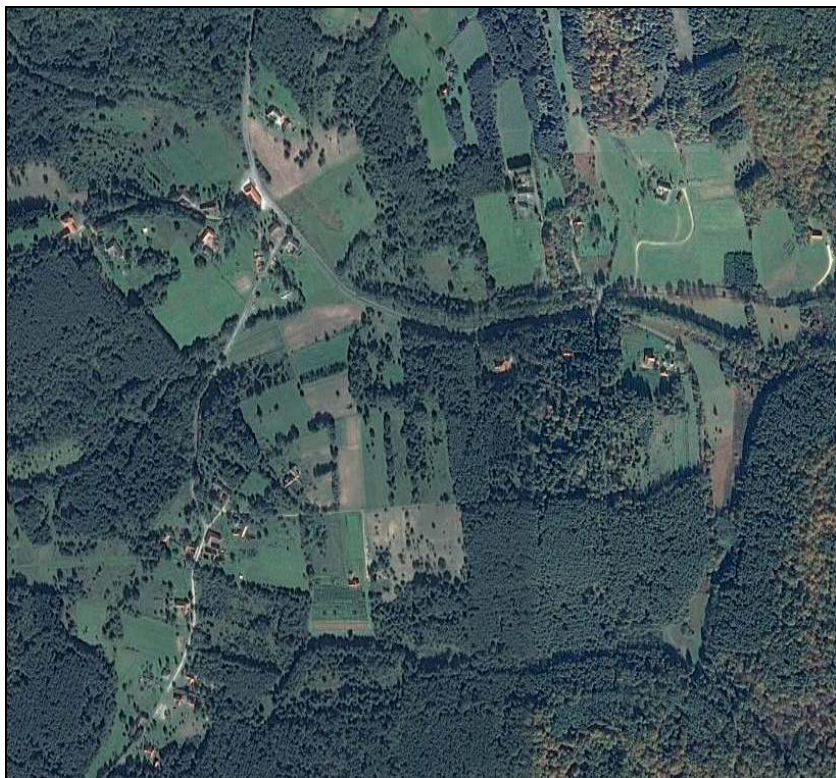


Fig. 4: Sporadicity in Andovci.
Source: mapygon.com.



Fig. 5: Lonely house in Verica-Ritkarovci.
Source: Zentai 2016.

The other part of the Slovenian settlements show the picture of a more close ribbon-plot village in the areas where cultivation is possible. There are not arables, pastures among the homes. Such like Dolnji Senik by nowadays (Fig. 6).



Fig. 6: Densely located houses of main street in Dolnji Senik.

Source: mapygon.com.

6. Folk architecture

The folk architecture and culture of Porabje carries parallel features with Órség but there is also its local uniqueness and characteristics. Comparing Porabje to Órség (that is not the same as Órség National Park because the area of the Natural Park is much bigger and involves the whole Porabje) as ethnographic landscape it can be said that one of the most significant difference was that houses were bigger in the Slovenian landscape but the furniture was simpler (Nagy 1998). Conformation of the fate and lifestyle of the nation settled down in the area of Porabje was determined by the natural environment basically. The landscape can be characterized by significant woodland (Zentai, Kercksmár, Veress 2016). The houses were built on the assart by the local people. The cultivated area gained by burning cut-over surrounded the houses like a ring. Wood was the natural building material in this wooded area evidently until the middle of the 18th century. Wood construction started to be neglected due to the forest protection measures of the landlords then the general provision number 1767 of Maria Theresa and the next severities of landlords from the middle of the 18th century. These restrictive measures were more enforced in the hilly area than in the area of Órség. Houses made of compact land and raw brick houses appeared here (Bíró 2016). ‘Open-fire house’ was widespread in Porabje like in Órség which represents the most ancient house type of this land. It has got only one huge living place with an opened stove (there’s no chimney at all). The stove was used for

heating, cooking and baking. The smoke left the place through the upper part of the door and the plank windows. The 'U-shaped building' also was very common in the hilly western part of Hungary. This structure was developed by the economic system based on animal farming. The inner place is defended by buildings around it against thieves and wolves. Three and four-sided pale houses were built out of that only a part of it remained later on. There is a house on the main street of the village in Verica-Ritkarovci out of that only the kitchen and the bedroom remained then it was completed with new building parts (Fig. 7).



Fig. 7: Bended layout building of pale house in Verica-Ritkarovci.

Source: <http://www.gatterfogado.hu/>.

Bended layout or 'L-shaped residential building' generally nor formed in this way but those were built as such. The longer branch of the building was used as residential house and the shorter one as farm building (Fig. 8). The separated chamber was typical porter's lodge the so-called 'kástu'. These houses were used for food storage not for living. Retting evaporators or hemp evaporators were separated buildings of the wealthy porter's lodge of Porabje and Órség where washing of canvas was prepared (Bíró 2016).

Every house had own name in Porabje. These ancient more thousand names of houses reveal a lot of things. One group refers to the location of the house e.g.: Nâkâmlinî – people living in gravel place, Graboštjî – people living in the valley. Significant part shows occupation of the original inhabitants for example Goslârî – The Fiddlers; Kováčinî – The Smiths; Lončárinî – The Potters; Mlijnârstjî – The Millers; Sâbaulinî – The Tailors. Names of houses hiding information about moving of people refer to ethnic origin e.g.: Kráincinî – The Krainaian; Rovátinî – The Croatians; Štajêrnî – The Styrians; etc. Other names invoke the social status or nickname of ancestors: Ercêdjî – The Dukes; Grofostjî – The Earls; Žlârinî – The Cottars etc. (www.galambdokter.hu).

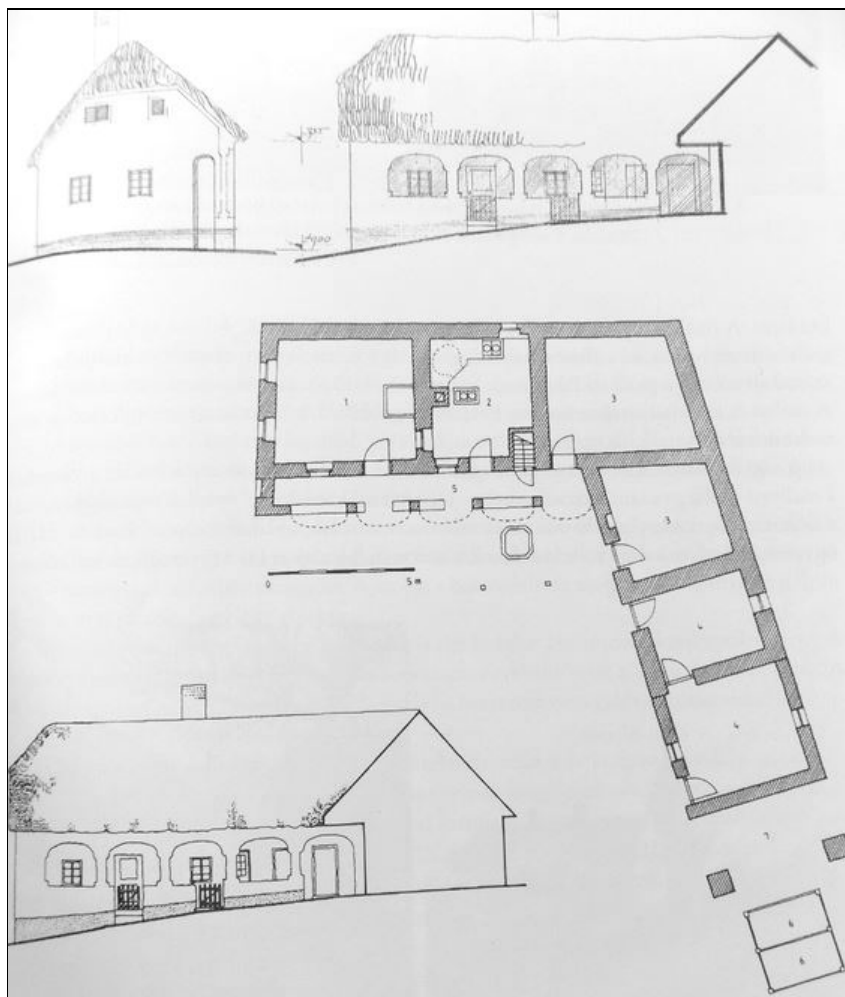


Fig. 8: Bended layout of house with porch, Andovci, 1973.

Source: Bíró 2016.

7. Development possibilities

Majority of villages of Porabje are sporadic and the number of inhabitants is also low. Except Gornji Senik all the small villages having less than five hundred people has many of the features of small village syndrome like as hilly landscape, poor transport links, quick and selective outward migration, ageing originating from old age structure, strong economic and social dependency on the central function settlement etc. Ethnic variability and border location that operated as a filter zone for decades complicate the situation in Porabje. Nowadays there are many forms of cross-border cooperation that is supported by the European Union. Several developments were implemented in the frame of Phare CBC (1999-2003) and Interreg III/A (2000-2006). Convention about promotion of the cross-border cooperation was signed in the first Hungarian-Slovenian joint government session between the local and regional authorities in 2007 then after two year preparation the Hungarian-Slovenian Cross-

border Joint Committee was formed in November 2009. Association of the Hungarian Slovenians founded the Slovenian Region Ltd in order to contribute in the frame of public interest activity of the company to the cultural, touristic and economic development of the Rába area (www.szlovenvidek.hu). The main projects were 'Neighbour to neighbour' and 'UPKAČ – Pearls of the tall trees'. The most important document of the cooperation is the Interreg V-A Slovenian-Hungarian Cooperation Program in the 2014-2020 economical period. The main objectives of the Program are better utilization of the natural and cultural values during cooperation in tourism, development of the local economy and preservation of the natural and cultural resources etc.

The main development possibilities and opportunities of Porabje are in the field of bio farming and tourism. Bio-production and local products have a market niche that has not been fully exploited yet. Local farmers, who manage farms in the Vend-region, can ask for support to cultivate their fields – if they do this in a nature-friendly way and conserve agricultural biodiversity (Csapó 2006). The unspoiled countryside with its rich forests and hunting grounds and an advantageous position at the open triple border between Austria, Hungary and Slovenia are factors which could enable successful development of farm tourism as a new sector. The nature protected area offers possibilities for creative tourism, active holidays on farms and cultural tourism (Baranyai, Csapó 2009). E feladatokban természetesen nem kerülhető meg az Őrségi Nemzeti Park. The National Park has an outstanding role in the economic development of the region, the growth of tourism and nature protection. The National Park is the constant organizer of farmer's forums, and helps the local farmers with guides introducing ecologically desired, sustainable farming practices. The National Park is the regional organizer of ecotourism, coordinating numerous programs and presenting nature trails (Baranyai, Baranyai, Tóth 2016).

References

- Balogh, A., Bajmócy, P. 2011: Majorok a Nyugat-Dunántúlon. Savaria University Press, Szombathely, 126p.
- Balogh, A., Bajmócy P. 2012: Egykori majorok tipizálása Vas megyei példákon. In: Földrajzi Közlemények, 2012. 136/2. pp. 165-181.
- Baranyai, G., Csapó, O. 2009: Possible Ways of Sustainable Development in the Vend-region. In: Gosar, A. ed.: Development Opportunities of Slovenian Border Regions. Založba Annales, UP ZRS Publishing House, Koper, pp. 257-270.
- Baranyai, O., Baranyai, G., Tóth, G. 2016: Possibilities for development of rural, protected areas in Hungary as an example of Őrség National Park. In: *Dynamiques Environnementales* 35 (1), Bordeaux, pp. 112-123.
- Beluszky, P. 2005: Őrség – Vendvidék, Felső-Rába-völgy: Szentgotthárd és környéke. Dialóg Campus Kiadó, Pécs, 207p.
- Benczik, Gy. 1998: Az Őrség és a Vendvidék kialakulása és későbbi története. In: Boda, L., Orbán, R. szerk.: Az Őrség és a Vendvidék – Kalauz turistáknak és természetbarátoknak. B.K.L. Kiadó, Szombathely, pp. 41-45.
- Bíró, F. 2016: Paraszti ház- és lakáskultúra Délnyugat-Dunántúlon. In: Bartha, D. szerk.: Az Őrségi Nemzeti Park I. Szülőföld Könyvkiadó, Óriszentpéter, pp. 466-496.
- Kovács, M. 2013: A nemzetiségek számbavétele a népszámlálások során. In: Mayer, É. szerk.: Népszámlálás – Nemzetiségi adatok. Barátság 20./Melléklet.
- M. Kozár, M. 1998: Szlovének. In: Nemzeti és etnikai kisebbségek Magyarországon. Auktor Könyvkiadó, Budapest. 32p.

- M. Kozár, M. 1999: A magyarországi szlovének helytörténetírása. In: Savaria – A Vas megyei Múzeumok Értesítője, 28. pp. 337-342.
- M. Kozár, M. 2007: „Sem okosak, sem gazdagok” – A magyarországi szlovének identitása, különös tekintettel a Felsőszölnökön, Rábatótfaluban és Szombathelyen élőkre. In: Bindorffer, Gy. szerk.: Változatok a kettős identitásra. Gondolat Kiadó, Budapest. pp.16-62.
- Nagy, E. 1998: Az Őrség és a Vendvidék néprajzi jellegzetességei. In: In: Boda, L., Orbán, R. szerk.: Az Őrség és a Vendvidék – Kalauz turistáknak és természetbarátoknak. B.K.L. Kiadó, Szombathely, pp. 62-72.
- Zentai, Z., Kercksmár, Zs., Veress, M. 2016: Az Őrség természetrajza. In: Bartha, D. szerk.: Az Őrségi Nemzeti Park I. Szülőföld Könyvkiadó, Óriszentpéter, pp. 40-95.
- <http://www.galambdoktor.hu/vendvidek/?r=21&c=18>
- <http://gatterfogado.hu/?l=latnivalok>
- <http://www.ketvolgy.hu/?module=news&fname=koszonto>
- www.mapygon.com
- <http://slovenci.hu/index.php/oktatas-kultura/a-szloven-nyelvoktatas-helyzete>
- <http://www.szlovenvidek.hu/hu/bemutakozas/>
- <http://www.szlovenvidek.hu/hu/bemutakozas/>

VILLAGES OF PORABJE: INDIVIDUAL ELEMENTS OF THE HUNGARIAN SETTLEMENT NETWORK

Summary

The Vend-region or Porabje in Slovenian is a very particular and special unique area of Hungary. The Slovenian minority living here with other nationalities primarily with Hungarians form the living population of the six classified villages. These villages were born from the former demesne lands that also played role in formation of the sporadic feature beyond history and natural, landscape features. It is significantly outlined on the map still today and in front of the visitor's eyes in case of several settlements. Porabje was one of the most isolated areas of Hungary for a long time in that the geopolitical situation after 1920 and the socialist development aspects of the decades after the 2nd World War also played role. Its closeness dissolved after the regime change thanks to the cross-border cooperation, application opportunities and taking the role of Órség National Park. All of these are the guarantee that these beautiful and diverse small settlements having unique natural and cultural values, and rich history in order to preserve much more besides their identity for the future.

THE DEMOGRAPHIC AGEING OF POPULATION IN BOSNIA AND HERZEGOVINA: CAUSES AND CONSEQUENCES

Alma Kadušić

Dr. sc., Assistant Professor

Department of Geography, Faculty of Science

University of Tuzla, Univerzitetska 4, 75000 Tuzla, Bosnia and Herzegovina

e-mail: alma.kadusic@untz.ba

Alija Suljić

Dr. sc., Associate Professor

Department of Geography, Faculty of Science

University of Tuzla, Univerzitetska 4, 75000 Tuzla, Bosnia and Herzegovina

e-mail: alija.suljic@untz.ba

Nedima Smajić

M.S., assistant

Department of Geography, Faculty of Science

University of Tuzla, Univerzitetska 4, 75000 Tuzla, Bosnia and Herzegovina

e-mail: nedima.smajic@yahoo.com

UDK: 314.18:914.971.5

COBISS: 1.01

Abstract

The demographic ageing of population in Bosnia and Herzegovina: causes and consequences

In this paper the age structure and the ageing population process in Bosnia and Herzegovina in the second half of the 20th century and the beginning of the 21st century is analyzed. The main reasons that caused changes in the age composition of the population and the population ageing in Bosnia and Herzegovina have been researched. The main causes of the population ageing in Bosnia and Herzegovina in the second half of the 20th century were primarily trends in fertility rates and secondarily trends in mortality rates. The economic growth of Bosnia and Herzegovina after World War II conditioned changes in the economic and educational structure of the population and with that the changes in the natural increase rates and migration balance. The war was the main cause of negative demographic changes in Bosnia and Herzegovina in the period from 1992 to 1995, and the post-war adverse socioeconomic, political and other circumstances have been the cause of negative demographic trends after 1995. The aim of this paper is to determine the level of population ageing in Bosnia and Herzegovina and the consequences this process could have on the demographic future of this country.

Key words

Demographic ageing, age structure, population, demographic changes, Bosnia and Herzegovina

1. Introduction

In the second half of the 20th century the age structure of Bosnia and Herzegovina's population was under the influence of many factors from which the most important were the economic, social, political and cultural growth of the country after the World War II. From 1953 to 1991 intensive processes of industrialization, urbanization and deagrarisation have caused significant demographic changes. These processes have conditioned the restructuring of the population from agricultural to non-agricultural activities, i.e., from the primary to the secondary and tertiary economic sector, a need for qualified workforce, a lower illiteracy rate and a higher level of education of the population, increase of the urban population, etc. The aforementioned processes have caused changes in the natural population growth, i.e., lower birth rates which caused a decline in the percentage of children and an increase of older persons in the population of Bosnia and Herzegovina. The migration balance made these trends even more complex in this period. Bosnia and Herzegovina is known for its dynamic migrations which were intensified in the second half of the 20th and the beginning of the 21st century (Ibreljić et. al. 2006). In accordance with the general socioeconomic circumstances, Bosnia and Herzegovina was affected by intensive migrations in the sixties and the seventies of the 20th century. The disproportion of the labor force contingent and industrial capacities caused a departure of the Bosnian population on temporary work abroad. However, men were the ones usually working abroad and women mainly went with them as accompanying family members so that temporary stay in foreign countries usually became permanent. It's an important notion that mostly young and productive people 20 to 44 years old were leaving the country in this period.

During the 1990s rapid demographic changes affected all countries of Central and Eastern Europe. The ageing process in these countries is a consequence of a socioeconomic transition from communist to capitalist societies. The decline in fertility rates combined with a greater emigration of the young population and extended lifetime expectancy all contributed to an intensive ageing process in these countries (Hoff 2008, 14). Bosnia and Herzegovina has a special place in this case because it suffered a war between 1992 and 1995 alongside the mentioned socioeconomic changes in the nineties of the 20th century. Around 2,2 million people were displaced inside Bosnia and Herzegovina's borders or abroad. In 1995 a process of repatriation of refugees started and by 2006 442137 refugees and 569869 displaced people returned to their former place of residence (Ibreljić et. al. 2006). Demographic losses in this period had a big impact on the demographics of Bosnia and Herzegovina in the post-war period. In addition to that, adverse economic, political, social and other circumstances have caused negative demographic trends in the post-war period. A noticeable decrease of birth rates, moderate increase of mortality rates and, consequently, low natural increase rates combined with the negative migration balance contributed to the decline of the total number of population in Bosnia and Herzegovina. Since 2007 the population of Bosnia and Herzegovina has had negative population growth rates, and because of adverse social, economic and other circumstances the country is still being abandoned by young and productive population. This affects the ageing process of Bosnia and Herzegovina's population as well as the further decline of its potential bio-dynamics and vitality, which in a long term can have a negative influence on the demographic trends in the future.

2. Methodology

The age structure of the population represents the fundamental characteristic of population structures. It is important because if used it can show the demographic growth of a specific population - the age population composition can show us the potential vitality and bio-dynamics of the population, especially when analysis of population composition by age is performed on five-year age groups (Friganović 1990, 111-121). An omnipresent view is that the ageing of a population is a demographic process that is considered to be a widespread phenomenon (d'Albris, Collard 2013, 618). This is an intensive demographic process of modern society that is characterized by the increase in the share of the population aged 60 or over and the increase in the average age of the population (Kerbler 2015, 305). Many societies have already attained older population while numerous developing countries are in the midst of the demographic transition and they are experiencing a rapid shift in the relative numbers of children and persons aged 60 or over (Mirkin, Weinberger 2001). According to a report from the United Nations from 2015 the number of the world population aged 60 or over had doubled in the last 50 years (Internet 1). Based on information from "UN World Population Prospects: The 2015 Revision", the number of people aged over 60 was 12,3% of the entire world population and it is expected to rise up to 21,5% until 2050.

Bosnia and Herzegovina too was not bypassed by contemporary world trends of population ageing process. To analyze the trends of the population aging of Bosnia and Herzegovina in the second half of the 20th and the beginning of the 21st century the average and median age of population have been calculated alongside the ageing index and the share of persons aged sixty or over in the entire population. The mentioned indicators are calculated on the basis of the population censuses in Bosnia and Herzegovina from 1953, 1961, 1971, 1981 and 1991 and on the evaluations from 2007 because the results from the 2013 census with information for the age structure of the population have not yet been made available to the public, alongside some other sources which publish information about the demographics of Bosnia and Herzegovina (UN reports). The average age of Bosnia and Herzegovina's population is calculated as a weighted arithmetic mean and the median age as a positional mean. Apart from that, the ageing population process and the age structure of the population of Bosnia and Herzegovina is analyzed by calculating the share of persons aged 60 or over in the entire population. The ageing index is calculated as the number of persons aged 60 or over per hundred persons under age 19 (Nejašmić, 2005, 181-183). For the assessment of the population age level, and the degree of ageing process, the so called vitality index was used. It represents the synthesis between the indicators of the natural population components (fertility and mortality) and the age structure of population (Wertheimer-Baletić 1999, 375).

3. Age structure and the population ageing of Bosnia and Herzegovina in the second half of the 20th century and the beginning of the 21st century

It is considered that the process of population ageing is present in a population if the average age is over 30 and that this process becomes faster and larger as the average age rises (Tasić 1963, 32). The age structure of the population and the indicators of the population ageing in Bosnia and Herzegovina can be analyzed based on the information about the share of the children, working-age population or mature population, and population aged sixty or over in the entire population. Based on the data from the 1953 census it was determined that the average age of the population

of Bosnia and Herzegovina was 25,5 and the median age was 18.9. Between 1961 and 2007 the average age of the population of Bosnia and Herzegovina has risen from 25,5 to 38,9 years and the median age from 21,2 to 38,2 years. In 2015, the median age of the population of Bosnia and Herzegovina has reached a value of 41,5 years (Tab. 1, Internet 2).

Tab. 1: Age structure of Bosnia and Herzegovina's population from 1953 to 2007.

Year	Age				% of population aged 60 or over	Ageing index
	0-19	20-59	60 +	Total		
1953	1 431 341	1 268 492	148 957	2 848 790	5,2	10,4
1961	1 529 027	1 550 809	196 066	3 277 935	6,0	12,8
1971	1 701 756	1 741 062	289 070	3 746 111	7,7	16,9
1981	1 567 425	2 206 427	340 497	4 124 256	8,3	21,7
1991	1 387 399	2 404 160	483 012	4 377 033	11,0	34,8
2007	852 413	1 910 527	684 213	3 447 153	19,9	80,3

Source: Population censuses in Bosnia and Herzegovina; Females and males in Bosnia and Herzegovina 2009. Agency for statistics of Bosnia and Herzegovina, Sarajevo.

As the table shows it is obvious that since 1953 the average age of the population of Bosnia and Herzegovina has been constantly growing. That means that the population ageing process in Bosnia and Herzegovina has started long ago, as is the case in some other countries in the region like Slovenia (Kerbler 2015), Croatia (Nejašmić, Toskić 2013) but also in other European countries. As a rule more developed countries have a larger median age because they also have a larger percentage of population older than 60 (Kinsella, Phillips 2005). The median age of the world population has increased in the period between 1950 and 2010 from 24 to 29 years and it is expected that by 2050 it will reach a value of 36 years. In the more developed countries in the world the median age has risen from 28 to 40 years, and by 2050 it should reach a value of 44 years. According to the same source it is expected that the median age of Bosnia and Herzegovina, Germany, Portugal, Malta, Serbia and Spain will reach a value of 50 years or more (Internet 3).

It is known that the population of a certain area can be classified based on the share of the population older than 60 or younger than 20 in the entire population. If the share of older people is less than 8% than that population is very young and if it is greater than 12 % it is an old population (Wertheimer-Baletić 1999, 367). Thus it can be seen, based on the data shown in Tab. 1, that Bosnia and Herzegovina had a very young population in 1953 because the share of persons aged 60 or over in the entire population was only 5,3%. In 2007 the share of persons aged 60 or over was 19.9% and in 2015 was 22,4% (Internet 2), which means that Bosnia and Herzegovina's population entered the advanced demographic age. The age index of Bosnia and Herzegovina's population increased from 10,4 to 80,3 in this period.

The demographic transition and the ageing population process are shown in the population pyramids of Bosnia and Herzegovina's population (Tab. 2, Fig. 1).

Tab. 2: The share of five-year age groups in the entire population of Bosnia and Herzegovina in 1991 and 2007.

Age	1991			2007		
	Total	Male	Female	Total	Male	Female
0-4	7,59	7,81	7,38	4,33	4,56	4,12
5-9	7,94	8,15	7,72	5,97	6,25	5,71
10-14	7,94	8,15	7,74	7,15	7,45	6,86
15-19	8,22	8,48	7,97	7,27	7,79	6,77
20-24	8,22	8,64	7,81	7,42	7,70	7,14
25-29	8,49	8,89	8,10	6,98	7,03	6,94
30-34	8,27	8,55	7,99	6,27	6,45	6,10
35-39	7,64	7,88	7,41	6,42	6,48	6,36
40-44	6,32	6,38	6,25	7,39	7,56	7,22
45-49	4,60	4,53	4,66	7,99	8,01	7,97
50-54	5,88	5,74	6,02	6,94	7,22	6,66
55-59	5,51	5,35	5,66	6,03	5,60	6,44
60-64	4,54	4,26	4,82	4,76	4,59	4,92
65-69	2,85	2,20	3,49	5,26	4,80	5,71
70-74	1,44	1,05	1,83	4,80	4,39	5,19
75 +	2,21	1,71	2,71	5,03	4,11	5,90
Unknown	2,34	2,23	2,45	0,00	0,00	0,00
Total	100,0	100,0	100,0	100,0	100,0	100,0

Source: Population censuses in Bosnia and Herzegovina; Females and males in Bosnia and Herzegovina 2009. Agency for statistics of Bosnia and Herzegovina, Sarajevo.

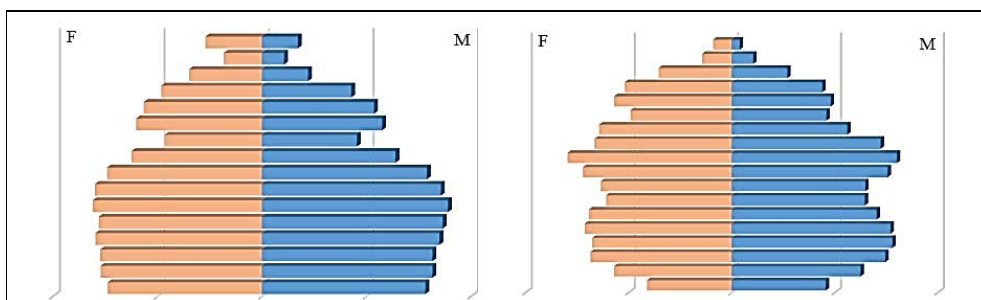


Fig. 1: Population pyramid of Bosnia and Herzegovina in 1991 (left) and 2007 (right).

Source: Population censuses in Bosnia and Herzegovina; Females and males in Bosnia and Herzegovina 2009. Agency for statistics of Bosnia and Herzegovina, Sarajevo.

Based on the data presented in Tab. 1 and 2 and Fig. 1 it can be seen that the population of Bosnia and Herzegovina has been affected by an intensive population ageing process. In the second half of the 20th century and especially in the beginning of the 21st century the number of the younger age groups has decreased and the share of the older ones has increased. The vitality index confirms this having been 0,035 in 1991 and only 0,008 in 2007 which points out to a large decline of potential bio-dynamics and vitality of the population of Bosnia and Herzegovina.

4. Causes and consequences of the ageing population process in Bosnia and Herzegovina

Many different factors influenced the demographic ageing process of Bosnia and Herzegovina's population but changes in the natural population growth and migrations (voluntary or forced) are the largest ones.

There is a significant correlation between the natural population growth of Bosnia and Herzegovina and its age structure. The process of demographic transition, i.e., the shift to lower birthrates started in the 18th century in Europe and the rest of the world, but in some countries it started much later. Still, this process was inevitable for every country in the world, and Bosnia and Herzegovina was no exception (Bošnjović 1990, 114). Due to socioeconomic progress after World War II Bosnia was in an early demographic transition stage since the mortality rate decreased below 30 ‰ with almost an unchanged level of birthrate which resulted with a high rate of population natural increase.

Tab. 3: Natural increase rates in Bosnia and Herzegovina in the period 1953 to 2013.

Year	Births	Deaths	Natural population change	Births	Deaths	Natural increase rates in ‰
				per 1000 people		
1953	110 373	41 199	69 174	38,6	14,4	24,2
1961	108 076	29 413	78 663	32,8	8,9	23,9
1971	82 694	24 915	57 779	21,9	6,6	15,4
1981	71 031	26 222	44 809	17,2	6,3	10,9
1991	65 430	31 411	34 019	14,9	7,2	7,8
1996	46 594	25 152	21 442	12,8	6,9	5,9
2007	33 835	35 044	-1 209	8,8	9,1	-0,3
2013	31 103	35 837	-4 734	8.2	9.5	-1.3

Source: Bosnia and Herzegovina population censuses; Demographics of Bosnia and Herzegovina 2008, Thematic Newsletter 02; Natural population change 2013, report number 1, year VIII, Agency for statistics of Bosnia and Herzegovina, Sarajevo.

In Bosnia and Herzegovina, the change from high to moderate rates of natural population increase happened in the seventies of the 20th century and stayed that way until 1991. The decline of the natural population increase rates occurred as a result of a certain socioeconomic progress that has been caused by the processes of industrialization, urbanization and deagrarisation, that is, the restructuring of the agricultural population into non-agricultural activities and emigration of the population from agricultural to urban-industrial areas. This socioeconomic development also increased the economic activity and the education level of the population, especially of the female part of the population, which resulted with lower birthrates. From 1953 to 1991 the proportion of the active population in the secondary and tertiary economic sector was growing, the share of the active agricultural population declined from 66,6% to 25,3% while the share of the primary economic sector declined from 68,4 to 27,2%. The illiteracy rate dropped from 30,0 to 8,4%, and the number of people with secondary education, college and university education increased (Population census 1953 and 1991).

The birth rate in this period decreased from 38,6 to 14,9 ‰, the mortality rate from 14,4 to 7,2 ‰, and, consequently, the natural population change decreased from 24,2 to 7,8 ‰. As a result of lower birth rates the share of persons aged 0-19 declined (from 50,2 to 24,7%), and the share of persons aged 60 and older increased (from 5,2 to 19,9%) in the entire population of Bosnia and Herzegovina, which indicates the process of demographic transition and demographic ageing of the Bosnian-Herzegovinian population.

The war in the period 1992 - 1995 caused significant demographic changes in Bosnia and Herzegovina. War casualties and forced migration caused a reduction in the total population of Bosnia and Herzegovina. In addition to the adverse economic, social,

political and other conditions it also caused a decrease of the population growth rates in Bosnia and Herzegovina in the postwar period. Birth rates in Bosnia and Herzegovina since 1996 have been below 14 ‰, while at the same time a slight noticeable increase in mortality rates was visible. Mortality rates increased from 6,9 to 9,5 ‰ between 1996 and 2013 due to the higher share of elderly population in the entire population of Bosnia and Herzegovina. These figures show that Bosnia and Herzegovina has entered a post-transition stage of the demographic development, although it is socio-economically lagging behind the highly developed countries where for decades low level of bio-reproduction is recorded (Frejka, Sobotka 2008). Since 2007 Bosnia and Herzegovina recorded a negative natural population change, which in 2013 reached a value of -1,3 ‰. The consequence of a significant decrease in the birth rates and natural population change rates in the second half of the 20th and beginning of the 21st century is the reduction of the share of young people and the increasing proportion of older people in the entire population of Bosnia and Herzegovina.

The age structure of the population of Bosnia and Herzegovina was also affected by migration of the population. Emigration caused reduction of the total number of Bosnia and Herzegovina's population and included mostly younger persons (20-40 years), which was directly reflected in the natural population change, and indirectly in the age structure. By 1991, migrations were caused by economic and social circumstances in the former Yugoslavia; men were the ones usually migrating to foreign countries and were named "temporary workers abroad" in the official statistics. They were often joined by family members (Sentić 1971). Bosnia and Herzegovina lost a significant proportion of its population this way and recorded a negative migration balance until 1991. In 1991 there were 234213 Bosnia and Herzegovina's citizens (5,4% of the entire population) working abroad on a temporary basis (Population census 1991, Agency for statistics of Bosnia and Herzegovina, Sarajevo).

In the period from 1992 to 1995 around 1,2 million people were exiled from Bosnia and Herzegovina and around a million people were displaced inside the country. The process of repatriation of refugees and displaced persons has been recorded since 1995. However, according to the preliminary results of the 2013 Population census there were 3791622 persons living in Bosnia and Herzegovina, whilst in 1991 there were 4377033 people which means that due to coercive migrations and war casualties the number of people in this country was reduced by 585311 (2013 Population census, Agency for statistics of Bosnia and Herzegovina, Sarajevo). The causes for the decline in the number of people in Bosnia and Herzegovina are also post-war voluntary economic migrations, so that Bosnia and Herzegovina still have a negative migration balance. For example, 4284 persons emigrated from the country in 2010 while only 309 immigrated to Bosnia and Herzegovina (Bosnia and Herzegovina's Ministry of Security, 2011), and about a third of the emigrants were between 20 and 34 years of age (Bosnia and Herzegovina's Ministry of Human Rights and Refugees, 2012). This means that young and reproductive generation is leaving Bosnia and Herzegovina, which negatively affects its population's natural reproduction. Thus, following 1991, the natural population change, emigration and external factors have all affected the population ageing of Bosnia and Herzegovina, which is reflected in the decrease of the percentage of young generation and the increase of the percentage of old generation within the entire number of population, as well as the increase of its average age and the ageing index.

The ensued changes in the age structure of Bosnia and Herzegovina's population are significant for the future demographic development of the country because this precise development will in the next few decades be dependent on the number of younger age groups in the present moment. The larger the share of the young generation, the larger the population's reproductive value will be. However, based on the current trends upon which the share of the young generation in the total population is decreasing and the share of the old generation is increasing, and with a negative migration balance, it is expected to have lower fertility rates and birth rates and higher mortality rates, and therefore a smaller number of young generation as well. According to the United Nations' estimations, Bosnia and Herzegovina is one of the countries in the world where an intensive ageing of the population is expected and the median age should reach 53,2 years of age by 2050 (Internet 3). Also, the same organization estimates that Bosnia and Herzegovina will be one of the countries where a 15% decrease in the total number of the population is expected in the ensuing decades where Bosnia and Herzegovina's total population should be around 3 million by 2050 and 1,9 million by 2100 (Internet 2). This is precisely why it is necessary to supervise the changes in the age structure of the population considering that it represents a solid basis for a long-term demographic development. However, it is also necessary to devote attention to other demographic components through adopting and implementing different measures of the population policy which will slow down and eliminate the negative demographic trends that Bosnia and Herzegovina has confronted in the past few decades.

5. Conclusion

Bosnia and Herzegovina is an area of dynamic demographic development. The demographic changes that affected this country's population were especially intensified in the second half of the 20th and the beginning of the 21st century. Those changes occurred as a consequence of socio-economic development in the period 1953 - 1991, the war from 1992 to 1995 as well as adverse economic, political, social and other circumstances in the post-war Bosnia and Herzegovina. In the period from 1953 to 1991 the industrial and economic development of Bosnia and Herzegovina caused restructuring of the population from agricultural to non-agricultural activities. Moreover, economic development caused a need for highly qualified workforce that led to a reduction of the illiteracy rate and an increase of the population's levels of education. Subsequently, all of this affected the natural population change, i.e., the decline of natural increase rates and consequently led to the decrease of the percentage of children and the increase of older persons in the entire population in Bosnia and Herzegovina. The population ageing process in this period was negatively influenced by voluntary economic migrations of Bosnia and Herzegovina's population for the temporary work abroad which, in time, led to a permanent stay. Thus Bosnia and Herzegovina recorded a negative migration balance up until 1991 and the people who emigrated were of the productive generation aged 20-40.

Bosnia and Herzegovina's demographic problems were intensified in the period from 1992 to 1995 when around a half of the population were exiled out of their homes due to forced migrations. Even though a significant number of exiled people returned to their pre-war places of residence, Bosnia and Herzegovina has lost around half a million people directly due to forced migrations, war casualties and post-war economic migrations while the indirect demographic losses are even larger. The loss of a significant number of people in the period from 1992 to 1995, adverse post-war socioeconomic and political circumstances, post-Dayton emigrations (usually of

younger population), and negative natural increase rates have all caused a significant ageing of Bosnia and Herzegovina's population where the percentage of persons aged 60 or over was 22,4% in 2015 and the median age was 41,5. Considering the current demographic trends and the existing socioeconomic circumstances in the country a decrease of potential bio-dynamics and vitality of Bosnia and Herzegovina's population is expected in the future as well.

References

- Bošnjović, I. 1990: Demografska crna jama - nova zamka industrijskog društva. Veselin Masleša. Sarajevo.
- d'Albis, H, Collard, F. 2013: Age groups and the measure of population aging. Demographic Research, Volume 29, Article 23. doi: 10.4054/DemRes.2013.29.23.
- Demographics of Bosnia and Herzegovina 2008, Thematic Newsletter 02. Agency for statistics of Bosnia and Herzegovina, Sarajevo.
- Females and males in Bosnia and Herzegovina 2009. Agency for statistics of Bosnia and Herzegovina, Sarajevo.
- Frejka, T., Sobotka, T. 2008: Fertility in Europe - Diverse, delayed and below replacement. Demographic Research, Volume 19, Article 3. doi: 10.4054/DemRes (2008.19.3).
- Friganović, M. 1990: Demogeografija - stanovništvo svijeta. Školska knjiga. Zagreb.
- Hoff, A. 2008: Population aging in Central and Eastern Europe as an outcome of the socio-economic transition to capitalism. Socialinis Darbas, No. 7 (2). Vilnius.
- Ibreljić, I., Kulenović, S., Kadušić, A., Smajić, S. 2006: Migration flows in Bosnia and Hercegovina after 1992. 46th Congress of European Regional Science Association (ERSA). Volos, Greece. Internet: <http://www-sre.wu-wien.ac.at/ersa/ersaconfs/ersa06/papers/173.pdf> (10.10.2015).
- Informacija o stanju iseljeništva iz Bosne i Hercegovine 2012. Ministarstvo za ljudska prava i izbjeglice. Sarajevo.
- Kerbler, B. 2015: Population Aging in Slovenia - A Spatial Perspective. Acta geographica Slovenica, 55-2. Ljubljana. DOI: <http://dx.doi.org/10-3986/AGS-1885>.
- Kinsella, K., Phillips, D. R. 2005: Global Aging - The Challenge of Success. Population Bulletin Vol. 60, No. 1. Population Reference Bureau (PRB). Washington, DC.
- Migracioni profil Bosne i Hercegovine za 2011. godinu. Ministarstvo sigurnosti BiH, Sektor za imigraciju. Sarajevo.
- Mirkin, B., Weinberger, M. B. 2001: The demography of population ageing. United Nations Population Bulletin, Special Issue No. 42/43. New York.
- Natural population change 2013, Report number 1, Year VIII. Agency for statistics of Bosnia and Herzegovina, Sarajevo.
- Nejašmić, I. 2005: Demogeografija - stanovništvo u prostornim odnosima i procesima. Školska knjiga. Zagreb.
- Nejašmić, I., Toskić, A. 2013: Starenje stanovništva u Hrvatskoj - sadašnje stanje i perspektive. Hrvatski geografski glasnik 75/1. Zagreb.
- Sentić, M. 1971: Naši građani na privremenom radu u inostranstvu. Stanovništvo, Broj 1-2. Institut društvenih nauka, Centar za demografska istraživanja. Beograd.
- Tasić, J. 1963: Dugoročne promjene starosne strukture stanovništva Jugoslavije. Stanovništvo, Godina I, Broj 1. Institut društvenih nauka, Centar za demografska istraživanja. Beograd.

Wertheimer-Baletić, A. 1999: Stanovništvo i razvoj. Mate-Zagreb. Zagreb.

Internet 1: World Population Aging 1950-2050. Population Division 2015. United Nations.

<http://www.un.org/esa/population/publications/worldageing19502050/pdf/80chapterii.pdf> (29.09.2015).

Internet 2: World Population prospects: The 2015 Revision. United Nations Department of Economic and Social Affairs/Population Division.

http://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf (04.01.2015).

Internet 3: World Population Aging 2013. United Nations Department of Economic and Social Affairs/Population Division. New York.

<http://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2013.pdf>. (08.01.2015).

THE DEMOGRAPHIC AGEING OF POPULATION IN BOSNIA AND HERZEGOVINA: CAUSES AND CONSEQUENCES

Summary

The ageing population process in Bosnia and Herzegovina is a result of dynamic demographic changes that happened in this country in the second half of the 20th and the beginning of the 21st century as a consequence of economic, social, political and other changes.

In the period from 1953 to 1991 the development of industry and other economic activities have led to population migrations from rural to urban areas, restructuring of the population from agrarian to non-agrarian activities, and in accordance with that, an increase in economic activity and the population's level of education, the improvement of life standard and health conditions, etc.

The aforementioned changes caused a decline in natural increase rates, which dropped from 24,2 ‰ to 7,4 ‰. The decline of the natural increase led to the decrease in the share of persons aged 0-19 (from 50,2% to 24,7%) and the increase of persons aged 60 or over (from 5,2% to 19,9%) in the entire population in Bosnia and Herzegovina, as well as to the increase in the average and median age of the population.

Voluntary economic migrations of Bosnia and Herzegovina's population to temporary work abroad which turned into a permanent stay in those countries affected the age structure of the population of Bosnia and Herzegovina in the period 1953 to 1991. People aged 20 to 40 were the ones who usually emigrated abroad, which reflected negatively on the bio-dynamics and vitality of Bosnia and Herzegovina's population. According to the 1991 Population census, 234213 citizens or 5,4% of the entire population of Bosnia and Herzegovina were abroad. Moreover, the war in the period 1992-1995 affected the demographics in Bosnia and Herzegovina negatively. The war casualties and forced migrations caused the decrease in the total number of the population, and therefore the potential bio-dynamics and vitality of the population. There were 4377033 people living in Bosnia and Herzegovina in 1991 and 3791622 in 2013 which means that country lost over 0,5 million people, whilst the indirect losses are even larger.

Adverse post-war economic, social, political and other circumstances are all affecting the demographic trends in Bosnia and Herzegovina in a negative way. The natural population change continued to decrease after the war and it has been negative since 2007 (in 2013 reached a value of -1,3 ‰). The migration balance is also negative and mostly the young population aged 20-34 still migrate abroad. The median age of Bosnia and Herzegovina's population increased from 38,2 in 2007 to 41,5 in 2015 while the share of persons aged 60 or over in the total number of population was 22,4% in the same year. Estimations show that Bosnia and Herzegovina will have around 3 million people by 2050 while the median age will increase to 53,2 years of age which would make Bosnia and Herzegovina's population among the oldest in the world. An intensive decline in the potential bio-dynamics and vitality of Bosnia and Herzegovina's population is noticeable and close attention needs to be paid to the age structure and ageing population process since it represents the basis for a long-term demographic development of Bosnia and Herzegovina. Creating and implementing adequate population policy measures is necessary since these can at least slow down the negative demographic trends in Bosnia and Herzegovina.

CHANGE IN THE STATUS OF INTERNALLY DISPLACED BOSNIAKS OF THE SREBRENICA MUNICIPALITY IN THE TUZLA CANTON DURING THE PERIOD 2005-2015

Alija Suljić

Dr. sc., Associate Professor

Department of Geography, Faculty of Science

University of Tuzla, Univerzitetska 4, 75000 Tuzla, Bosnia and Herzegovina

e-mail: alija.suljic@untz.ba

Alma Kadušić

Dr. sc., Assistant Professor

Department of Geography, Faculty of Science

University of Tuzla, Univerzitetska 4, 75000 Tuzla, Bosnia and Herzegovina

e-mail: alma.kadusic@untz.ba

Dževad Mešanović

Dr. sc., Assistant Professor

Department of Geography, Faculty of Science

University of Tuzla, Univerzitetska 4, 75000 Tuzla, Bosnia and Herzegovina

e-mail: dzevad.mesanovic@untz.ba

Sabahudin Smajić

Dr. sc., Assistant Professor

Department of Geography, Faculty of Science

University of Tuzla, Univerzitetska 4, 75000 Tuzla, Bosnia and Herzegovina

e-mail: sabahudin.smajic@untz.ba

UDK: 314.745:914.971.5

COBISS: 1.01

Abstract

Change in the status of internally displaced Bosniaks of the Srebrenica municipality in the Tuzla canton during the period 2005-2015

The war during the period 1992-1995 has caused massive forced migrations of the population in Bosnia and Herzegovina and in this period about 1.2 million people fled beyond the borders of Bosnia and Herzegovina while about 1 million were displaced inside the country. After the Dayton Peace Agreement, there started the process of return of refugees and displaced persons in Bosnia and Herzegovina. However, even after more than 20 years since the signing of the Agreement a significant number of refugees and displaced persons has not returned to their pre-war places of residence. This paper explores the number and the change in the status of the internally displaced Bosniaks of Srebrenica Municipality in the period 2005-2015, those who were residing in Tuzla Canton of the Federation of Bosnia and Herzegovina. According to the Federal Ministry of Refugees and Displaced Persons in Tuzla Canton, in 2005, the status of internally displaced persons had 2016 households with a total of 5549 members, and by 2015 this status has kept 1099 households with a total of 2867 members. The aim of this paper is to point out to some more significant factors that led to a reduction in the number of Bosniaks from the area of Srebrenica municipality who had the status of internally displaced persons in Tuzla Canton.

Key words

Bosniaks, people of Srebrenica, internally displaced persons, status, Tuzla Canton, Srebrenica municipality, municipalities of the Tuzla Canton

Uredništvo je članek prejelo 23.5.2016

1. Introduction

Bosnia and Herzegovina is known as an area of dynamic migration trends that were particularly intensified at the end of the twentieth century as a result of forced migrations. In the period from 1992 to 1995, half of the pre-war Bosnian population was displaced with about 1,2 million residents fled out of Bosnia and Herzegovina (Vallador Alvarez 2015, 6). Neighboring countries have accepted around 40% of the refugees from Bosnia and Herzegovina, and a significant number of Bosnians took refuge in Germany, Austria, Canada, USA and Australia. Around a million people were displaced within Bosnia and Herzegovina (Pasic 2015, 7). Similar data on the intensity of displacement of the Bosnian-Herzegovinian population in the period 1992-1995 was given by the IDMC, and the Norwegian Refugee Council, according to which over half of the Bosnian-Herzegovinian population were displaced during the period 1992-1995, of which about 1,3 million were forced out of Bosnia and Herzegovina; about 500000 fled to neighboring countries and around 700,000 to the countries of Western Europe, including about 350000 in Germany (A profile of the internal displacement situation, IDMC, NRC 2006).

A particular example of negative demographic trends and forced displacement in the period 1992-1995 represents the Municipality of Srebrenica, which is situated in the eastern part of Bosnia and Herzegovina, on the border with Serbia. In this period Serbian forces carried out mass expulsion and killing of Bosniak population. In the area of this municipality, according to the census of 1991, there lived 36666 inhabitants, of which 75.2% represented the Bosniak population. By occupation of the "UN Safe Area of Srebrenica" in 1995 the Serbian army committed genocide against the Bosniak population. In July 1995 there were killed around 8,000 men of the Bosniak population (Van de Bildt 2015, 115), and at the same time the expulsion of this municipality's population was carried out so they were forcibly displaced throughout Bosnia and Herzegovina or fled to other countries of the world (Kulenovic, Suljic 2006, 12). According to the 2013 census in this municipality were enumerated 15242 inhabitants (Agency for Statistics of Bosnia and Herzegovina 2013), which means that as a result of mass murder and persecution, slow and weak post-war return process, this municipality lost about 21000 residents or 584 % of the pre-war population.

According to Article 4 and 5 of the Law on Displaced Persons and Returnees in the Federation of Bosnia and Herzegovina and Refugees from Bosnia and Herzegovina, a displaced person is a citizen of Bosnia and Herzegovina who, after 30. April 1991, has been displaced in the territory of the Federation as a result of conflict, persecution, a well-founded fear of being persecuted or having his/her rights violated within the territory of Bosnia and Herzegovina, and who is neither able to return in safety and with dignity to his/her former place of residence nor has voluntarily decided to settle in a new place of living. A returnee is a refugee from Bosnia and Herzegovina or a displaced person who has expressed a wish to return to his/her former place of residence to the responsible body and who is in the process of returning, as well as a refugee from Bosnia and Herzegovina and a displaced person who has returned to his/her former place of residence. Returnees shall cease to be considered returnees upon the expiry of a six-month deadline, counting from the day of their re-establishment in their former place of residence. Returnee is not a person who has established himself/herself in another place of residence within Bosnia and Herzegovina (Law on Displaced Persons and Returnees in the Federation BiH and Refugees from BiH. Official Gazette of the Federation BiH, No. 15/05). Although after

the Dayton Peace Agreement the process of returning refugees and displaced persons has been going on, according to the data of the Federal Ministry of Displaced Persons and Refugees in the Federation of Bosnia and Herzegovina there were 38,820 displaced persons registered by 31.12.2014. On the territory of this Bosnian-Herzegovinian entity in 2005 the status of internally displaced persons from the area of the Srebrenica municipality had 10139 persons, and in 2013 3174 persons (Database of displaced persons and refugees 2005).

The largest number of displaced inhabitants of Srebrenica, that is, more than a half of the displaced residents of Srebrenica in FBiH have found refuge in Tuzla Canton. In 2005, in Tuzla Canton, there were registered 5549 displaced persons from the area of Srebrenica municipality, and by 2015 that number was reduced to 2867 people (Database of displaced persons and refugees. Ministry of Work, Social affairs and Return of Tuzla Canton. Tuzla, 2015).

However, the reduction in the number of Srebrenica people with the status of displaced persons did not happen in this period as a result of returning the displaced persons to the municipality of Srebrenica. By the end of 2005, 1754 households with a total of 3946 members returned to their pre-war places of residence in the municipality of Srebrenica, whereas in the year 2015, in the Srebrenica municipality were less than 2000 inhabitants of Bosniak population. A certain number of displaced persons decided not to return to their pre-war places of residence due to past trauma of war, sense of insecurity, adverse economic and social conditions in the Republic of Srpska. The population of returnees often face poverty due to lack of employment opportunities, poor access to social and health services, the education system is ethnically divided and so on. In addition, younger generations of the displaced population have integrated into the new environment, their ties to the area of origin weakened, and thus their desire to return has weakened. Therefore, the reduction in the number of Srebrenica people with the status of displaced persons in the area of Federation of Bosnia and Herzegovina and Tuzla Canton, to a lesser extent was caused by the process of returning displaced persons to the municipality of Srebrenica. For the most part, it is the consequence of the social, economic, and political situations and the legislation in the Federation of Bosnia and Herzegovina and Tuzla Canton in the post-war period.

2. Materials and Methods

The study of the change in the number and status of internally displaced Bosniaks from the Srebrenica Municipality in the area of Tuzla Canton and Federation of Bosnia and Herzegovina, in the period 2005-2015, was conducted on the basis of the Database on displaced persons and refugees of the Federal Ministry of Displaced Persons and Refugees (data for 2005 and 2015) and the Ministry of Labour, Social Affairs and Return of Tuzla Canton (data for 2015). The database on displaced persons and refugees for 2005 was formed on the basis of re-registration process of refugees and displaced persons in order to determine the actual number of persons in the said status. Data for 2005 contain an individualized list of the holders of displaced person status, as well as the number of members of their family households according to the pre-war place of residence and the current place, municipality and canton of residence in the Federation of Bosnia and Herzegovina. Data for 2015, with similar content as in 2005, include exclusively displaced Bosniaks of Srebrenica in the area of Tuzla Canton.

In addition to the mentioned data on the internally displaced Bosniaks of Srebrenica Municipality in Tuzla Canton, other statistical data were also used, which are directly or indirectly related to the internally displaced Bosniaks of Srebrenica. These are the following databases:

- Individualized list of Bosniak victims of genocide in the municipality of Srebrenica, in the period from 1992 to 1995 (containing 5400 killed and fallen persons);
- Database of the Service for the return of Srebrenica Municipality, about the number of returnees to the municipality of Srebrenica by 31.12.2004. (contains information on 1687 households with a total of 3835 members by their settlements in the municipality of Srebrenica);
- An excerpt from the Central Voters Register of Bosnia and Herzegovina 2006. The Central Election Commission of Bosnia and Herzegovina, Sarajevo (contains data on 10283 voters with the right to vote in the municipality of Srebrenica).

The other sources of information relating to the issue and the subject of research were also consulted, such as professional and scientific papers, statistical data of governmental and non-governmental organizations, as indicated in the list of references.

All the mentioned data were compared with data from the Database of displaced persons and refugees, which was obtained from the relevant ministries at the level of the Federation BiH and Tuzla Canton. The purpose of these comparisons was to reach more exact indicators on the status and the number of internally displaced Bosniaks of the Srebrenica Municipality in the area of Tuzla Canton, as well as the actual number of displaced persons after the fall of the "UN Safe Area of Srebrenica", July 1995, and deportation of civilians, mainly women, children and the elderly to the area of Tuzla district (today Tuzla Canton), as well as the number of returnees in the municipality of Srebrenica. In addition to the method of comparison, the other used methods were the method of case studies and method of meta-analysis.

3. Number of internally displaced Bosniaks of the Srebrenica Municipality in the area of Tuzla Canton in the period 2005-2015

In the period from 1992 to 1996 the temporary accommodation in Tuzla Canton was given to about 15000 displaced Bosniaks from the Srebrenica Municipality. After signing the Dayton Peace Agreement in late 1995, and the cessation of the state of war in Bosnia and Herzegovina in the first half of 1996, and finally opening of traffic roads both within Bosnia and Herzegovina and to foreign countries, there occurred migrations of internally displaced Bosnians of the Srebrenica municipality. These migrations have taken place both within the Federation of Bosnia and Herzegovina and towards the Western European or overseas countries. According to unofficial estimates, between 5 and 10 thousand of Srebrenica Bosniaks live outside Bosnia and Herzegovina. Although there are no exact figures to indicate how many Bosniaks of Srebrenica municipality have really been displaced in the territory of Tuzla canton (Tuzla district), it is assumed that in this period, in Tuzla Canton were residing about 80% of the total number of displaced Bosniaks from Srebrenica. However, through the process of registration of displaced persons and refugees in the post-war period, by the competent institutions in the Federation of Bosnia and Herzegovina, the actual number of displaced persons from the area of Srebrenica within Tuzla Canton and the entire Federation of Bosnia and Herzegovina was determined.

By 2005, more than half of the internally displaced Bosniaks from the Srebrenica municipality had a residence in the area of Tuzla Canton. Out of the total number of expelled persons from Srebrenica who lived in FBiH, in the municipalities of Tuzla Canton lived approximately 54% of all displaced families, or 54,7% of all displaced persons (Kulenovic et. al. 2006, 16). Thus, in the area of Tuzla Canton in 2005, there were 2016 households resident with a total of 5549 members of the internally displaced people from Srebrenica. By 2015, this number decreased to 1099 households with a total of 2867 members (Tab. 1).

Tab. 1: Number of persons expelled from Srebrenica, by municipalities of the Tuzla Canton, in 2005 and 2015.

Year	2005		2015	
Canton / Municipality	Number of households	Number of members	Number of households	Number of members
Total, TK	2016	5549	1099	2867
Banovići	167	419	94	218
Čelić	9	24	1	1
Doboj Istok	11	33	5	16
Gračanica	108	312	68	207
Gradačac	114	379	61	208
Kalesija	45	144	51	142
Kladanj	31	99	16	56
Lukavac	375	1064	184	521
Srebrenik	522	1418	196	424
Tuzla	300	807	195	506
Živinice	334	850	228	568

Source: Database of displaced persons and refugees. Federal Ministry of Displaced Persons and Refugees. Sarajevo, 2015.

In relative numbers shown, the number of households of the internally displaced Bosniaks from Srebrenica in the period 2005-2015 decreased by 45,5%, and the total number of household members decreased by 48,3%. The process of reducing the number of displaced persons in Tuzla Canton, and other administrative units of the Federation of Bosnia and Herzegovina, was affected by several factors, the most significant being demographic (bio-reproductive), economic and housing. Of demographic factors the most important is low birth rate among the refugee population which was influenced by the so-called external factors, in other words, by the loss of a large number of male population in fertility age during the period from 1992 to 1995, which led to a large gender disproportion in the displaced population from Srebrenica and thus to termination of bio-reproduction in women who were married. Economic factors also had a major impact on the number of displaced residents of Srebrenica in Tuzla Canton. A large number of displaced and expelled persons in the municipality of Srebrenica had lost immediate family members (children, husbands, parents) who were killed, and thus according to current legislation in the Federation of Bosnia and Herzegovina they could have provided adequate socio-economic benefits such as the right to a permanent family care allowance. In addition, a number of displaced persons from Srebrenica lost their status of displaced persons by solving their employment-legal status, that is, by getting employment and housing (Suljić et. al. 2015, 9).

However, even though there was a significant reduction in the number of households (that is, the total number of internally displaced Bosniaks from the Srebrenica Municipality), still their relative proportion increased in the area of Tuzla Canton in relation to other areas of the Federation of Bosnia and Herzegovina. In 2005, the

share of internally displaced Bosniaks of Srebrenica Municipality who stayed in the area of of Tuzla Canton amounted to about 55% of the total number of displaced Srebrenica people in FBiH. In 2015, this share was much higher being approximately 76,7% of the total number of internally displaced households, or 77,7% of the total number of internally displaced persons from Srebrenica who have the status of displaced persons in the Federation of Bosnia and Herzegovina. There are several reasons that caused the expelled Bosniaks from Srebrenica to, in large numbers, retain the status of displaced persons in Tuzla Canton in relation to other cantons of the Federation of Bosnia and Herzegovina where this population resided. However, there are two most important reasons: one is geographical, the other is socio-economic. The area of Tuzla Canton is geographically closest to the municipality of Srebrenica, so the majority of refugees and internally displaced Bosniaks of Srebrenica hope that, sooner or later, they will return to their pre-war places of residence in the municipality of Srebrenica. Another reason is the status or socio-economic nature, because people who have got legally recognized status of displaced or expelled persons are entitled to some legally provided benefits, such as for example the right to a permanent family care allowance, the right to health care, etc.

The very process of returning to pre-war places of residence of internally displaced persons from Srebrenica did not significantly contribute to the overall reduction in people with the status of displaced persons. Although some official reports of government at all levels in Bosnia and Herzegovina show that the return of internally displaced persons to their pre-war places of residence was satisfactory, it can not be claimed for the municipality of Srebrenica. As an example, the data from the "Service for return" of Srebrenica municipality by the end of 2004 may be used. According to the aforementioned service of the Srebrenica municipality by the end of 2004 in this municipality have returned 1310 Bosniak families with a total of 3048 members. That these figures are much lower is shown by the data obtained on the basis of selected lists from the central electoral register of voters of Bosnia and Herzegovina for the general elections in Bosnia and Herzegovina in 2006. Namely, the permanent residence in the area of Srebrenica had 1384 persons of Bosniak nationality who were aged 18 years and over (persons with the right to vote). If to this number is added about 20% of Bosniaks who are under the age of 18 years, it gives a total of 1730 people, or approximately 1800 Bosniaks who lived in the area of Srebrenica municipality in mid-2006 (BiH Central Voters Register. Central Election Commission. Sarajevo, 2006). From the above said, it comes out that the process of return of displaced persons to their pre-war places of residence can not be taken as an important cause of the decrease in the number of people with the status of a displaced person, especially when it comes to the number of returns to the municipality of Srebrenica.

4. Spatial distribution of internally displaced Bosniaks of the Srebrenica Municipality in the area of Tuzla Canton in 2005 and 2015

The territorial distribution of internally displaced persons from Srebrenica in the municipalities of Tuzla Canton was conditioned by several factors. The first and foremost factor is the original accommodation of internally displaced people of Srebrenica after their deportation from the occupied, so-called, "UN Safe Area" of Srebrenica in July 1995. The people from Srebrenica who were expelled, were first placed in military facilities and tents in Dubrave, near Tuzla, and later relocated to other municipalities of Tuzla Canton, primarily in the following municipalities: Banovići, Lukavac, Srebrenik, Tuzla and Živinice, and later in the municipalities of

Gračanica, Gradačac and Kladanj. This can be seen as well from the total number of internally displaced persons from Srebrenica who mostly left in the municipalities in which they were placed at the end of 1995 and beginning of 1996 (Tab. 2).

Tab. 2: Comparison of distributions of displaced persons from Srebrenica by municipalities of the Tuzla Canton in 2005 and 2015.

Year	2005		2015	
Canton / Municipality	Number of households	Number of members	Number of households	Number of members
Total, TK	2016	5549	1099	2867
Banovići	167	419	94	218
Čelić	9	24	1	1
Doboj Istok	11	33	5	16
Gračanica	108	312	68	207
Gradačac	114	379	61	208
Kalesija	45	144	51	142
Kladanj	31	99	16	56
Lukavac	375	1064	184	521
Srebrenik	522	1418	196	424
Tuzla	300	807	195	506
Živinice	334	850	228	568

Source: Database of displaced persons and refugees. Federal Ministry of Displaced Persons and Refugees. Sarajevo, 2015.

Other factors that have influenced the distribution of displaced persons from Srebrenica to the area of Tuzla Canton can be included in the group of geographic factors. The most important are geographical, topographical and traffic positions of municipalities in Tuzla Canton, or the proximity to the Tuzla City as the administrative, cultural, health and university center of Tuzla Canton.

The best view of territorial and numerical distribution of internally displaced Bosniaks of Srebrenica Municipality in 2005 in the municipalities of Tuzla Canton can be obtained through the relative numbers. The order of municipalities from Tuzla Canton is given by the largest share of internally displaced Bosnians: Srebrenik 25,6%, Lukavac 19,2%, Živinice 15,3%, Tuzla 14,5%, Banovići 7,6%, Gradačac 6,8%, Gračanica 5,6%, Kalesija 2,6%, Kladanj 1,8%, Doboj Istok 0,6% and municipality Čelić 0,4% of the total number of internally displaced Bosniaks of Srebrenica municipality throughout Tuzla Canton. So, from the above relative numbers, that is, shares of the number of internally displaced persons from Srebrenica over Tuzla Canton, it can be seen that most of the displaced persons had a residence in the municipalities in which the displaced persons were located at the end of 1995 and beginning of 1996, which gravitate towards Tuzla City. In addition to the aforementioned, a significant impact on the regional distribution of the displaced Bosniaks of Srebrenica Municipality in the area of Tuzla Canton had a traffic position and size of the settlement of residence. Namely, the regional distribution of families displaced from Srebrenica in these municipalities was conditioned, first of all, by favorable geo-traffic position of these settlements compared to municipal urban centers (Kulenović et. al. 2006, 17-19).

In 2015, the largest number of displaced persons from the municipality of Srebrenica had a residence in the following municipalities of Tuzla Canton: Živinice 19,8%, Lukavac 18,2%, Tuzla 17,6%, Srebrenik 14,8%, Gradačac 7,3%, Gračanica 7,2%, Kalesija 5,0%, Banovići 7,6%, Kladanj 2,0% and municipality Doboj Istok 0,6% of

the total number of internally displaced Bosniaks of Srebrenica Municipality in the area of Tuzla Canton.

Based on these data, a conclusion can be made that in the period 2005-2015, certain changes happened in the proportion of internally displaced Srebrenica people in the municipalities of Tuzla Canton. The most significant decrease in the share of the displaced persons was recorded in the municipality of Srebrenik, and an increase in the municipality of Živinice. In other municipalities of Tuzla Canton there was no significant variation in the number of displaced persons from Srebrenica. These changes do not mean that a large number of internally displaced persons left some municipalities, and moved to others in the Tuzla Canton, even though such migrations existed. In most cases, if there was no return to pre-war places of residence, displaced persons resolved their housing and economic needs in the municipality area of residence, and hence by the force of law they lost the right to the status of displaced persons. The status of displaced person in the Federation of Bosnia and Herzegovina may cease for various reasons, the most important are: voluntary return to their former place of residence; refusal to return to a former place of residence, although a voluntary return to his/her former place of residence is possible, in safety and dignity, and when there are no compelling reasons arising out of previous persecution or other strong humanitarian reasons; when a displaced person has voluntarily decided to permanently settle elsewhere in the territory of the Federation; when a displaced person has made a free use of his/her pre-war property in his/her former place of permanent residence (sale, exchange, rent); when a displaced person has made a free use of his/her property in his/her place of temporary residence (purchase or construction of house, apartment); when a displaced person has used assistance/donation for an urgent repair of his/her house, apartment in his/her place of permanent/temporary residence; in case of death (Law on Displaced Persons and Returnees in the Federation BiH and Refugees from BiH. Official Gazette of the Federation BiH, No. 15/05). One of the indicators that there were no significant intra-municipal migrations of displaced persons is that these people in the 10-year period, for the most part, retained the same place of residence. The best examples are the municipalities of Živinice, Tuzla, Srebrenik and Lukavac.

5. Distribution of internally displaced Bosniaks of the Srebrenica municipality in municipalities of the Tuzla Canton by gender and selected age groups in the year 2015

According to the data from the International Commission on Missing Persons 7755 residents of the municipality of Srebrenica were killed around 11 July 1995. Of that number, DNA analysis identified 6918 people (89% of the total number of killed), and 803 persons are still missing, that is, 10% of the total number of deaths in the genocide (International Commission on Missing Persons, 2015). Males make up the majority of the victims, but there were also women and children among victims (a little more than 5% of victims are children under the age of 15 years) (Leydesdorff 2011, 12). Therefore, most of the displaced Bosniaks of Srebrenica are female persons, which is understandable, bearing in mind that in the area of Srebrenica during the war, from 1992 to 1995, were killed more than 5000 males (Suljic et. al. 2015, 9). Tab. 3. shows data on distribution of the displaced people from Srebrenica in the municipalities of Tuzla Canton, by gender and corresponding age groups.

Tab. 3: Distribution of displaced persons from Srebrenica in municipalities of the Tuzla Canton by gender and selected age groups in 2015.

Canton / Municipality	Total	Gender	Age distribution					
			total	0-4	5-17	18-50	51 +	unknown
Tuzla Canton	2,822	male	1,174	17	145	827	184	1
		female	1,648	19	136	834	658	1
Banovići	217	male	88	1	10	59	17	1
		female	129	1	7	70	51	0
Čelić	1	male	0	0	0	0	0	0
		female	1	0	0	0	1	0
Doboj Istok	17	male	6	0	1	5	0	0
		female	11	0	0	8	3	0
Gračanica	205	male	85	1	9	66	9	0
		female	120	3	8	61	48	0
Gradačac	208	male	88	1	13	64	10	0
		female	120	1	16	66	37	0
Kalesija	132	male	56	0	8	38	10	0
		female	76	0	8	39	29	0
Kladanj	42	male	23	0	2	14	7	0
		female	19	0	1	8	10	0
Lukavac	553	male	237	3	24	177	33	0
		female	316	5	32	170	109	0
Srebrenik	436	male	177	5	30	119	23	0
		female	259	4	30	102	123	0
Tuzla	469	male	198	2	24	137	35	0
		female	271	4	21	139	106	1
Živinice	542	male	216	4	24	148	40	0
		female	326	1	13	171	141	0

Source: Database of displaced persons and refugees. Federal Ministry of Displaced Persons and Refugees. Sarajevo, 2015.

Based on the data presented in table 3 it is evident that the part of female persons in the total number of displaced persons in Tuzla Canton is 58,4%, and the proportion of males only 41,6%. In the age group 18-50 years there is an almost equal proportion of male and female population, 29,3% of men and 29,6% for women. However, a significant difference exists between the proportion of male and female population aged 51 and over; only 6,5% of male and 23,3% of female population. One of the main reasons for this gender disproportion is the suffering of the male population in the municipality of Srebrenica during the period 1992-1995. Also, the proportion of the male population aged 18-50 years in the total male population is 70,4% and the share of females, aged 18-50 years, in the total female population is 50,6%. This difference was, probably, conditioned by entering marriages for a part of the female population, which created legal requirements for losing the status of displaced persons.

From the above, it can be concluded that the share of mature and late-age population will increase, and the share of young population will decrease. Not only it is the matter of the biological aging process, and the associated demographic process of aging of the displaced from Srebrenica, but also it is the loss of the status of displaced persons on the basis of the acquisition of certain socio-economic conditions that are prescribed by law and regulated. The very return to the pre-war place of residence does not have a significant role in the process of reducing the number of people with the status of internally displaced persons.

6. Conclusion

Among a large number of factors that have influenced the number of internally displaced Bosniaks of Srebrenica in Tuzla Canton the political, geographical, socio-economic, legal and demographic factors can be sorted out. The political factors include war events around the so-called "UN Safe Area of Srebrenica" in July 1995, mass killings of young and middle-aged men, the expulsion of women and children to the area of today's Tuzla Canton and others. Geographical factors are determined by the shortest distance between the area of Tuzla Canton and the municipality of Srebrenica. Socio-economic factors, such as employment, housing, marrying, etc., have caused giving up or losing the status of displaced persons. The latter is related to the legal or statutory factors. Demographic factors are reflected in the low birthrate with refugee populations, gender disproportion which was conditioned by the mass murder of young and middle-aged men during the genocide in July 1995, especially young, married men and others.

As for the territorial distribution of internally displaced people of Srebrenica in the municipalities of Tuzla Canton, during the period 2005-2015, it can be concluded that there were no significant changes, as observed in relative numbers. A significant reduction in the share of the displaced persons occurred in the municipality of Srebrenik, with simultaneous increase that occurred in the municipality Živinice, while in other municipalities this change was not significant. Considering their pre-war places of residence, the internally displaced Bosniaks in Tuzla Canton, originally were from 61 inhabited places of the municipality of Srebrenica, whereas from 10 settlements there was not even one person with the status of a displaced person. Only in two municipalities of Tuzla Canton, Sapna and Teočak, there were no internally displaced Bosniaks of Srebrenica.

The majority of the displaced Bosniaks of Srebrenica are women as a result of the destruction of the male population during the war and mass killings during the genocide in July 1995. The highest and almost equal share for both genders is in the population age group of 18 to 50 years. A significant difference between the shares of both genders occurs in the population aged 51 and over, where the share of women compared to men is 3.6 times higher. The main reason for this gender disproportion is the destruction of male population during the genocide in the municipality of Srebrenica, from 1992 to 1995.

The paper was created within the framework of the scientific-research project "The change in the status of the refugees and internally displaced Bosniaks of the Srebrenica Municipality in the territory of FBiH" which was approved and funded under the 5th Internal call of the University of Tuzla for financing/co-financing of projects in the field of science of importance for the Federation BiH in 2014, entitled "Support for research of importance for the Federation" (No. 01/2-2995/15) from 26.05.2015.

References

- A profile of the internal displacement situation - Bosnia and Herzegovina. Internal Displacement Monitoring Centre (IDMC), Norwegian Refugee Council. Geneva, 2016.
- BiH Central Voters Register. Central Election Commission. Sarajevo, 2006.
- Database of displaced persons and refugees 2005. Federal Ministry of Displaced Persons and Refugees. Sarajevo. Internet: www.fmroi.gov.ba/bosanski/statistika/index.php (29.02.2016).
- Database of displaced persons and refugees. Federal Ministry of Displaced Persons and Refugees. Sarajevo, 2015.
- Database of displaced persons and refugees. Ministry of Work, Social affairs and Return of Tuzla Canton. Tuzla, 2015.
- Kulenović, S., Suljić, A. 2006: Demografske posljedice genocida nad Bošnjacima sigurnosne zone UN Srebrenica, jula 1995. Zbornik radova Prirodno-matematičkog fakulteta Univerziteta u Tuzli, Svezak geografija, Godina III, Broj 3. Tuzla.
- Kulenović, S., Suljić, A., Kadušić, A. 2006: Razmještaj interno raseljenog (prognanog) stanovništva iz općine Srebrenica na području Tuzlanskog Kantona. Zbornik radova Prirodno-matematičkog fakulteta Univerziteta u Tuzli, Godina III, Broj 3, Svezak geografija. Tuzla.
- Law on Displaced Persons and Returnees in the Federation BiH and Refugees from BiH. Official Gazette of the Federation BiH, No. 15/05, 16.03.2005.
- Leydesdorff, S. 2011: Surviving the Bosnian Genocide. Indiana University Press. Bloomington and Indianapolis, USA.
- Pašić, L. 2015: Political and Social consequences of continuing displacement in Bosnia and Herzegovina - Bosnia and Herzegovina twenty years on from The Dayton Peace Agreement. Forced migration review, Issue 50. Refugee Studies Centre, Oxford Department of International Development, University of Oxford. Oxford.
- Preliminarni rezultati popisa stanovništva, domaćinstava i stanova u Bosni i Hercegovini 2013, Saopštenje broj 1. Agencija za statistiku Bosne i Hercegovine, Sarajevo.
- „Service for return“ of Srebrenica municipality. (31.12.2004).
- Statistics of Missing Persons per Municipality of Disappearance: Srebrenica-1995. International Commission on Missing Persons. Internet: <http://www.icmp.int> (05.03.2015).
- Suljić, A., Kadušić, A., Mešanović, Dž., Smajić, S. 2015: Promjena statusa interno raseljenih Bošnjaka općine Srebrenica u periodu 2005-2015. godine na području Zeničko-dobojskog kantona. Zbornik radova Prirodno-matematičkog fakulteta Univerziteta u Tuzli, Svezak geografija, Godina XI, Broj 11. Tuzla.
- Vallador Alvarez, M. P. 2015: Anex 7: Why are we still discussing it - Bosnia and Herzegovina twenty years on from The Dayton Peace Agreement. Forced migration review, Issue 50. Refugee Studies Centre, Oxford Department of International Development, University of Oxford. Oxford.
- Van de Bildt, J. 2015: Srebrenica: A Dutch national trauma. Journal of Peace, Conflict and Development, Issue 21. Faculty of Social Sciences, University of Bradford, UK.

CHANGE IN THE STATUS OF INTERNALLY DISPLACED BOSNIAKS OF THE SREBRENICA MUNICIPALITY IN THE TUZLA CANTON DURING THE PERIOD 2005-2015

Summary

The studies on changes in the status of internally displaced Bosniaks of Srebrenica Municipality in Tuzla Canton during the period 2005-2015 were aimed to point out the main factors that have contributed to reducing the number of displaced persons, and that it was not significantly influenced by the return to the area of Srebrenica Municipality. Of the total number of internally displaced Bosniaks of Srebrenica Municipality within the Federation of Bosnia and Herzegovina, 55% of them lived in the area of Tuzla Canton by 2005, and 10 years later, that proportion increased to 77%, although the absolute number of internally displaced persons from Srebrenica in that period decreased by about 64% in the Federation of Bosnia and Herzegovina, or about 52% in Tuzla Canton. The most important factors that influenced the process of changing the status of displaced persons are classified in the group of socio-political (war and post-war situation in Bosnia and Herzegovina), geographic (distance between the area of Tuzla Canton and Srebrenica municipality), socioeconomic (resolving employment-legal relations and housing issues), demographic (low birthrate and gender disproportion in the refugee population) and legal factors (loss of status due to changes prescribed by law).

In late 1995 and early 1996, in Tuzla Canton area there were about 18500 Bosniaks from Srebrenica, including 15000 people who were expelled or fled after the occupation of the Srebrenica enclave in July 1995, and about 3500 people who were evacuated from the Srebrenica enclave in the spring of 1993.

Internally displaced Bosniacs stayed within the area of whole Tuzla Canton, except in the municipalities of Sapna and Teočak, and the most numerous were in the following municipalities: Srebrenik 25,6%, Lukavac 19,2%, Živinice 15,3% and Tuzla 14,5%, according to data from 2005, or in the municipalities: Živinice 19,8%, Lukavac 18,2%, Tuzla 17,6% and Srebrenik 14,8%, according to data from 2015. The territorial distribution of families displaced from Srebrenica in these municipalities was conditioned, first of all, by favorable geo-traffic position of these settlements in relation to the municipal urban centers.

In the area of Tuzla Canton in 2015 internally displaced Bosnians were originally from 61 settlements of the municipality of Srebrenica, whereas from 10 pre-war settlements of this municipality there was not even one internally displaced person.

The majority of the internally displaced Bosniaks of Srebrenica is made up of women with a share of 58,4%, while the proportion of males is only 41,6%. In the age group 18-50 years there is an almost equal proportion of male and female population, with 29,3% of the male, and 29,6% of the female population. A significant difference exists between the proportion of male and female population aged 51 and over; only 6,5% of male and 23,3% female population. The main cause of this gender disproportion is the destruction of male population during the genocide in the Municipality of Srebrenica, from 1992 to 1995.

TEMPERATURNI OBRAT IN TERMALNI PAS V SLOVENSKIH GORICAH MED MURO IN PESNICO

Martin Marič

Profesor geografije in zgodovine
Trate 51, SI - 2213 Zgornja Velka, Slovenija
e-mail: maric.tine@gmail.com

UDK: 551.584:914.971.2

COBISS: 1.01

Izvleček

Temperaturni obrat in termalni pas v Slovenskih goricah med Muro in Pesnico

Temperaturni obrat in termalni pas sta dva topoklimatska pojava, ki sta v Slovenskih goricah v veliki meri vplivala na razširjenost vinogradništva in sadjarstva. V članku smo z meritvami in analizami dokazali prisotnost temperaturnega obrata in termalnega pasu v Slovenskih goricah med Muro in Pesnico. Analizirali smo tudi v katerih vremenskih tipih pojava nastaneta in v katerih sta najintenzivnejša. S pomočjo meritev smo skušali dokazati spodnjo mejo termalnega pasu v Slovenskih goricah med Muro in Pesnico.

Ključne besede

temperaturni obrat, termalni pas, vremenski tip, Slovenske gorice med Muro in Pesnico

Abstract

Temperature inversion and thermal belt in the Slovenske gorice region between the Mura and Pesnica Rivers

Temperature inversion and thermal belt are the two topoclimatic phenomena, which influence the prevalence of vineyards and orchards in the Slovenske gorice region. The presence of temperature inversion and thermal belt within the Slovenske gorice region was proven by our measurements and analyses. Furthermore, we analysed their occurrence and their intensity in different weather types. Our aim was also to prove the lower limit of thermal belt in the Slovenske gorice region between the Mura and Pesnica Rivers.

Key words

Temperature inversion, thermal belt, weather type, the Slovenske gorice region between the Mura and Pesnica Rivers

1. Uvod

V gričevju Slovenskih gorik vinska trta ter sadno drevje rasteta predvsem na pobočjih nad dolinami rek in potokov. Vzrok temu so topoklimatske razmere Slovenskih gorik. Doline so zaradi pogostih temperaturnih obratov in posledične višje temperature na pobočjih manj primerne za rast občutljivih kulturnih rastlin kot sta sadno drevje in vinska trta. Temperaturni obrat ali temperaturna inverzija je pojav, pri katerem se temperature z višanjem nadmorske višine večajo, namesto padajo. Poznamo štiri vrste temperaturne inverzije, nas je zanimala prizemna oz. radiacijska inverzija (Šegota 1988). Ta vrsta temperaturnega obrata se pojavlja predvsem v hladnem delu dneva, ko so noči jasne in mirne (Yoshino 1976; Ogrin 2000, 2003, 2005). V Sloveniji je letno takih dni okoli 50 % (Petkovšek 1965, povzeto po Ogrin 2000). Radiacijska temperaturna inverzija nastane, ko se zaradi dolgovalovnega sevanje Zemlje v jasnih nočeh tla ohladijo in posledično se ohladi tudi zrak nad tlemi. V jasnih nočeh ni oblačnega pokrova, ki bi preprečil izgubo dolgovalovnega sevanja. Prav tako je pomemben dejavnik za nastanek temperaturnega obrata mirno ozračje brez vetra, ki bi premešal ozračje (Šegota 1988; Ogrin 2000). Hladen zrak nad tlemi je težji in gostejši od toplega, zato se steka v nižje ležeče doline, na višje ležečih pobočjih in slemenih pa ostaja toplejši zrak. V dolinah nastaja jezero hladnega zraka, ki počasi odteka proti nižjim točkam reliefa. S stekanjem hladnega zraka v doline pa se zrak lahko nasiči z vlago in nastane radiacijska megla (Ogrin 2003).

Posledica pogostega temperaturnega obrata pomeni tudi toplejšo minimalno in povprečno letno temperaturo na predelih nad dolinami. Ta pojav je v Sloveniji prvi podrobneje predstavil akademik Gams, ki je termalni pas opredelil kot toplejši pas od tega na dnu dolin in kotlin in onega nad njim in je torej najtoplejši pas v državi (Gams 1996, 6). Tako kot temperaturni obrat je tudi termalni pas najbolj izrazit v hladni polovici dneva ob anticiklonalnem vremenu (Žiberna 1992; Gams 1996). V termalnem pasu so najugodnejše podnebne razmere za vinogradništvo in sadjarstvo, saj je v dolinah večja možnost pozebe pa tudi vlage je v dolinah več (Gams 1996; Žiberna 1992; Ogrin 2007).

Omeniti je potrebno, da sta tako temperaturni obrat kot termalni pas spremenljiva pojava, ki sta odvisna od reliefa in od vremenske situacije. Tako je vsaka dolina s pobočjem edinstvena in ima svoje temperaturne posebnosti (Žiberna 1999; Ogrin 2007).

Spodnja meja termalnega pasu je težko določljiva, saj je spremenljiva in se v Slovenskih goricah praviloma pojavlja med 15 in 30 metri nad dnom doline. V veliki večini primerov se lahko orientiramo tudi po večstoletni tradiciji vinogradništva na tem območju, kjer spodnja meja vinogradov sovpada s spodnjo mejo termalnega pasu (Kert 1973; Žiberna 1992).

V članku smo analizirali podatke z meteoroloških postaj, ki so ležale na našem območju na različnih reliefnih tipih. Analizirali smo lastne meritve, s katerimi smo dokazali obstoj in intenzivnost temperaturnega obrata in termalnega pasu glede na vremenske tipe.

2. Metodologija

Podatke, s katerimi smo dokazali obstoj termalnega pasu v Slovenskih goricah med Muro in Pesnico, smo pridobili na spletnih straneh Agencije Republike Slovenije za

okolje. Analizirali smo podatke za meteorološko postajo Polički Vrh, ki leži v dolini in približno 11,5 km oddaljeno postajo Zgornja Ščavnica, ki leži na slemenu. Analizirali smo temperature med leti 1969 in 1993, ko je postaja Zgornja Ščavnica prenehala obratovati. Novejše podatke za leta 2008 - 2013 smo za postajo Zgornja Velka, ki leži na pobočju, črpali iz spletnega agrometeorološkega portala Slovenije. Za dokaz temperaturnega obrata so predvsem zanimive analize povprečnih mesečnih, povprečnih letnih ter povprečnih minimalnih temperatur.

Temperaturni obrat smo dokazovali z lastnimi terenskimi meritvami na treh različnih relacijah tik pred sončnim vzidom, ko je največja možnost temperaturnega obrata, zaradi najbolj ohlajenega ozračja. Meritve smo opravljali v juliju in avgustu 2013, novembru 2013 in marcu 2014. V avtomobil smo na višino 2 metra od tal namestili temperaturni senzor termometra. Temperature smo odčitovali na vnaprej določenih točkah, med katerimi je bilo 10 metrov višinske razlike. Prva relacija je potekala od reke Mure pri Tratah (232 m n.v.) do 3500 metrov oddaljenega slemena v kraju Lokavec (398 m n.v.), nato smo se po slabih treh kilometrih spustili v dolino reke Ščavnice (276 m n.v.). Druga relacija je imela začetno merilno točko dober kilometer po dolini Ščavnice gorvodno na nadmorski višini 286 metrov. V poldrugem kilometru smo se vzpeli na Zgornjo Velko, na grič s cerkvijo Marije Snežne (406 m n.v.), nato pa se po glavni cesti spustili do 4,5 km oddaljenega Sladkega Vrh (236 m n.v.). Zraven beleženja temperatur smo spremljali tudi vremensko situacijo (padavine, oblačnost, veter, vidljivost), na podlagi katere smo določili vremenski tip po Čadežu (Žiberna 1996), ki je vremenske tipe v grobem razdelil na 4 glavne tipe: anticiklonalni vremenski tip (A) je brez stalnih vetrov, oblačnost večja kot 5/10 praviloma ne traja več kot tri ure zapored, možna megla, količina padavin ne presega 1 mm. Pri podtipu 2 je možen prehod megle v dvignjeno meglo ali stratusno oblačnost. Ciklonalni tip (C) je vremenski tip, kjer je količina padavin nad 1.0 mm, nevihte se ne pojavljajo, oblačnost manjša od 5/10 nikoli ne traja več kot 3 ure zapored, možna megla. V advektivnem vremenskem tipu (D) je spremenljivo oblačno vreme, količina padavin je pod 1.0 mm, pihajo vetrovi stalnih smeri, zjutraj in zvečer je lahko brezvetrje, možen pojav megle, nevihtnih oblakov ni, oblačnost manjša od 5/10 se ne zadžuje več kot 3 ure zapored. V konvektivnem (K) vremenskem tipu so značilne vročinske nevihte v labilni atmosferi z vetrovi nestalnih smeri, padavine niso nujne, možna megla. Pri Čadeževi klasifikaciji poznamo tudi 8 mešanih vremenskih tipov, ki nastanejo kot kombinacija osnovnih tipov (Honzak 2008).

Po Čadeževi klasifikaciji vremenskih tipov smo ocenili tudi vremenske situacije pri analizi lastnih meritev merjenja termalnega pasu. Prve meritve smo opravljali v kraju Slatenik, kjer je veliko obdelovalnih površin zasajenih z vinogradi, ki se pojavljajo nekaj metrov nad dolino. Meritve smo opravljali z merilnimi gumbki, ki so bili zaščiteni z zaklonom za sevanje. Merilne gumbke (dataloggerje) smo postavili 2 metra od tal. Merilne gumbke smo s pomočjo programske opreme Thermotrack sinhronizirali ter jim določili uro prve meritve. Temperaturni gumbki so temperature beležili na vsakih 15 minut, merili so z natančnostjo 0,1 °C. Prvi datalogger je bil postavljen v dolini na nadmorski višini 282 metrov, kar je le 7 metrov nad dolino potoka, ki teče v smeri zahod-vzhod ter je desni pritok Jakobskega potoka. Drugi datalogger je bil nameščen v vinogradu 200 metrov zračne razdalje proti severovzhodu na pobočju jugozahodne ekspozicije (325 m n.v. - 50 m relativne višine). Zadnji datalogger je bil stacioniran v vinogradu na samem slemenu griča 111 metrov nad dnem doline (386 m n.v.). Postaje so temperature beležile med 10. julijem 2013 in 30. septembrom 2013, se pravi prav v času, ko je dozorevalo sadno drevje ter grozdje in ko je temperatura pomemben faktor pri zorenju in kakovosti pridelka. Od 1. novembra do 11. decembra

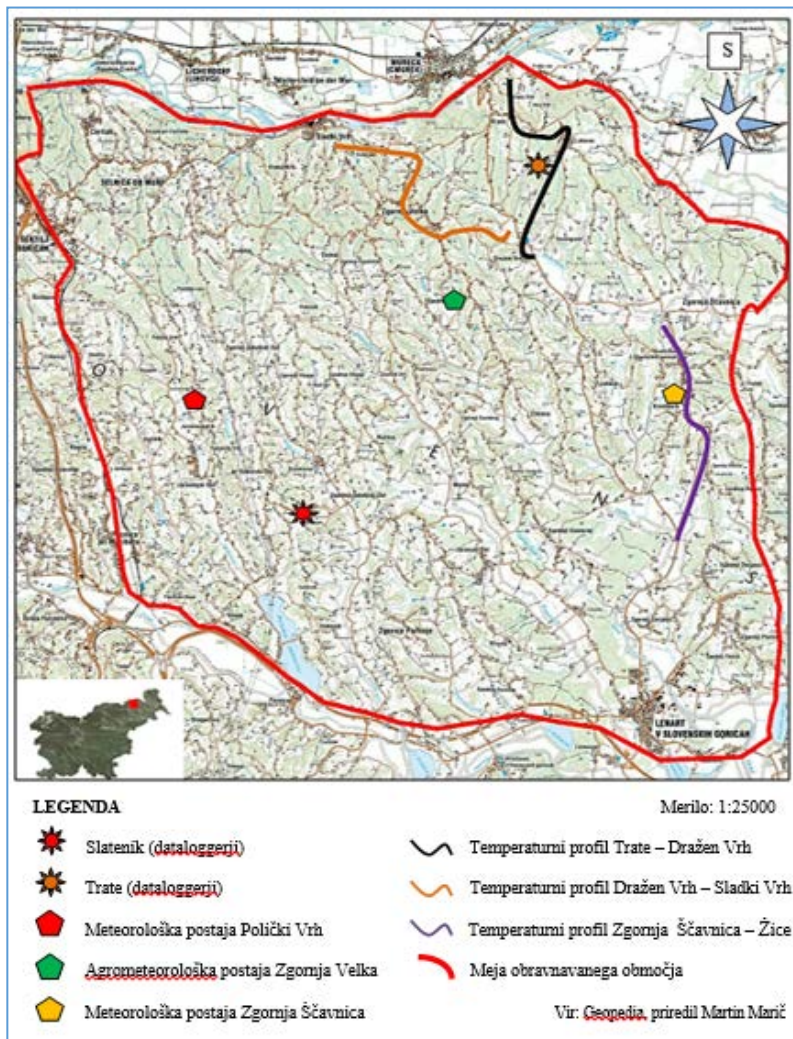
2013 smo opravljali isto vrsto meritev na nekoč sadjarskem in vinogradniškem območju na Tratah, kjer smo imeli dolinski datalogger na višini 316 m n. v. (4 m r.v.), pobočni datalogger je ležal na 19 metrih relativne višine, slemenski pa na 39 metrih relativne višine.

3. Temperaturni obrat v Slovenskih goricah med Muro in Pesnico

Meritve, s katerimi smo ugotavljali pojav temperaturnega obrata, smo opravljali v različnih vremenskih tipih. Julijski meritvi na relaciji Trate-Lokavec-Dražen Vrh smo opravljali v anticiklonalnem vremenskem tipu. Temperature na najnižji točki ob reki Muri so bile v vseh meritvah nekoliko toplejše kot meritve nekaj metrov višje, kar lahko pripišemo mikroklimi ob reki Muri, ki blaži absolutne temperature. Temperature so v anticiklonalnem vremenskem tipu z višino postajale toplejše. Na približno 40 metrih relativne višine so temperature pričele naraščati. Na najvišji točki v Lokavcu so bile 28. julija temperature kar 6,3 °C toplejše kot na najhladnejši točki v dolinskem pasu. Podobna temperaturna situacija je bila ob spustu v dolino reke Ščavnice, kjer so bile v julijskih meritvah temperature tukaj še hladnejše kot v dolini reke Mure. Najnižja točka v dolini reke Ščavnice je bila kar za 7,6 °C hladnejša od najtoplejše temperature na slemenu, ki je ležala 119 metrov nad dolino Ščavnice. Sklepamo, da je dolina Mure toplejša zaradi že prej omenjenega mikrovpliva večje reke na temperature.

Avgustovske temperaturne meritve smo opravljali tudi v drugih vremenskih tipih. Ugotovili smo, da v advektivnem vremenskem tipu temperaturni obrat na prvem delu poti med Muro in Lokavcem ni bil izražen, saj je bila temperatura v dolini Mure toplejša za 0,4 °C. Na drugem delu poti med Lokavcem in dolino Ščavnice pa se je pojavil temperaturni obrat, saj je bila dolina Ščavnice hladnejša za 2 °C. V anticiklonalno-advektivnem vremenskem tipu so meritve dokazale obstoj temperaturnega obrata, ki pa ni bil tako izrazit kot v anticiklonalnem podnebjju, saj so temperature z višino maksimalno narastle za 2,5 do 3 °C. Manj izrazit temperaturni obrat v tem vremenskem tipu je posledica večje oblačnosti in prevetrenosti, ki je podrla višinsko-temperaturno plastovitost. V ciklonalnem vremenu se v obeh meritvah temperaturni obrat ni pojavil, saj pogoji z oblačnostjo, dežjem ter vetrom tega niso dopuščali. Temperaturni obrat smo skušali dokazati tudi v novembru. Opravili smo dve meritvi v anticiklonalnem vremenu, pri prvi meritvi je v dolinah bila prisotna radiacijska megla, pri drugi meritvi pa je bila slana. V obeh primerih je bil temperaturni obrat jasno izražen. Temperaturni obrat se je pri teh meritvah pričel na približno 40 metrih nad dolino reke Mure, vendar je spodnja meja vinogradov tod še višja, kar kaže na nevarnost spomladanske pozebe. Dober pokazatelj na kateri relativni višini je smotrno tukaj zasaditi vinsko trto in sadno drevje je meritev, ki je bila opravljena 13. marca 2014, ko so bili tipični vremenski pogoji za temperaturni obrat. V dolinah se je pojavila slana, ki je poškodovala cvetje tedaj cvetoče marelice, na pobočjih ter slemenih pa slane ni bilo. Temperatura ob Muri pri Tratah je bila -0,4 °C, ta se je nato še znižala, na 30 metrih relativne višine je bila -1,6 °C. Temperatura je bila nad lediščem šele na dobrih 80 metrih relativne višine. To je potrdilo prejšnje domneve iz jesenskih meritev, da lahko jezero hladnega zraka v dolini reke Mure tukaj sega tudi višje. Na slemenu je bila najtoplejša temperatura 3,7 °C izmerjena na 150 metrih relativne višine. Ob spustu v dolino Ščavnice smo ugotovili, da je jezero hladnega zraka segalo do višine 30 metrov nad dolino. Na najnižji točki je bila temperatura -2,1 °C, 35 metrov višje pa že 1,6 °C. Pri marčevski analizi temperatur glede na nadmorske višine smo naredili tudi regresijo in korelacijo. Dokazali smo, da se v povprečju z vsakim metrom temperatura zviša za 0,03 °C, pri spustu pa za zniža za 0,05 °C. Korelacijski

faktor je v obeh primerih velik (0,9 in 0,93), kar dokazuje, da je temperaturni obrat zelo močan, saj lahko v več kot 80 % napovemo dviganje temperature z višanjem nadmorske višine.



Slika 1: Območje Slovenskih goric med Muro in Pesnico z lokacijami meritev.

Analize meritev druge relacije so potrdile domneve, da je temperaturni obrat najbolj izražen v anticiklonskem vremenskem tipu. Avgustovska meritev v anticiklonskem vremenskem tipu je med dolino Ščavnice in gričem Zgornje Velke pokazala, da je bila temperatura v dolini za 4,3 °C hladnejša. Povsem enaka temperaturna razlika je bila tudi v dolini reke Mure, čeprav je ta dolina od ščavniške nižja za 40 metrov. Vzroki za to tičijo v tem, da Mura in ribnik v bližini ustvarjata posebno blažjo mikroklimo. Velika možnost, da temperatura v tej dolini ni hladnejša, pa so tudi zidane površine Sladkega Vrha, kjer smo izmerili zadnjo temperaturo. Tudi v anticiklonsko-advektivnem vremenskem tipu se je temperaturni obrat pojavil in bil razpoznaven, temperaturne razlike niso bile tako intenzivne kot v anticiklonskem vremenskem tipu. V

ciklonalnem vremenskem tipu se temperaturni obrat ni ustvaril, z višino je temperatura padala.

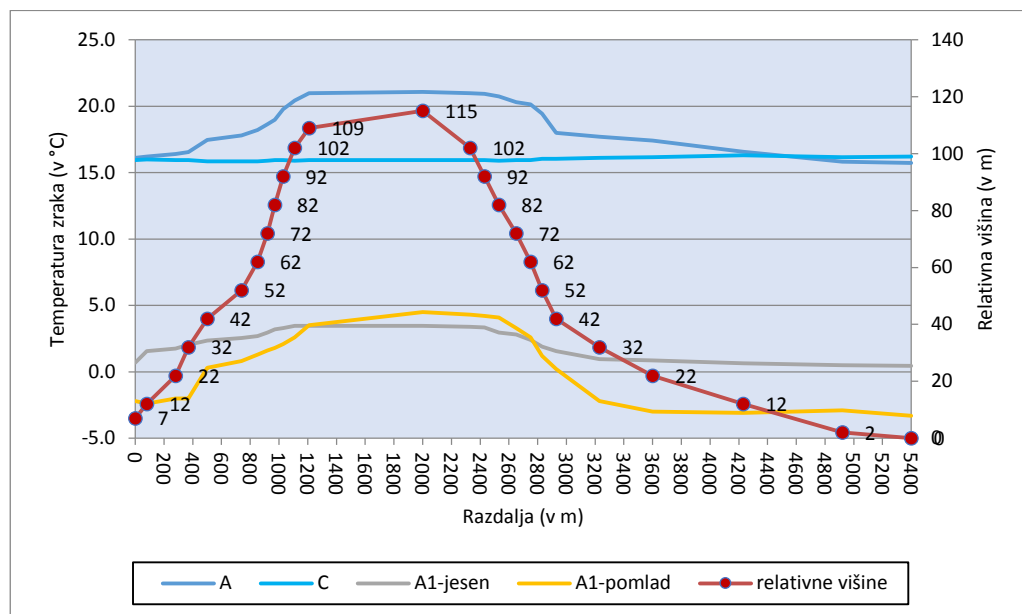
Preglednica 1: Tabela zanimivejših meritev temperaturnega obrata z minimalnimi in maksimalnimi temperaturami glede na relativne višine in vremenski tip.

Datum	T min/ rel. višina)	T max/ rel. višina	T max/ rel.višina	T min/ rel. višina	Vrem. tip
	Meritve pri vzponu		Meritve pri spustu		
	Relacija Trate (232 m n.v.)-Lokavec(395 m n.v.)-Dražen Vrh (276 m n. v.)				
28.7. 2013	19,1 °C/ 8 m	25,4/163 m	25,6 °C/ 114 m	18 °C/ 0 m (dolina Ščavnice)	A1
23.7. 2013	14,1 °C/ 8 m	15,3 °C/ 163 m	17 °C/ 84 in 94 m	12,9 °C/ dolina Ščavnice	AD
24.8. 2013	16,9 °C /158 m	18,2 °C / 0 m (dolina reke Mure)	17,5 °C/ 0-34 m	16,8 °C/ 114 m	C
1.11. 2013	5,4 °C/ 8 m in 18 m	8,4 °C/ 163 m	8,4 °C/ 119 m	6,3 °C/ 0 m (dolina Ščavnice)	A1
13.3. 2014	-1,6 °C/ 28 m	3,6 °C / 163 m	3,7 °C/ 114 m	-2,1 °C/ 0 m (dolina Ščavnice)	A1
	Relacija Dražen Vrh (286 m n.v.)-Zgornja Velka (406 m n.v)-Sladki Vrh (236 m n.v)				
23.8. 2013	12,3 °C /dolina reke Ščavnice	16,6 °C/ 110 m	16,6 °C / 163 m in 153 m	12,3 °C / 10 m	A1
13. 8. 2013	14,7 °C/ 5 m	17,4 °C /114 m in 120 m	17,4 °C/ 169m in 153 m	12,3 °C/ dolina reke Mure	AD
1.11. 2013	5,4 °C / 0 m (dolina Ščavnice)	8,3 °C/ 120 m	8,3 °C/ 169 m in 163 m	5,8°C/ 0 m (dolina reke Mure)	A1
13.3. 2014	-2,6 °C/ 24 m	3,9 °C/ 120 m	3,9 °C/ 169 m	-2,6 °C/ 0 m (dolina Mure	A1
	Relacija Zgornja Ščavnica (255 m n.v.)-Sveta Ana (363 m n.v)-Žice (248 m n.v.)				
28.7. 2013	18,3 °C/ 0 m (dolina Ščavnice) in 5 m	25,2 °C/ 108 m	25,2 °C/ 115 m	18 °C/ 0 m (dolina Velke)	A1
13.3. 2014	-2,4 °C/ 5 m	4,5 °C / 108 m	4,5 °C/ 115 m	-3,3 °C/ 0 m (dolina Velke	A1

Vir: Lastne meritve.

Pri meritvi, ki je bila opravljena 1. novembra v anticiklonalnem vremenu je bil temperaturni obrat izražen tako ob vzponu iz Ščavniške doline (temperaturna razlika 2,9 °C) kot spustu proti Muri. Temperaturni obrat ob spustu v dolino Mure (Sladki Vrh) je bil šibkejši, saj je bila dolina hladnejša za 2,5 °C. Podobne temperaturne razlike so bile tudi pri drugi meritvi, ko je bila temperatura pod lediščem. V obeh meritvah smo opazili, da je bila dolina Ščavnice zopet hladnejša kot dolina Mure. S stališča kmetijstva je bila tudi tu najpomembnejša marčevska meritev. Temperatura na začetni dolinski točki na Dražen Vrh je bila -2,1 °C, opazili smo pojav slane. 50 metrov višje na pobočjih je bila temperatura že nad lediščem, tudi slane več ni bilo opaziti. Na griču Zgornje Velke je temperatura narasla na 3,9 °C. Vožnja in spust proti Muri pa je zopet ohladil prizemne temperature, ki so se med 30 in 40 metri nad dolino spustile pod ledišče. V Sladkem Vrh je bila temperatura -2,6 °C, kjer se je pojavila slana. Temperature so dokazale, da so površine pod 40 metri relativne višine manj primerne za sadjarstvo, saj je prav tega dne že cvetela marelica, ki je v dolinah pomrznila. Korelacija med višanjem temperature z višanjem nadmorske višine je tudi tukaj zelo velika. Temperatura se po modelu na vsak meter pridobljene višine dvigne za 0,05°C, pri spustu pa se na vsak meter zniža za 0,03 °C.

Zadnje meritve smo opravljali med dolino reke Ščavnice (Zgornja Ščavnica) preko slemena Svete Ane do doline potoka Velke v Žicah. Na tej relaciji smo na najkrajši razdalji in najmanjših relativnih višinah dobili najizrazitejše primere pojava temperaturnega obrata. Opravili smo tri meritve v anticiklonskem vremenskem tipu. Pri prvi meritvi smo ugotovili, da se pri vožnji zgolj dobra dva kilometra in pri dvigu na 110 metrov relativne višine temperatura dvigne za 4,1 °C, pri drugi meritvi kar za 6,9 °C, pri tretji pa za 4 °C. Pri spustu s slemena Svete Ane proti dolini Velke, kjer poteka tudi glavna cesta Lenart-Trate (Cmurek), pa so bile temperaturne razlike še hladnejše. Končna merilna točka je ležala 115 m nižje. Temperatura v dolini je bila pri prvi meritvi 4,4 °C, pri drugi 7,2 °C, pri tretji pa 4,5 °C hladnejša kot na najtoplejši točki na slemenu. Tudi tukaj je pri jesenskih meritvah temperaturni obrat obstajal, vendar ni bil tako izrazit kot pri poletnih meritvah. Temperaturna na slemenu je bila pri prvi in drugi jesenski meritvi v anticiklonskem vremenskem tipu toplejša za največ 3 °C. Najzanimivejša marčevska meritev je tudi tukaj dokazala zakaj so primernejša območja ta, ki ležijo višje in imajo višje temperature ter manj možnosti pozebe. V dolini Ščavnice je temperatura bila -2,2 °C, na tleh pa je bila opazna močna slana. Ob vzponu nad 35 m nad dolino slane več ni bilo temperatura pa je skokovito narasla, na slemenu je dosegla tudi 4,5 °C. Le dva kilometra kasneje, ob spustu v dolino reke Velke so bile temperature še nižje (-3,3 °C). Slana je bila še močnejše prisotna kot v dolini Ščavnice ali Mure. Sklepamo lahko, da se je jezero hladnega zraka tudi tukaj zadrževalo do višine 40 metrov nad dolino, vendar je bil odtok hladnega zraka dolvodno onemogočen oz. upočasnjjen, zato je bila tukaj temperatura najnižja. Dokazali smo, da je pri tej meritvi kar 95% povezava med višanjem izmerjenih temperatur z naraščanjem nadmorske višine. Temperatura se po modelu z vsakim višinskim metrom zviša za 0,06 °C. Pri spustu se je temperatura znižala kar za 0,08 °C na meter višinske razlike.



Slika 2: Višinsko temperaturni profil meritev temperaturnega obrata na relaciji Zgornja Ščavnica-Sveta Ana-Žice glede na vremenske tipe.

Vir: Lastne meritve.

4. Termalni pas v Slovenskih goricah med Muro in Pesnico

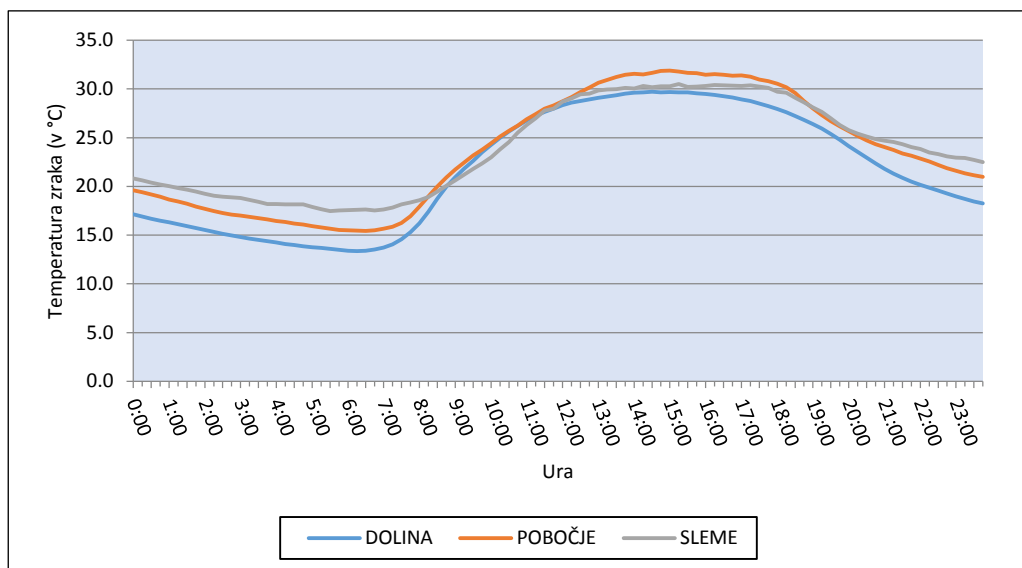
Z analizo meteoroloških podatkov iz meteoroloških postaj Polički Vrh, Zgornja Ščavnica ter Zgornja Velka smo ugotovili, da se termalni pas na tem območju pojavi. Ugotovili smo, da imata postaji Zgornja Ščavnica in Zgornja Velka toplejše povprečne ter minimalne temperature zraka. Zgornja Ščavnica ima v dolgoletnem povprečju za 0,9 °C višje povprečne temperature kot Polički Vrh, ki leži v dolini. Postaja Zgornja Velka, ki leži znotraj termalnega pasu 40 m r. v. ima povprečne mesečne temperature za 0,4 °C toplejše kot Polički Vrh v istem obdobju. Minimalne mesečne temperature so bile na Zgornji Ščavnici 1,8 °C višje kot na Poličkem Vrh. Na Zgornji Velki pa so bile minimalne mesečne temperature za 0,6 °C višje.

Podobne ugotovitve smo hoteli dokazati tudi z lastnimi meritvami iz treh dataloggerjev, ki so bili razmeščeni na različnih reliefnih oblikah v Slateniku ob Jakobskem dolu. Analize meritev so nam dale potrditev obstoja termalnega pasu v Slovenskih goricah med Muro in Pesnico. V 83-ih dneh je bila povprečna temperatura v dolini za 1,2 °C hladnejša kot na slemenu in 1,1°C hladnejša kot na pobočju. Najboljši vpogled kdaj in kako se pojavi termalni pas pa nam je prikazala podrobna analiza urnih temperatur. Opazimo, da se termalni pas formira v hladnem delu dneva. Takrat tla začnejo sevati toploto, hladni zrak iz višjih predelov gričevja pa se steka proti dolini. Ob polnoči pa vse tja do 7.00 je sleme za 2,5° C toplejše od doline in približno stopinjo toplejše od pobočja. Po 7. uri se termalni pas prične razkrajati, kar sovpada s sončnim vzidom. Sonce postane poglavitni dejavnik pri razporeditvi dnevnih temperatur. Od 12. do 19. ure je pobočje najtoplejše, to je predvsem zaradi jugovzhodne ekspozicije. Do 11.45 je dolina toplejša kot sleme, vendar ni nikoli toplejša od pobočja. Okoli 15. ure je pobočje kar za 1,7 °C toplejše od doline in 1,3 °C toplejše od slemena. Okoli 19. ure, kar sovpada tudi z povprečnim zaidom Sonca, pa se prične zopet formirati vertikalno naraščanje temperatur. Največja temperaturna plastovitost je zvečer ob 23.45, ko je dolina od slemena hladnejša za 2,3 °C, od pobočja pa za 1,4 °C. Termalni pas se poleti ter v zgodnji jeseni formira ob 20. uri in obstaja vse tja do 8. ure zjutraj. Torej je v najtoplejšem delu leta kar 12 ur prisotna toplejša temperatura na višjih predelih tega dela gričevja Slovenskih goric.

V obdobju meritev je kar 26 dni imelo anticiklonalni vremenski tip (A1) in prav v tem vremenskem tipu je bil termalni pas najbolj razvit. Ure pričetka in konca pojava so podobne kot smo jih že opisali pri povprečnih urnih temperaturah. Najbolj izrazit termalni pas je v anticiklonalnem vremenskem tipu tik pred sončnim vzidom, ko je sleme kar za 4,3 °C toplejše od doline in 2,2 °C toplejše kot pobočje. Tudi v anticiklonalnem vremenskem tipu se termalni pas čez dan razgradi. Formirati se začne po 20. uri, ko temperature razlike med dolino in slemenom okoli polnoči zopet dosežejo 4 °C.

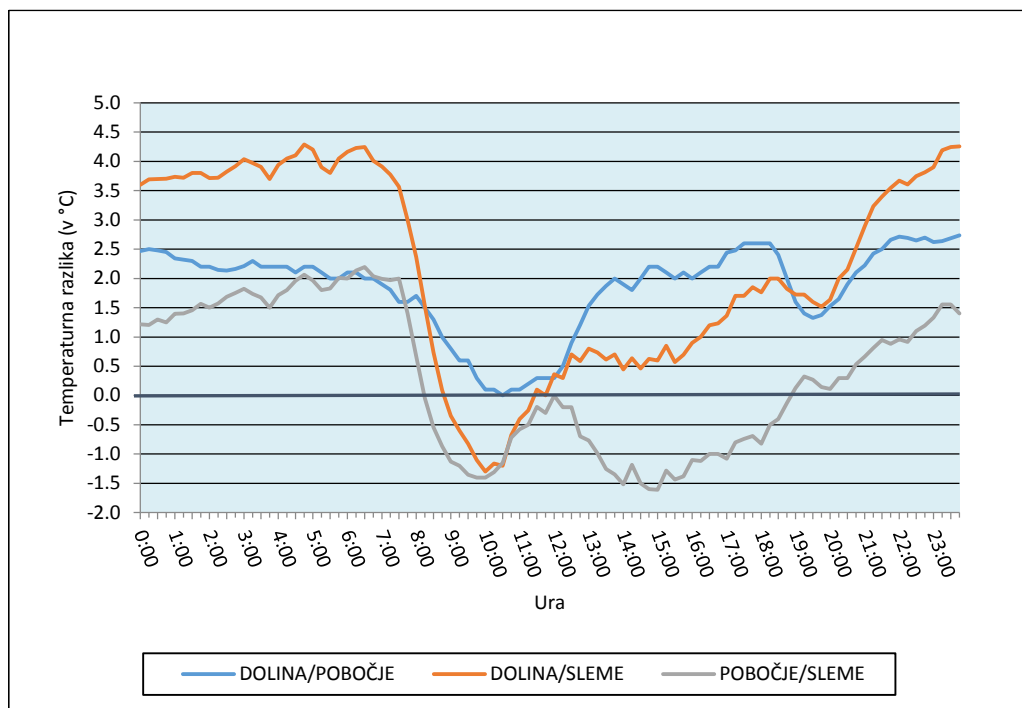
Kar 23 dni je imelo mešan anticiklonalno advektiven vremenski tip, v katerem je bil pojav termalnega pasu prisoten, vendar so bile temperaturne razlike med dolino, pobočjem ter slemenom manjše. Sleme je bilo tik pred sončnim vzidom toplejše za 3,1 °C.

Advektivni vremenski tip je bil zabeležen v 12 dneh meritev, v hladni polovici dneva je termalni pas bil prisoten, vendar so temperaturne razlike še manjše. Sleme je toplejše za največ 2 stopinji Celzija.



Slika 3: Povprečne urne temperature zraka v anticiklalnem vremenskem tipu na Slateniku (10. julij- 30. september 2013).

Vir: Lastne meritve.



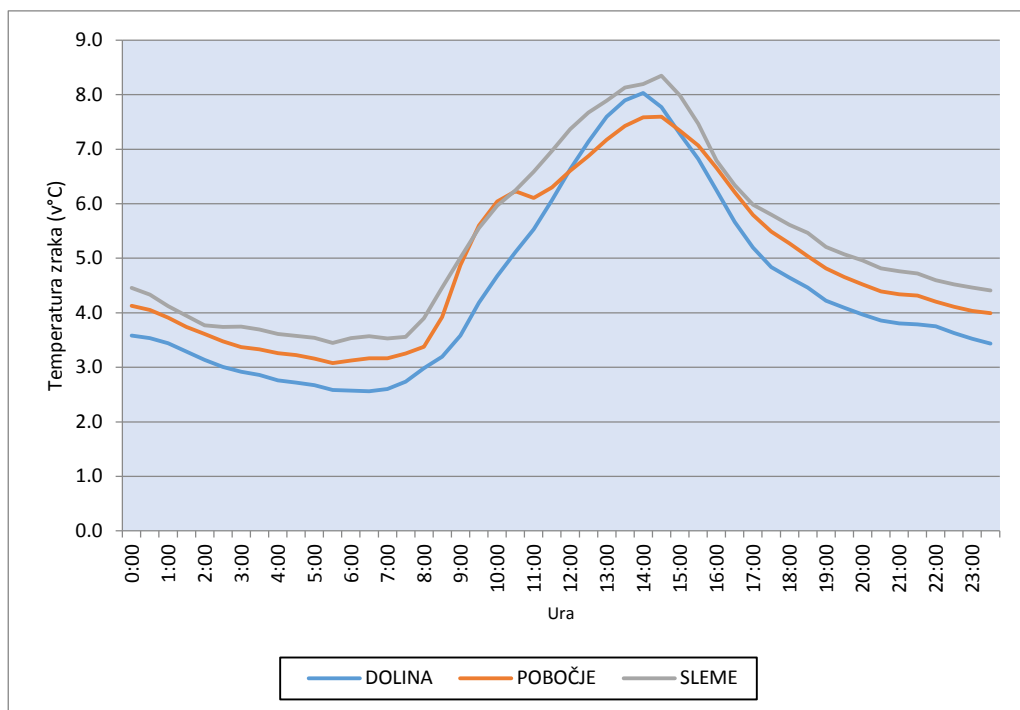
Slika 4: Povprečne urne temperaturne razlike v anticiklalnem vremenskem tipu na Slateniku (10. julij-30. september 2013).

Vir: Lastne meritve.

V dvanajstih dneh s ciklonskim vremenskim tipom (C) z oblačnim, deževnim vremenom se termalni pas ni pojavil, ob zgodnjih jutranjih urah se je nakazal, vendar se je proti jutru razgradil in zvečer se ni formiral. Podobno je bilo tudi v advektivno-ciklonskem (DC) vremenskem tipu, ki se je pojavil v petih dneh. V 3 dneh se je pojavil mešani vremenski tip anticiklonsko-konvektivni v katerem pa se je zjutraj formiral močan termalni pas, s temperaturnimi razlikami okoli 3,5 °C, vendar se zvečer ta pas ni formiral. V ciklonsko-konvektivnem vremenskem tipu pa se termalni pas ni pojavil.

Termalni pas smo z istim načinom skušali dokazati tudi v kraju Trate na severnem delu Slovenskih goric med Muro in Pesnico. Meritve smo opravljali med 1. novembrom in 11. decembrom 2013, zanimalo nas je, ali se termalni pas pojavlja tudi na nižjih relativnih višinah ter do katere višine se zadržuje hladen zrak. Postaja na sllemenu v povprečju vseh meritev za 0,8 °C toplejša kot dolinska. Pobočje pa je bilo 0,5 °C toplejše kot dolina. V povprečju smo glede na temperature ugotovili, da je tukaj spodnja meja termalnega pasu nekje okoli 20 metrov relativne višine. Jezero hladnega zraka se v teh dolinica potokov ne zadržuje dolgo, saj je strmec teh dolin še dovolj visok, da se hladni zrak vali proti ščavniški dolini. Temperaturna situacija je podobna kot na Slateniku. Termalni pas se pojavi v hladnejši polovici dneva, ki pa je glede na letni čas daljša. Tako je sleme najtoplejše predel vse do 9. ure, ko se višinsko-temperaturna plastovitost razkroji. Zaradi jesenskih vremenskih situacij in manjše moči Sonca je sleme najtoplejše predel skozi ves povprečen dan meritev. Dolinska postaja je čez dan hladnejša tudi zaradi same lokacije ob gozdu, in strmem pobočju ob njej, ki ne omogoča, da bi na postajo direktno sevalo Sonce. Tipična temperaturna razlika za termalni pas pa se začne po zaidu Sonca okoli 5. ure. Sleme je v povprečju zjutraj od doline toplejše za 1,5 °C, od pobočja pa za 0,5 °C. Po 5. uri pa je temperaturna razlika med dolino in 35 višinskih metrov višjim slemenom okoli 1°C.

Od skupno 41 dni meritev, je bil kar v 15 dneh anticiklonski vremenski tip. Prav v tem vremenskem tipu in v tem letnem času ugotovimo, zakaj so dolinska območja manj primerna za vinogradništvo in sadjarstvo, saj se je v tem obdobju v dolini večkrat pojavila močna slana, ki je na pobočju ter sllemenu ni bilo, ali je bila v manjši meri. Povprečna temperatura meritev (A1) v dolini je tik pred vzdodom Sonca bila -1,3 °C, na pobočju, -0,1, na sllemenu pa 0,7 °C. Zaradi mikrolokacije dolinske postaje ter zadrževanja hladnega zraka v dolini je tudi čez dan bila pobočna in sllemska postaja izrazito toplejša (3,5 °C). V anticiklonsko advektivnem vremenskem tipu, ki se je pojavil v 8-ih dneh je situacija podobna le da so temperaturne razlike manjše (sleme je toplejše za približno 1 °C). V treh dneh anticiklonsko-ciklonskega vremenskega tipa se je termalni pas ponoči formiral, čez dan temperaturne plastovitosti ni bilo, niti se zvečer ni ustvarila. To je posledica dežja in izenačitve temperature ter oblačnega pokrova, ki je preprečil izgubo toplote. V ciklonskem vremenskem tipu, ki je bil zabeležen 13 dni meritev pa relativne višine, nakloni in ekspozicije ne predstavljajo glavnih modifikatorjev klime, saj je dolina bila toplejša kot sleme in pobočje. Podobno smo zaznali tudi v advektivnem vremenskem tipu, ko je temperatura z višino padala, le pozno zvečer, ko se je veter pomiril, se je pojavil termalni pas.



Slika 5: Povprečne urne temperature zraka na Tratah (1. november - 11. december 2013).

Vir: Lastne meritve.

5. Zaključek

Pojav temperaturnega obrata v Slovenskih gorah je vzrok, da se je nad dolinami potokov in rek pojavil termalni pas, ki ima toplejše temperature in kjer je manj možnosti za pozebo. Prav to je v preteklosti tudi oblikovalo tipično podobo te regije, ki ima na pobočjih in slemenih zasajene kulturne rastline, ki so bolj občutljive na hladnejše temperature ter pozebo. Z analizo meritev temperaturnega obrata smo dokazali, da je največja možnost pojava temperaturnega obrata v anticiklonskem vremenskem tipu tik pred sončnim vzhodom. Temperaturne razlike med najhladnejšo merilno točko v dolini ter najtoplejšo na pobočju ali slemenu so presegale 5 °C. Temperaturni obrat se na vseh treh relacijah pojavlja na različnih relativnih višinah, praviloma pa med 20 in 40 metri nad dolinami. V ostalih vremenskih tipih je temperaturni obrat manj izrazit, ali pa se sploh ne formira (ciklonski vremenski tip). Predvsem zanimivi so izsledki meritev v anticiklonskem vremenskem tipu na vseh relacijah 13. marca 2013. Analize meritev nam potrjujejo, da ponekod v Slovenskih gorah vinogradi in sadovnjaki ležijo na 40 in več metrih relativne višine predvsem zaradi slane. Ta se je tega dne pojavila prav v vseh dolinah, kjer smo opravljali meritve. Temperature na pobočjih in slemenih so bile tudi do 7,8 stopinj celzija toplejše. V tem času je na tem območju tudi že cvetela marelica, ki je v nižjih predelih zaradi slane pomrznila.

Obstoj toplejšega območja nad dolinskim dnom smo potrdili z dvema ločenima meritvama na dveh različnih lokacijah. Ugotovili smo, da se termalni pas na območju

Slovenskih goric med Muro in Pesnico pojavlja v različnih letnih časih. Spodnja meja termalnega pasu sovпада s spodnjo mejo vinogradov na tem območju. Ta meja je težko določljiva, vendar glede na meritve in opazovanja sklepamo, da leži med 20 in 40 metri nad dnem doline. Povprečna temperatura doline je na Slateniku za 1, 1 °C hladnejša kot 50 metrov višje ležeča pobočna postaja. Tudi na nižjih relativnih višinah je termalni pas jasno izražen. Ta pojav je najbolj jasno izražen v hladnem delu dneva, največje temperaturne razlike pa so tik pred sončnim vzhodom, ko je sleme in pobočje lahko toplejše tudi za več stopinj. Najbolj se to odraža v anticiklalnem vremenskem tipu. Ta vremenski tip je bil najbolj zastopan pri obeh meritvah. Pri ostalih kombinacijah anticiklalnega vremenskega tipa je termalni pas manj izražen, temperaturne razlike so nižje. Temperaturni obrat se je slabo ali se ni pojavil v ciklalnem vremenskem tipu ter njegovih kombinacijah. Za zaključek naj povemo, da smo ugotovili, da je relativna višina glaven dejavnik spreminjanja temperatur v Slovenskih goricah med Muro in Pesnico.

Literatura

- Gams, I. 1996: Termalni pas v Sloveniji, Geografski vestnik 68. Zveza geografskih društev Slovenije, Ljubljana.
- Honzak, M. 2008: Vremenski tipi in njihova uporaba. Fakulteta za matematiko in fiziko UL, Ljubljana. Pridobljeno 31. 10. 2013, http://mafija.fmf.uni-lj.si/seminar/files/2007_2008/seminarIIIslo.pdf.
- Kert, B. 1973: Družbena geografija osredja Zahodnih Slovenskih goric (območje občine Lenart): doktorska disertacija. Univerza v Ljubljani, Filozofska fakulteta, Ljubljana.
- Ogrin, D. 2000: Nekatere topoklimatske značilnosti razporejanja temperature zraka in burje v razgibanem reliefu Slovenije. Dela, 15. Oddelek za geografijo Filozofske fakultete UL, Ljubljana.
- Ogrin, M. 2003: Vpliv reliefa na oblikovanje nekaterih mezoklimatskih tipov v Sloveniji. Geografski vestnik, 75, št. 1. Zveza geografskih društev Slovenije, Ljubljana.
- Ogrin, M. 2005: Značilnosti temperaturnih inverzij. Geografski obzornik, 52, št. 2. Zveza geografov Slovenije, Ljubljana.
- Ogrin, D. 2007: Uporabnost kartiranja vinogradov kot metode za ugotavljanje prostorskih značilnosti termalnega pasu. Dela 28. Oddelek za geografijo Filozofske fakultete UL, Ljubljana.
- Šegota, T. 1988: Klimatologija za geografe. Školska knjiga, Zagreb.
- Yoshino, M. M. 1975. Climate in a small area. University of Tokyo press, Tokyo.
- Žiberna, I. 1992: Vpliv klime na rabo tal v SV Sloveniji s posebnim ozirom na vinsko trto: magistrsko delo. Univerza v Ljubljani, Filozofska fakulteta, Ljubljana.
- Žiberna, I. 1996: Mestna klima Maribora: doktorska disertacija. Univerza v Ljubljani, Filozofska fakulteta, Ljubljana.
- Žiberna, I. 1999: Temperaturni obrat v hriboviti Sloveniji. Dela 13. Oddelek za geografijo Filozofske fakultete UL, Ljubljana.

TEMPERATURE INVERSION AND THERMAL BELT IN THE SLOVENSKE GORICE REGION BETWEEN THE MURA AND PESNICA RIVERS

Summary

Temperature inversion occurrence in the Slovenske gorice region is the cause that above the valleys of streams and rivers thermal belt with its higher temperatures is formed, which reduces the possibility for frost. This also formed the typical image of this region where the cultural plants are planted on slopes, because they are more sensitive to lower temperatures and frost. The highest possibility of the occurrence of temperature inversion is in anticyclone weather type right before sunrise which was proven by our analysis of measurements. The temperature differences between the coldest and the warmest spot in the valley exceeded 5 °C. Temperature inversion appeared in different relative heights in all three stations, but mostly between 20 and 40 meters above the valley. In all the other weather types temperature inversion is less pronounced, or it is not formed at all (cyclone weather type). Above all, the most interesting results were in anticyclone weather type on the 13th of March 2013. The analyses of measurements confirm that somewhere vineyards and orchards lie on 40 meters (or higher) relative height because of frost. On this day, frost appeared in all three valleys, where we did the measurements. The temperatures on slopes and ridges were up to 7,8 °C higher. An apricot was already blooming at that time of the year, but it froze in the lower areas due to frost.

The existence of the warmer area above the valley was confirmed by the two separate measurements on two different locations. We learned that thermal belt in the Slovenske gorice region is appearing in different seasons. The lower limit of thermal belt coincides with the lower limit of vineyards. This limit is hard to determine, however, considering the measurements and observations, we conclude that it lies between 20 and 40 meters above the valley. The average temperature of the valley in Slatenik is 1,1 °C lower than in the 50 meters higher station on the slope. This phenomenon is the most obviously expressed in the cold part of the day, the highest temperature differences are right before the sunrise, when the slope is significantly warmer. This reflects the most in anticyclone weather type. This weather type is predominant in both of the measurements. At all the other combinations of anticyclone weather type thermal belt is less expressed and the temperature differences are lower. Temperature belt was badly occurred or was not occurred at all in cyclone weather type and its combinations. To sum up, we learned that relative height is the main factor of changing of temperatures in the Slovenske gorice region between the Mura and Pesnica Rivers.

PRIMERJAVA STANJA VODNE BILANCE IN POTREB IZBRANIH KMETIJSKIH KULTURNIH RASTLIN PO VODI V POMURJU

Tatjana Kikec

Dr. geografije – področje izobraževanja

Juša Kramarja 19, SI – 9000 Murska Sobota, Slovenija

e-mail: tatjana.kikec@gmail.com

UDK: 551.589:632.112

COBISS: 1.01

Izvleček

Primerjava stanja vodne bilance in potreb izbranih kmetijskih kulturnih rastlin po vodi v Pomurju

V prispevku smo raziskali stanje vodne bilance v Pomurju, njegov količinski, časovni in prostorski vidik ter ga primerjali s potrebami izbranih kmetijskih kulturnih rastlin po vodi v posameznih razvojnih fazah. Primerjava je pokazala, da je razporeditev stanja vodne bilance preko leta, ta je v Pomurju negativna med aprilom in II. dekada avgusta, dokaj ugodna za ozimna žita. Vode jim primanjkuje le v drugi polovici rastne dobe, s polj pa jih pospravimo še pred največjim pomanjkanjem vode v tleh v poletnih mesecih. Večina ostalih kmetijskih kulturnih rastlin kot so koruza, krompir, sladkorna pesa, buče ter zelenjadnice se s pomanjkanjem vode v tleh sooča večji del rastne dobe. V najbolj občutljivejših razvojnih fazah so v poletnih mesecih, ko je primanjkljaj vode v tleh največji in jih ta tudi najbolj prizadene. Posledice so poškodovanost kultur ter količinsko manjši pridelek slabše kakovosti.

Ključne besede

vodna bilanca, Pomurje, kmetijske kulturne rastline, potencialna evapotranspiracija rastline

Abstract

Comparison of Water Balance and the Needs of Selected Agricultural Crops for Water in Pomurje Region

In this article we investigate the state of the water balance in the Pomurje region, its quantitative, temporal and spatial perspectives, and compare it with the needs of selected agricultural crops for water in various stages of development. The comparison has shown that the distribution status of the water balance throughout the year – in Pomurje region it is negative between April and the second half of August – is quite favourable for winter grain. The grain lacks water only in the second half of the growing season, as it is picked before the greatest shortage of water in the soil during the summer months. Most other agricultural crops such as corn, potatoes, sugar beet, pumpkins and vegetables face water scarcity in the ground for the major part of the growth period. Their most sensitive stages of development take place during summer months when the water deficit in the soil is the largest, thus they are greatly affected. The consequences are damaged crops and lower quantities of crops with inferior quality.

Key words

Water balance, Pomurje region, agricultural crops, potential evapotranspiration of plants

Uredništvo je članek prejelo 10.11.2016

1. Uvod

Rastline potrebujejo za uspešno rast in razvoj poleg toplote in svetlobe tudi določeno količino vode oziroma vlage v tleh. Potrebe po vodi se razlikujejo od rastline do rastline in od njihove razvojne oz. fenološke faze. Razpoložljive količine vode na izbrani lokaciji določimo z izračunom vodne bilance in so odvisne od količine padavin, potencialne evapotranspiracije, sposobnosti prsti za zadrževanje vode ter predhodnih vodnih zalog. Vse pogostejši pojav kmetijske suše na območju Pomurja, ta se je v zadnjih dvajsetih letih (1994–2014) pojavila kar v štirinajstih letih (1994, 1995, 1997, 2000, 2001, 2002, 2003, 2004, 2006, 2007, 2010, 2011, 2012 in 2013; SURS 2014, ARSO 2014), nam kaže na razhajanja med potrebami kulturnih rastlin po vodi in dejansko razpoložljivimi količinami. Pomanjkanje vode pri rastlinah povzroči sušni stres, posledično se upočasni njihova rast, ob dolgotrajnejšem pomanjkanju vode nastopijo trajne poškodbe na rastlinah, kar se pozna na količini in kakovosti pridelka.

Vse izrazitejše spremembe podnebja, ki se na območju Pomurja kažejo med drugim v višjih temperaturah in manjši količini padavin, vplivajo tudi na spremembo vodne bilance. V večjem delu vegetacijske dobe je ta že tako ali tako negativna, ob daljšem izostanku padavin pa se primanjkljaj vode v tleh poveča do te mere, da je ogroženo uspevanje kulturnih rastlin. Poznavanje količinskega, prostorskega in časovnega vidika vodne bilance na eni strani in potreb kulturnih rastlin po vodi v posameznih razvojnih fazah na drugi strani je ključno za različne možne prilagoditve novo nastalim razmeram. Na podlagi poznavanja stanja lahko načrtujemo različne ukrepe s katerimi bi se prilagodili vse pogostejšemu pojavu kmetijske suše¹ in zmanjšali posledice ob njenem pojavu.

2. Metodologija

Za potrebe izračuna vodne bilance smo si z Agencije Republike Slovenije za okolje pridobili podatke o višini padavin in potencialni evapotranspiraciji za obdobje 1961–2010 za meteorološke postaje Murska Sobota, Veliki Dolenci, Lendava, Gornja Radgona, Blaguš in Jeruzalem. Pri izbiri meteoroloških postaj smo upoštevali njihovo razporeditev na preučevanem območju, lego glede na relief in obstoj ter dostopnost čim daljšega niza podatkov. Meteorološke postaje na desnem bregu Mure so predčasno zaključile z opazovanji, zato je njihov niz podatkov nekoliko krajši, za Jeruzalem do leta 2008, za Gornjo Radgono do leta 2001 in za Blaguš do leta 1992. Potencialno evapotranspiracijo so izračunali na Agenciji RS za okolje po Penman-Monteithovi metodi, ki upošteva naslednje meteorološke spremenljivke: temperaturo zraka, relativno zračno vlago, hitrost vetra in sončno sevanje (Allen et al. 1998 povz. po Frantar et al. 2008, 39). Vodno bilanco smo izračunali po poenostavljeni formuli, tako da smo od dnevne višine padavin odšteli dnevno vrednost potencialne evapotranspiracije (ETP)². Na podlagi dnevnih podatkov smo izračunali dekadne, mesečne in letne vrednosti.

¹ O kmetijski suši govorimo, ko rastlinam v obdobju rasti primanjkuje vlage v prsti za njihov normalen razvoj. Padavin je premalo ali pa se izcedijo v nepravem času, kar najprej povzroči poškodbe na rastlinah in v skrajnem primeru njihovo trajno ovenelost (Duden 2001, 535–536).

² Vodna bilanca je vezana na krogotok vode v naravi in nam pove, da je količina padavin (P) enaka vsoti količine odtekle (Q) in izhlapele vode (I), kakor tudi spremembe količine vodne zaloge (N) in biološke ter industrijske porabe (R). To lahko zapišemo v obliki enačbe:

$$P = Q + I + N + R$$

Potrebe izbranih kulturnih rastlin po vodi so odvisne od podnebnih dejavnikov, vrste rastline in od stopnje njenega razvoja. Potencialno evapotranspiracijo rastline, ki pomeni količino vode, ki jo rastlina potrebuje za nemoten razvoj, izraženo v mm/dan ali v l/m²/dan, smo izračunali po priporočilih Organizacije Združenih narodov za prehrano in kmetijstvo (FAO) (Irrigation ... 1986). Za izračun smo uporabili formulo:

$$ET_c = ET_0 \times kc$$

Pri čemer pomenijo:

ET_c - potencialna evapotranspiracija rastline [mm/dan]

ET₀ - referenčna dnevna potencialna evapotranspiracija [mm/dan]

kc - koeficient rastline, ki je različen za posamezne kulture v posamezni fazi razvoja

Podatke o referenčni dnevni potencialni evapotranspiraciji (ET₀) smo uporabili za meteorološko postajo Murska Sobota za obdobje 1961–2010, ki smo jih pridobili z Agencije RS za okolje. Koeficient rastline (kc) je odvisen od vrste kulture, fenološke faze in od podnebnih značilnosti. Podnebne značilnosti vplivajo na trajanje rastne dobe rastline in na čas nastopa ter trajanje posameznih razvojnih faz. Za določitev koeficienta rastline je potrebno za vsako posamezno kulturo določiti: (1) skupno rastno dobo, (2) posamezne fenološke faze ter njihovo trajanje in (3) vrednost koeficienta rastline za posamezno kulturo v vsaki izmed fenoloških faz (Irrigation... 1986). Podatke o skupni rastni dobi v dnevih, se pravi od setve/saditve do zadnjega dneva žetve/izkopa/obiranja in podatke o trajanju posameznih fenoloških faz smo si za izbrane kulturne rastline pridobili z Agencije RS za okolje za fenološko postajo Murska Sobota ter za vinsko trto za fenološko postajo Veliki Dolenci. Na fenoloških postajah beležijo podrobnejše fenološke faze posameznih kultur, medtem ko priporočila FAO upoštevajo le štiri osnovne razvojne faze (Irrigation... 1986):

1. Začetna faza: obdobje od setve ali presajanja, dokler posevek prekriva približno 10 % tal.
2. Razvojna faza rastlin: obdobje se začne ob koncu začetne faze in traja, dokler ni dosežena popolna pokritost tal (70–80 %), vendar ne pomeni, da je rastlina največje višine.
3. Srednja faza: obdobje se začne ob koncu razvojne faze rastline in traja do končne zrelosti, vključuje cvetenje.
4. Zaključna faza: obdobje se začne ob koncu srednje faze in traja do zadnjega dne žetve; vključuje tudi fazo zorenja.

Okvirne vrednosti koeficienta rastline za posamezno kulturo v posamezni fenološki fazi smo si pridobili v priporočilih FAO. Ker pa se trajanje posameznih fenoloških faz ne ujema z dekadnimi vrednostmi referenčne potencialne evapotranspiracije smo koeficiente posameznih kulturnih rastlin morali določiti na dekadnem nivoju. To smo naredili tako, da smo prešteli število dni trajanja posamezne fenološke faze v posamezni dekadi in izračunali natančnejši koeficient rastline po formuli (Irrigation... 1986):

$$kc = \frac{\text{št. dni v I. dekadi}}{\text{št. dni dekade (10)}} \times kc_1 + \frac{\text{št. dni v II. dekadi}}{\text{št. dni dekade (10)}} \times kc_2$$

Pri čemer pomenijo:

kc₁ - okvirna vrednost koeficienta rastline za razvojno fazo rastline v I. dekadi

kc₂ - okvirna vrednost koeficienta rastline za razvojno fazo rastline v II. dekadi

Dobljeno vrednost zaokrožimo na 0,05 oziroma 0,00 (Irrigation... 1986). Ker nas poleg dnevnih vrednosti potencialne evapotranspiracije rastlin zanimajo zlasti dekadne vrednosti, smo dobljene vrednosti pomnožili s številom dni v dekadni (10).

3. Značilnosti vodne bilance v Pomurju

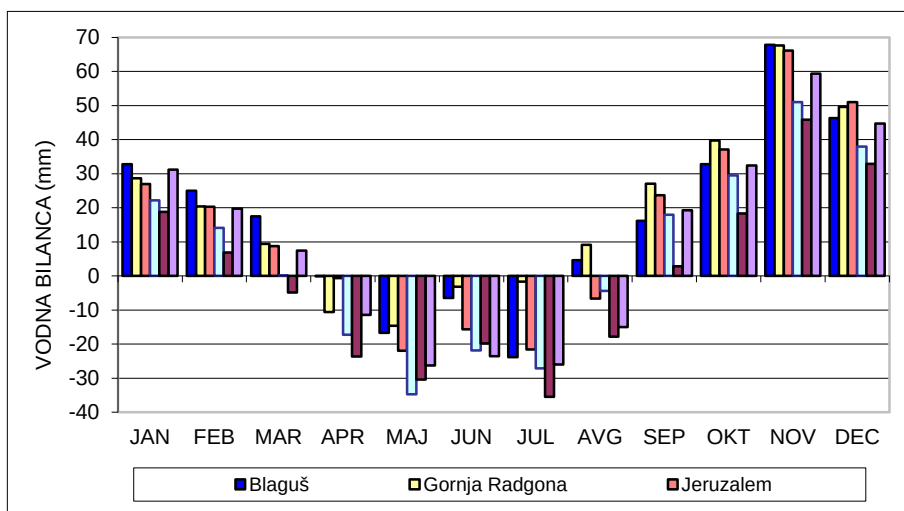
Razmeroma grobo, pa vendar dovolj objektivno ugotovimo sušna obdobja na neki lokaciji z izračuni vodnih bilanc, ki večinoma temeljijo na poprejšnjem izračunu evapotranspiracije in na meritvah višine padavin v določenem časovnem intervalu ob poznavanju vodnoretencijskih lastnosti tal (Kajfež Bogataj, Svet 1993, 22). S pojmom evapotranspiracija označujemo celoten proces prehajanja vode s površine Zemlje v atmosfero. Kolikšen del pade na evaporacijo in kolikšen na transpiracijo je težko določiti, saj oba procesa potekata istočasno in se tekom rastne dobe rastlin spreminjata glede na pokrovnost tal. Z vrednotenjem razlike med evapotranspiracijo in višino padavin lahko v določenem časovnem obdobju ugotavljamo, ali je v tleh vode za rastline preveč, dovolj ali premalo. Sušna obdobja so vsa tista z negativno vodno bilanco.

Vodna bilanca je bila na območju Pomurja v obdobju 1961–2010 negativna spomladi, ko je primanjkovalo v povprečju 28,3 mm vode v tleh, in poleti, ko se je primanjkljaj povečal na v povprečju 42,7 mm. Jesen in zima sta beležila presežek vode v tleh, ki je znašal v jeseni v povprečju 109,1 mm in pozimi v povprečju 88,2 mm. Primanjkljaj vode v tleh se pojavlja med aprilom in avgustom, torej v večjem delu vegetacijske dobe (april–september), kar je z vidika kmetijskih kulturnih rastlin izrazito neugodno in negativno vpliva na njihovo rast in razvoj.

Negativna vodna bilanca se na območju Pomurja prvič pojavi že v II. dekadi marca (v povprečju -1,5 mm), ko pade na tem območju, v primerjavi z ostalima dekadama marca, razmeroma malo padavin (v povprečju le 13,1 mm). V III. dekadi marca se začasno pojavi manjši presežek vode v tleh (v povprečju 4,9 mm), v I. dekadi aprila pa se prične daljše obdobje negativne vodne bilance. V prvih dveh dekadah aprila primanjkljaj v povprečju ne preseže v 2,3 mm, medtem ko med III. dekadno aprila in I. dekadno julija v posamezni dekadi primanjkuje v povprečju med 7,0 in 8,5 mm vode v tleh. Povprečni mesečni primanjkljaj se tako z 10,6 mm aprila, maja poveča na 24,1 mm. Primanjkljaj je največji na vzhodnem delu regije na meteoroloških postajah Lendava, Veliki Dolenci in Murska Sobota in se s pomikom proti zahodu postopno zmanjšuje. V zadnjih dveh dekadah junija se primanjkljaj vode v tleh ponovno nekoliko zmanjša in znaša v posamezni dekadi v povprečju med 3,5 in 4,6 mm. V zahodnem delu regije se na meteoroloških postajah Gornja Radgona in Blaguš za krajši čas pojavi celo manjši presežek vode v tleh, ki pa v posamezni dekadi ne preseže 3,0 mm. Julija sicer pade nekoliko več padavin (v povprečju 101,1 mm), vendar se hkrati poviša tudi temperatura zraka (povprečna temperatura 19,8 °C), kar poveča potencialno evapotranspiracijo, več vode porabijo tudi rastline. Julija tako primanjkuje v povprečju 22,6 mm vode v tleh, primanjkljaj je največji v I. dekadi (v povprečju -10,4 mm) in v III. dekadi (v povprečju -11,2 mm). V zahodnem delu preučevanega območja se na meteoroloških postajah Blaguš in Gornja Radgona ponovno začasno pojavi manjši presežek vode v tleh, ki pa v posamezni dekadi ne preseže 10,7 mm.

Avgusta, ko večina kmetijskih kulturnih rastlin že prehaja v zaključne fenološke faze, nekatere pa so že zapustila polja, se primanjkljaj vode v tleh močno zmanjša in znaša v povprečju le še 5,0 mm. Dekadne vrednosti nam razkrijejo, da se primanjkljaj vode

v tleh pojavlja le v prvih dveh dekadah avgusta (v I. dekadi v povprečju -6,5 mm in v II. dekadi v povprečju -5,3 mm), v III. dekadi pa se že pojavi presežek vode v tleh, ki znaša v povprečju 6,8 mm. V času poletja se večina padavin pojavlja v obliki ploh z veliko intenzivnostjo, posledično voda hitro steče po površju, precejšen del je zaradi visokih temperatur izhlapi in le manjši del je pronica v tla, pa še ta navlaži le zgornje horizonte prsti (Kikec 2015, 199). Septembra se presežek vode v tleh poveča na v povprečju 17,8 mm, oktobra znaša v povprečju 36,1 mm, največji pa je novembra, ko znaša v povprečju 59,6 mm. Z nastopom meteorološke zime se prične zmanjševati tudi presežek vode v tleh, ta znaša v povprečju decembra 43,7 mm, januarja 26,7 mm, februarja 17,7 mm in je najmanjši marca, ko znaša v povprečju le 6,4 mm. Zmanjšajo se tudi razlike med posameznimi meteorološkimi postajami. Še posebej pomembne so padavine v obliki snega, ki se počasi tali in voda počasi pronica v prst in obnavlja vodne zaloge, zaradi nižjih temperatur je v tem času tudi izhlapevanje manjše.



Slika 1: Mesečna vodna bilanca na izbranih meteoroloških postajah na območju Pomurja v obdobju 1961–2010*.

*Meteorološka postaja Blaguš 1961–1992, meteorološka postaja G. Radgona 1961–2001 in meteorološka postaja Jeruzalem 1961–2008.

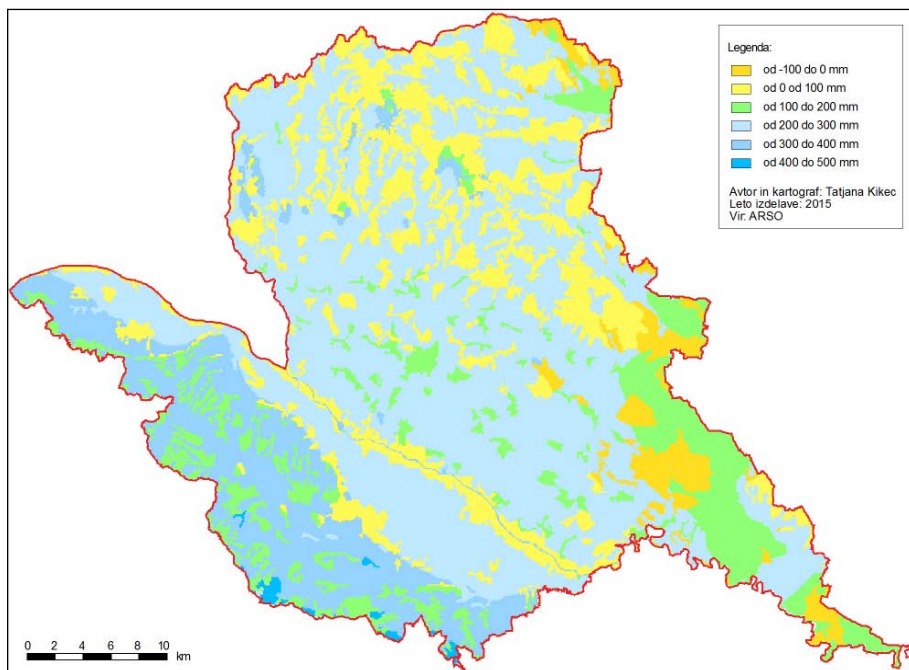
Vir: ARSO 2014; lastni izračuni.

3.1 Prostorska razporeditev vodne bilance

Na podlagi podatkovnih slojev o višini padavin in potencialni evapotranspiraciji, ki so ju na Agenciji RS za okolje ustvarili z interpolacijo podatkov vseh obstoječih meteoroloških postaj na območju Pomurja za obdobje 1971–2000, smo pripravili nov podatkovni sloj o preprosti vodni bilanci. To smo storili tako, da smo v programskem paketu ArcGIS oba sloja med seboj odšteli ter tako dobili razmeroma dobro prostorsko sliko stanja vodne bilance na območju Pomurja. Pri izračunu potencialne evapotranspiracije je bila upoštevana tudi pokrovnost tal, ki pomembno vpliva na količino izhlapele vode.

Največji letni primanjkljaj vode v tleh (do -100 mm) se pojavi na skrajnem vzhodu Pomurja, kjer je padavin najmanj in kjer prevladuje gozdna vegetacija. Pozitivna vodna bilanca z letnim presežkom vode do 100 mm se pojavi na območjih z gozdno vegetacijo (ta v primerjavi z drugimi vrstami vegetacije transpirira v zrak mnogo večje

količine vode), in sicer na celotnem območju Prekmurja, ter na zahodu do vzhodnega vznožja Radgonsko-Kapelskih goric in osrednjega dela Apaškega polja. Na zahodnejše ležečih območjih je letni presežek vode manjši. Na teh območjih prevladujejo evtrične in distrične rjave prsti na pliocenskih sedimentih, ponekod najdemo tudi plitve do srednje globoke obrečne prsti. Skupno se letni presežek vode do 100 mm pojavi na 18,8 % (251,0 km²) površine območja. Na njivskih površinah na hipogleju (v preteklosti so bile izvedene melioracije) in deloma na obrečnih prsteh na skrajnem vzhodu Pomurja, kjer pade 800–825 mm padavin, ter na gozdnih površinah na evtrični in distrični rjavi prsti na miocenskem peščenem laporju ter na distrični rjavi prsti na pliocenski glini v zahodnem delu območja, kjer pade 925 mm padavin in več, znaša letni presežek vode v tleh 100–200 mm. Območja zavzemajo 13,3 % (177,6 km²) površine regije. Na travniških in njivskih površinah na območju Prekmurja, na zahodu do vznožja Radgonsko-Kapelskih in Ljutomerskih goric ter osrednjega dela Apaškega polja z letnimi višinami padavin do 925 mm se pojavlja presežek vode v tleh, ki znaša 200–300 mm. Med prstmi prevladujejo hipoglej in psevdoglej (izvedene melioracije), obrečne prsti ter distrične rjave prsti in distrični ranker. Ta območja obsegajo slabo polovico Pomurja (48,4 % oz. 647,2 km²). Letni presežek vode v tleh 300–400 mm se pojavi na njivskih in travniških površinah na psevdogleju, hipogleju ter na evtrični in distrični rjavi prsti na miocenskem peščenem laporju v zahodnem delu območja. Največji letni presežek vode v tleh, 400–500 mm, se pojavlja na njivskih in vinogradniških površinah na distrični rjavi prsti na pliocenski glini na skrajnem jugozahodu na območju Ljutomerskih goric. Primanjkljaj vode v tleh je torej največji na vzhodnem delu Pomurja in se s pomikom proti zahodu postopno zmanjšuje.



Slika 2: Vodna bilanca med letoma 1971 in 2000.

Vir: Lastni izračuni, 2015.

Preglednica 1: Primanjkljaj/presežek vode v tleh* na kmetijskih površinah.

Razred	Gozdovi		Njive, vrtovi		Travniki, pašniki	
[mm]	[km ²]	[%]	[km ²]	[%]	[km ²]	[%]
-100–0	53,3	4,0	2,7	0,2	0,4	0,0
0–100	233,2	17,4	16,8	1,3	0,6	0,0
100–200	57,3	4,3	78,1	5,8	7,1	0,5
200–300	17,6	1,3	575,9	43,1	24,1	1,8
300–400	8,5	0,6	157,7	11,8	5,7	0,4
400–500	0,3	0,0	4,3	0,3	0,0	0,0

Razred	Sadovnjaki		Vinogradi		Ostalo		Skupaj	
[mm]	[km ²]	[%]	[km ²]	[%]	[km ²]	[%]	[km ²]	[%]
-100–0	0,0	0,0	0,0	0,0	0,2	0,0	56,6	4,2
0–100	0,0	0,0	0,7	0,1	1,7	0,1	253,0	18,9
100–200	0,0	0,0	1,0	0,1	36,7	2,7	180,3	13,5
200–300	0,0	0,0	10,6	0,8	22,7	1,7	650,9	48,7
300–400	0,6	0,0	13,4	1,0	4,3	0,3	190,2	14,2
400–500	0,0	0,0	1,0	0,1	0,7	0,1	6,3	0,5

Vir: Medmrežje 2; ARSO 2014; lastni izračuni.

*Podatki veljajo za analizirano obdobje 1971–2000.

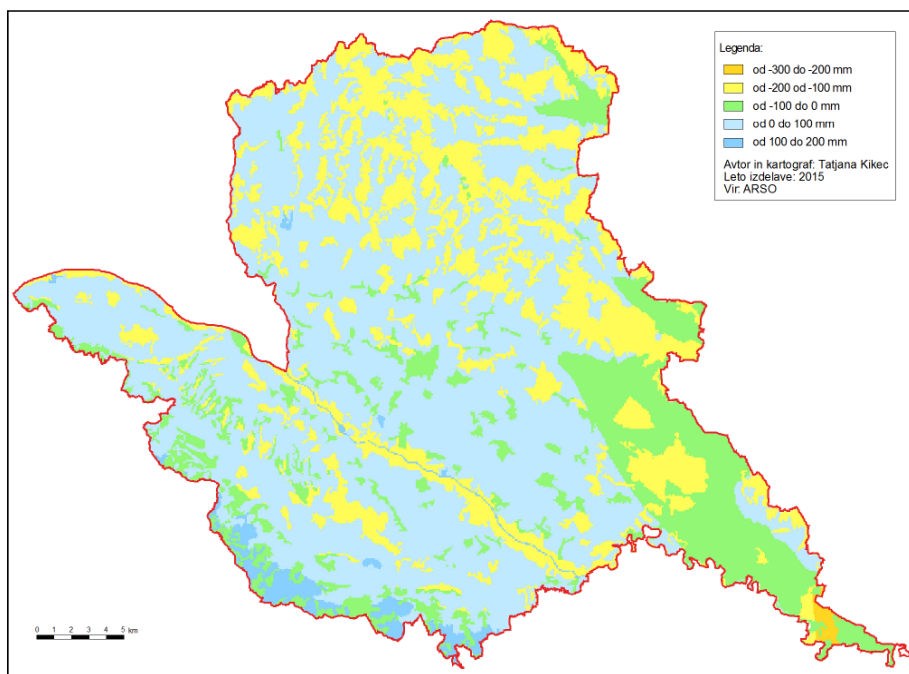
Za razvoj kulturnih rastlin je zlasti pomembna vodna bilanca v času vegetacijske dobe. Do nje smo prišli tako, da smo v programskem paketu ArcGIS od podatkovnega sloja ocena višine padavin v času vegetacijske dobe odšteli podatkovni sloj ocena potencialne evapotranspiracije v času vegetacijske dobe ter smo tako dobili oceno vodne bilance v času vegetacijske dobe. Ocena zato, ker smo do nje prišli na podlagi povprečnega deleža padavin ter povprečnega deleža potencialne evapotranspiracije v času vegetacijske dobe, izračunanega na podlagi podatkov šestih analiziranih meteoroloških postaj (Kikec 2015, 222).

V času vegetacijske dobe se največji primanjkljaj vode v tleh, od -300 do -200 mm, pojavi na skrajnem jugovzhodu Pomurja na območju Murske šume, kjer v tem času pade do 500 mm padavin. Primanjkljaj vode v tleh od -200 do -100 mm se pojavi na gozdnih površinah na celotnem vzhodnem in osrednjem delu Pomurja do vznožja Vzhodnih Slovenskih goric na zahodu. Ta območja obsegajo slabo četrtno (23,9 % oz. 320,0 km²) površine Pomurja. Na njivskih površinah na skrajnem vzhodu in jugovzhodu območja, kjer pade v času vegetacijske dobe do 525 mm padavin, ter na gozdnih površinah v zahodnem delu Pomurja na območju Vzhodnih Slovenskih goric, kjer pade 575 mm in več padavin, se pojavlja na 16,6 % (221,7 km²) površine območja do 100 mm velik primanjkljaj vode v tleh. Na dobri polovici (56,8 % oz. 759,9 km²) površine Pomurja se v času vegetacijske dobe pojavlja presežek vode v tleh do 100 mm. To so njivska in travniška območja, izjema je skrajni vzhodni in jugovzhodni del Pomurja. Največji presežek vode v tleh, od 100 do 200 mm se v času vegetacijske dobe pojavlja na njivskih in vinogradniških površinah na skrajnem zahodu v Vzhodnih Slovenskih gorinah, kjer pade 625 mm in več padavin.

Primanjkljaj vode v tleh se pojavi najprej na skrajnem vzhodu Pomurja v marcu in se v naslednjih mesecih postopno povečuje in širi proti zahodu. Maja tako primanjkuje vode v tleh v večjem delu območja, izjema je skrajni zahodni del (Vzhodne Slovenske

gorice z Radgonsko-Kapelskimi goricami), kjer se primanjkljaj praktično ne pojavi oz. se pojavi le v posameznih sušnih letih.

Z vidika pridelave kmetijskih kulturnih rastlin nas zanima zlasti pojav primanjkljaja vode v tleh na njivah in vrtovih, ki se v Pomurju nahajajo na 835,5 km² oz. na 62,5 % površine območja. Aprila imajo ta na območju Prekmurja, vzhodnega dela Prlekije in vzhodnega dela Apaškega polja do 10 mm presežka vode v tleh, kar je pomembno za normalno razraščanje ozimnih žit. Maja imajo presežek vode v tleh do 10 mm le še njivske površine na skrajnem zahodu Pomurja, v preostalem delu pa se že pojavlja primanjkljaj vode, ki znaša do 20 mm. Presežek vode je v tem času še zlasti pomemben za klasenje in cvetenje pšenice ter vznik koruze in krompirja. Junjsko deževje običajno nekoliko poveča zalogo vode v tleh, na njivskih površinah se tako primanjkljaj pojavlja le še na vzhodnem delu Goriškega ter v osrednjem in vzhodnem delu Ravenskega ter Dolinskega in znaša do 10 mm. Visoke julijske temperature povečajo evapotranspiracijo, poveča pa se tudi primanjkljaj vode v tleh. Primanjkljaj do 10 mm se pojavi na njivskih površinah na celotnem območju Prekmurja (izjema je vzhodni del, kjer se primanjkljaj poveča na 20 mm), v zahodnem delu do vzhodja Radgonsko-Kapelskih goric, osrednjem delu Apaškega polja in celotnem Murskem polju. V tem času potrebuje krompir največje količine vode saj prehaja iz fenofaze metličenja v fenofazo cvetenja. Avgusta se glede na izračunane ocene obdobjnih vrednosti na njivskih površinah primanjkljaj vode v tleh naj ne bi več pojavljal.



Slika 3: Ocena vodne bilance v času vegetacijske dobe med letoma 1971 in 2000.
Vir: Lastni izračuni, 2015.

Poleg njivskih površin nas z vidika stanja vodne bilance zanimajo tudi sadovnjaki, ki se v Pomurju nahajajo le na 0,6 km² površine ter še zlasti vinogradi, ki zavzemajo 26,7 km² oz. 2,1 % površine območja. Kot nam že poimenovanje izdaja, se vinogradi na večjih površinah nahajajo v Lendavskih in v Radgonsko-Kapelskih goricah ter v

pomurskem delu Vzhodnih Slovenskih goric ali Ljutomersko-Ormoških goric, v manjšem obsegu tudi na območju Goričkega, zlasti v njegovem jugovzhodnem delu. Na teh območjih prevladujejo distrične rjave prsti na pliocenski glini, pesku in drobnem prođu ter evtrične in deloma distrične rjave prsti na miocenskem peščenem laporju. V času vegetacijske dobe imajo ta območja presežek vode v tleh do 100 mm, Ljutomersko-Ormoške gorice ponekod tudi do 200 mm. Vinogradniške površine v Lendavskih goricah imajo aprila presežek vode v tleh do 10 mm, medtem ko se med majem in julijem soočajo s primanjkljajem vode v tleh do 10 mm. Avgusta se ponovno pojavi presežek vode v tleh do 10 mm, ki se septembra poveča na od 20 do 30 mm. Na vinogradniških površinah v Radgonsko-Kapelskih in v Vzhodnih Slovenskih goricah znaša aprila presežek vode v tleh od 10 do 20 mm ter maja do 10 mm, ponekod v Radgonsko-Kapelskih goricah se maja pojavi primanjkljaj vode v tleh do 10 mm. Junija znaša presežek vode v tleh od 0 do 20 mm, julija se ta na večjem delu zmanjša na do 10 mm, avgusta pa se presežek vode v tleh ponovno poveča na od 10 do 20 mm, v večjem delu Vzhodnih Slovenskih goric na do 30 mm. Septembra v času zorenja grozdja se presežek vode v tleh poveča na od 20 do 40 mm.

Navedeno predstavlja le oceno povprečnega stanja, dejansko stanje v posameznih, zlasti v sušnih letih, je lahko precej drugačno, primanjkljaj vode v tleh je takrat običajno bistveno večji, pomanjkanje vode pa traja tudi dalj časa.

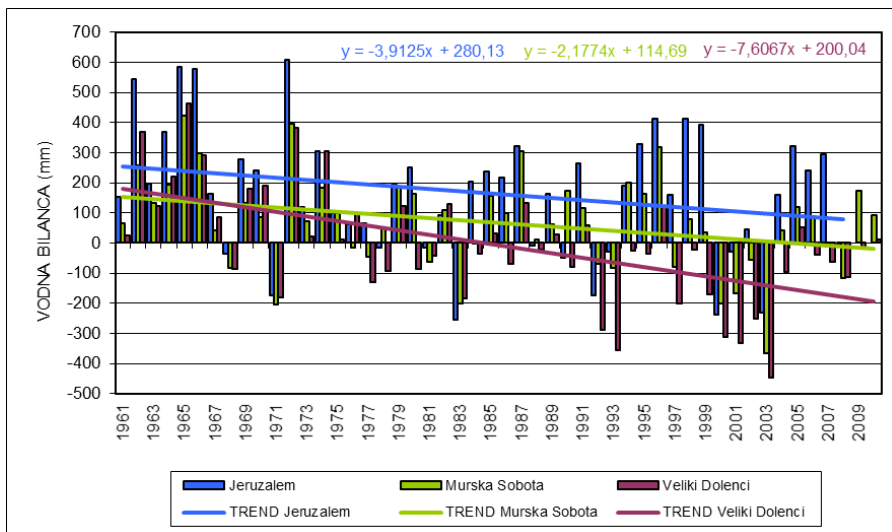
3.2 Trendi spreminjanja vodne bilance

Izračunani linearni trendi letne razlike med višino padavin in potencialno evapotranspiracijo kažejo, da se je primanjkljaj vode v tleh v analiziranem obdobju najbolj povečal na meteorološki postaji Veliki Dolenci na severovzhodu Pomurja (-6,3 mm/10 let), kjer je letna vodna bilanca že tako negativna (-6,6 mm). To sovпада z nekoliko višjimi temperaturami, ki povečujejo evapotranspiracijo in z zmanjševanjem višine padavin v tem delu Pomurja. Ostale analizirane meteorološke postaje beležijo pozitivno letno vodno bilanco, vendar se je glede na izračunane trende letni presežek vode v tleh v analiziranem obdobju zmanjšal. Na meteorološki postaji Blaguš v zahodnem delu Pomurja za -46,6 mm/10 let, v termalnem pasu ležeči meteorološki postaji Jeruzalem za -37,7 mm/10 let, na meteorološki postaji Murska Sobota v osrednjem ravninskem delu za -34,9 mm/10 let ter na meteorološki postaji Gornja Radgona za -29,6 mm/10 let in meteorološki postaji Lendava na skrajnem jugovzhodu za -27,0 mm/10 let.

V času vegetacijske dobe so izračunani linearni trendi za analizirano obdobje na vseh šestih analiziranih meteoroloških postajah negativni. Primanjkljaj vode v tleh se je najbolj povečal na meteorološki postaji Veliki Dolenci (-42,8 mm/10 let), sledi meteorološka postaja Blaguš (-33,5 mm/10 let) ter meteorološka postaja Gornja Radgona (-15,5 mm/10 let), kjer se v času vegetacijske dobe pojavlja manjši presežek vode v tleh (6,1 mm). Najmanjše povečanje primanjkljaja vode v tleh je bilo na meteorološki postaji Lendava (-14,8 mm/10 let) in Jeruzalem (-13,2 mm/10 let).

Primanjkljaj vode v tleh se je glede na izračunane linearne trende v analiziranem obdobju najbolj povečal v času poletja (v povprečju -15,6 mm/10 let), in sicer najbolj julija (v povprečju -10,8 mm/10 let), za več kot polovico manj avgusta (v povprečju -4,81 mm/10 let), kar je z vidika uspevanja kulturnih rastlin zelo neugodno. Le malo manj se je primanjkljaj vode v tleh povečal spomladi (v povprečju -15,5 mm/10 let), najbolj maja (v povprečju -7,0 mm/10 let) in aprila (v povprečju -6,3 mm/10 let). V času zime je vodna bilanca pozitivna, vendar je trend negativen (v povprečju -9,8 mm/10 let), presežek vode v tleh se je najbolj zmanjšal januarja (v povprečju -5,9

mm/10 let) in februarja (v povprečju -3,1 mm/10 let). Glede na pozitivne trende višine padavin septembra in oktobra je trend vodne bilance v jeseni le minimalno negativen (v povprečju -0,9 mm/10 let), septembra (v povprečju 5,7 mm/10 let) in oktobra (v povprečju 1,3 mm/10 let) pa se je presežek vode v tleh povečal.



Slika 4: Trendi letne vodne bilance na meteoroloških postajah Jeruzalem, Murska Sobota in Veliki Dolenci (1961–2010*).

*Meteorološka postaja Jeruzalem 1961–2008.

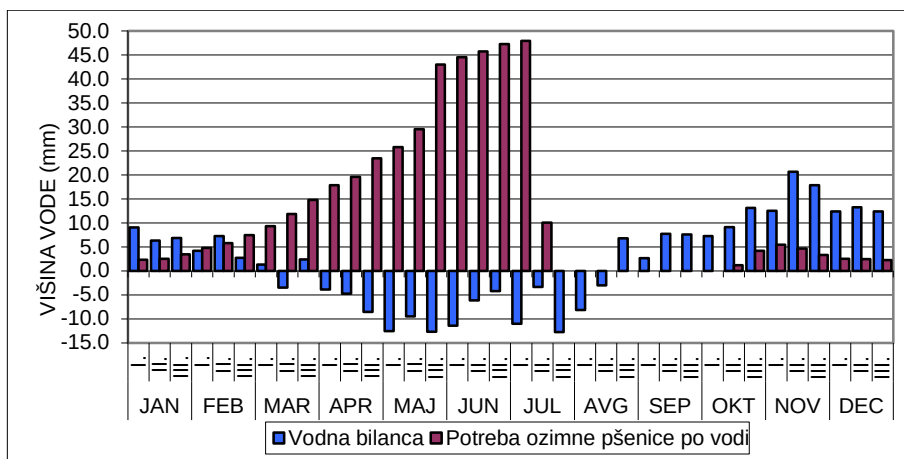
Vir: ARSO 2014; lastni izračuni.

Stanje in trendi vodne bilance so z vidika uspevanja kulturnih rastlin izrazito neugodni, saj se primanjkljaj vode v tleh najbolj povečuje v spomladanskih in poletnih mesecih, torej večji del vegetacijske dobe, ko so potrebe rastlin po vodi največje. Dodatno k neugodnim razmeram botruje dejstvo, da je večina njivskih površin na plitvih do srednje globokih prsteh na produ in pesku (tip ranker), kjer meteorna voda zelo hitro odteče v večje globine in ni več na voljo koreninskemu sistemu rastlin (Kajfež-Bogataj, Bergant 2005, 38–39).

4. Primerjava potreb izbranih kulturnih rastlin po vodi s stanjem vodne bilance

Potencialna evapotranspiracija (ETP) je tista količina vode, ki jo porabijo rastline, kadar so ves čas rasti in razvoja optimalno preskrbljene s talno vodo, te jim je nikoli ne primanjkuje in je nikoli ni preveč. V naravi to optimalno preskrbo s talno vodo le težko dosežemo. Na splošno porabijo rastline v celotnem ciklu letnega razvoja in rasti manj vode, kot je vrednost potencialne evapotranspiracije na začetku in na koncu vegetacije. Med cvetenjem in dozorevanjem je številne kmetijske kulturne rastline porabijo 10 do 20 % več od vrednosti potencialne evapotranspiracije (Matajc 1996, 141). Učinkovitost padavin za rastline je poleg fenološke faze odvisna tudi od globine koreninskega sistema, kar je med drugim odvisno tudi od tipa in globine prsti. Lahke peščene in prodnate prsti imajo majhno vodnoretencijsko kapaciteto, v globini koreninskega sistema ne zmorejo zadržati dovolj vode, zato se hitro izsušijo. Vodna bilanca je tako pozitivna le na dan, ko dežuje in morda še kakšen dan pozneje, potem pa se prst ponovno izsuši in pride do pomanjkanja vode v tleh (Kikec 2015, 200).

Različne kmetijske kulturne rastline imajo zelo različne potrebe po vodi, razlike se pojavljajo tako v količini potrebne vode, kot tudi v njeni razporeditvi po posameznih fenoloških fazah. Razporeditev vodne bilance še najbolj ustreza ozimnim žitom, ki jih kmetje v Pomurju sejejo v II. oz. III. dekadi oktobra, ko je vodna bilanca pozitivna. Do vključno II. dekade marca potrebe ozimnih žit po vodi ne presegajo presežka vode v tleh, kar omogoča v primeru ugodnih toplotnih razmer njihov neoviran vznik, razvoj in razraščanje. Od začetka marca se potrebe žit po vodi pričnejo postopoma večati, s primanjkljajem vode se prvič soočijo v II. dekadi marca, od I. dekade aprila pa jim vode primanjkuje vse do žetve. Ozimna pšenica ima največje potrebe po vodi med III. dekado maja in I. dekado julija, ko ji te v posamezni dekadi primanjkuje 43,0–48,0 mm. Od polne zrelosti do žetve med 5. in 30. julijem se potreba ozimne pšenice po vodi močno zmanjša (v II. dekadi julija potrebuje le še 10,1 mm vode), primanjkljaj vode v tleh pa se postopno povečuje, kar pa pšenice več ne ovira. V večini let tako polja zapusti še preden se na območju pojavi največji primanjkljaj vode v tleh. Pomanjkanje vode jo najbolj prizadene konec aprila in maja, ko je v fazi klasenja, v tem času v posamezni dekadi potrebuje 23,4–43,0 mm vode, primanjkljaj vode v tleh pa v tem času znaša 8,6–12,7 mm. V celotni rastni dobi potrebuje ozimna pšenica 442,7 mm vode, v povprečno namočenem letu pa ji na območju Pomurja primanjkuje 291,7 mm vode.

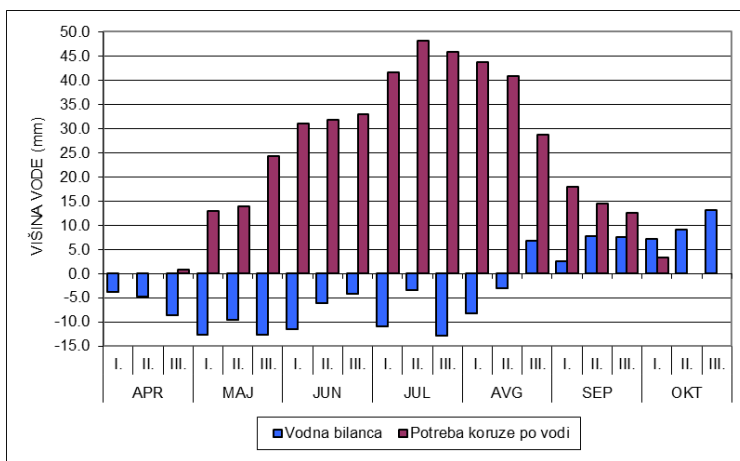


Slika 5: Primerjava potreb ozimne pšenice po vodi s stanjem vodne bilance na meteorološki postaji Murska Sobota v obdobju 1961–2010.

Vir: ARSO 2014; Fenološki podatki ... 2014; Irrigation ... 1986; lastni izračuni.

Večina ostalih kmetijskih kulturnih rastlin je v času največjega primanjkljaja vode v tleh v Pomurju ravno v najbolj občutljivejših razvojnih fazah, ko jih pomanjkanje najbolj prizadene. Koruza je v primerjavi z ozimnimi žiti večja porabnica vode, v rastni dobi potrebuje za nemoteno rast 445,1 l vode. Kmetje jo v Pomurju sejejo med 19. aprilom in 10. majem, ko se že pojavlja primanjkljaj vode v tleh, ki znaša v povprečju do 12,9 mm, kar lahko ovira vznik semen. Potreba kornice po vodi se poveča po vzniku rastline ter v času intenzivne rasti, vse dokler se rastlina ne razvije do te mere, da zeleni pokrov skorajda v celoti prekrije tla. Takrat ostane njena potreba po vodi začasno bolj ali manj enaka. V posamezni dekadi junija potrebuje kornica 31,0–33,0 mm vode, primanjkljaj vode v tleh pa v tem času znaša v posamezni dekadi 4,2–11,5 mm. Največje potrebe po vodi ima kornica od začetka metličenja v začetku julija do mlečne zrelosti sredi avgusta, ko v posamezni dekadi porabi 40,8–48,2 mm vode. V tem

obdobju je tudi najbolj občutljiva na pomanjkanje vode, ki pa je v Pomurju v tem času običajno primanjkuje. Ko rastlina doseže voščeno zrelost, se njena potreba po vodi prične postopno zmanjševati, vodna bilanca pa je v tem času v Pomurju že pozitivna.

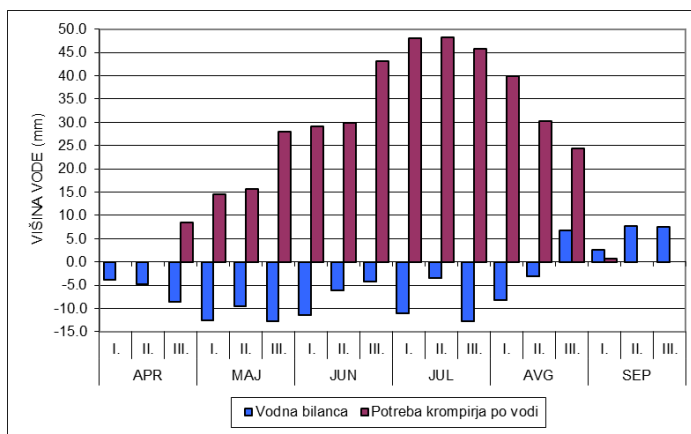


Slika 6: Primerjava potreb koruze po vodi s stanjem vodne bilance na meteorološki postaji Murska Sobota v obdobju 1961–2010.

Vir: ARSO 2014; Fenološki podatki ... 2014; Irrigation ... 1986; lastni izračuni.

V času celotne rastne dobe koruzi v povprečno namočenem letu na območju Pomurja primanjkuje 404,1 mm vode. Krompir potrebuje v rastni dobi za nemoteno rast in razvoj 406,0 mm vode, na območju Pomurja pa mu je v povprečno namočenem letu primanjkuje 396,4 mm. Glede na vremenske in talne razmere ga kmetje sadijo med 8. in 27. aprilom. Krompir, za razliko od koruze, potrebuje že v III. dekadi aprila 8,4 mm vode za vznik, vendar te v tem času na območju Pomurja že primanjkuje (-8,6 mm). Sorazmerno z rastjo se povečuje tudi njegova potreba po vodi, med III. dekadno maja in II. dekadno junija v posamezni dekadi potrebuje v povprečju 29,0 mm vode, primanjkljaj vode v tleh v tem času v Pomurju znaša 6,2–12,7 mm. V času cvetenja v II. in III. dekadi junija ter v času oblikovanja prvih gomoljev julija in v I. dekadi avgusta, se njegova potreba po vodi še poveča. Takrat je tudi najbolj občutljiv na pomanjkanje vode, v posamezni dekadi je potrebuje v povprečju 40,0–48,2 mm. Ravno v tem času se na območju Pomurja pojavlja največji primanjkljaj vode v tleh, ki znaša v posamezni dekadi 3,4–12,8 mm. Krompir se na pomanjkanje vode prilagaja z nižjim in skromnejšim nadzemnim delom ter z bolj drobnimi in manjšim številom gomoljev. Ko doseže fiziološko zrelost, se njegova potreba po vodi zmanjša, v zadnji fazi tik pred izkopom v I. dekadi septembra potrebuje le še 0,8 mm vode. V času izkopavanja krompirja je vodna bilanca v Pomurju ponovno pozitivna.

Med vrtninami ima največje potrebe po vodi paradižnik, ki v rastni dobi za nemoteno rast potrebuje 446,8 mm vode. Na območju Pomurja se s pomanjkanjem vode sooča celotno rastno dobo, v povprečno namočenem letu mu primanjkuje 414,9 mm vode. Vodna bilanca je negativna že ob njegovi setvi v III. dekadi aprila, v drugem delu rastne dobe pa njegove potrebe po vodi presežejo presežek vode v tleh, ki se pojavlja od III. dekade avgusta naprej. Paradižnik potrebuje največ vode med I. dekadno julija in I. dekadno avgusta, v posamezni dekadi med 41,9–46,2 mm.



Slika 7: Primerjava potreb krompirja po vodi s stanjem vodne bilance na meteorološki postaji Murska Sobota v obdobju 1961–2010.

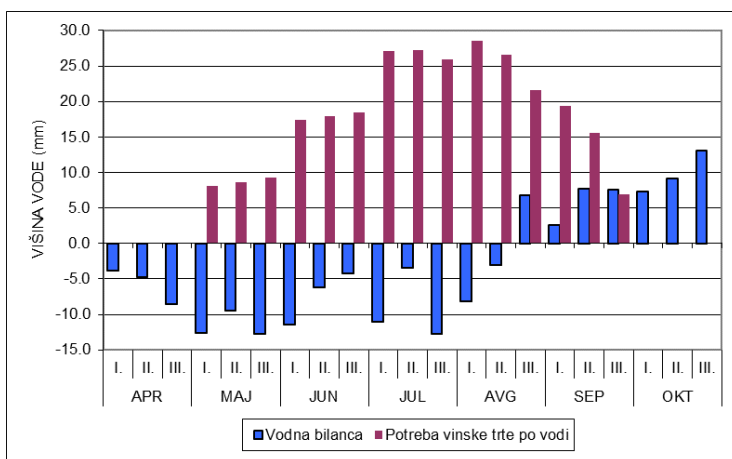
Vir: ARSO 2014; Fenološki podatki... 2014; Irrigation ... 1986; lastni izračuni.

Nekoliko manjša porabnica vode je paprika, ki v rastni dobi, od II. dekade maja do II. dekade septembra potrebuje 346,2 mm vode (Prav tam). Največ je potrebuje med I. dekadom julija in II. dekadom avgusta, v posamezni dekadi 35,5–42,0 mm, ko se na območju Pomurja pojavlja primanjkljaj vode v tleh, ki znaša v posamezni dekadi 3,1–12,8 mm. Podobno kot paradižnik, se tudi paprika v Pomurju sooča s pomanjkanjem vode v celotni rastni dobi, v povprečno namočenem letu ji primanjkuje 329,0 mm vode.

Bučke potrebujejo v rastni dobi, ki traja v Pomurju od II. dekade maja do I. dekade septembra, 385,7 mm vode, največ julija in v I. dekadi avgusta, v posamezni dekadi 38,1–42,0 mm, ko je vodna bilanca na območju Pomurja izrazito negativna. Kljub nekoliko krajši rastni dobi se tudi bučke, podobno kot paradižnik in paprika, v Pomurju soočajo s pomanjkanjem vode v celotni rastni dobi, primanjkuje jim 376,4 mm vode.

Vinska trta je v primerjavi z drugimi kulturnimi rastlinami manjša porabnica vode, v rastni dobi je porabi le 278,8 mm; v Pomurju ji v povprečno namočenem letu primanjkuje 254,1 mm vode. Zaradi globljega koreninskega sistema ima dostop do vode tudi v večji globini, ko so zgornji horizonti prsti že izsušeni. Potreba vinske trte po vodi preseže razpoložljive količine vode v tleh s pojavom prvih listov v I. dekadi maja, ko v posamezni dekadi maja potrebuje v povprečju 8,7 mm vode; primanjkljaj vode v tleh znaša v tem času v posamezni dekadi 9,6–12,7 mm. Njena potreba po vodi se še nekoliko poveča v času cvetenja junija (v posamezni dekadi potrebuje v povprečju 17,9 mm vode), največje potrebe po vodi pa ima vinska trta v fazi formiranja plodov in rasti grozdnih jagod julija in avgusta. V posamezni dekadi julija potrebuje v povprečju 26,8 mm vode in v posamezni dekadi avgusta v povprečju 25,6 mm vode, medtem ko znaša primanjkljaj vode v tleh julija v povprečju 22,6 mm in avgusta v povprečju 5,0 mm. S pričetkom zorenja grozdnih jagod se potreba vinske trte po vodi prične postopno zmanjševati, v zadnji fazi zorenja tik pred trgatvijo konec septembra oz. v začetku oktobra potrebuje v posamezni dekadi le še 6,9 mm vode. Od III. dekade avgusta naprej je vodna bilanca v Pomurju že minimalno pozitivna, vendar se vinska trta, zaradi velikih potreb po vodi, do vključno II. dekade septembra sooča s pomanjkanjem vode. Pomanjkanje vode jo manj prizadene, zlasti dobro prenaša krajša sušna obdobja.

Med velike porabnike vode spada sadno drevje, zlasti jablana, ki na območju Pomurja v rastni dobi, med II. dekada aprila in I. dekada oktobra, potrebuje 518,7 mm vode. Jablana potrebuje že v začetnih razvojnih fazah precejšnje količine vode (v posamezni dekadi aprila v povprečju 12,7 mm), njena potreba po vodi pa se v sledečih razvojnih fazah še stopnjuje vse do faze rasti plodov, ko med II. dekada junija in III. dekada julija v posamezni dekadi potrebuje 39,8–42,0 mm vode. S pričetkom zorenja plodov se njena potreba po vodi postopno zmanjšuje, vendar ji vse do obiranja plodov konec septembra in v začetku oktobra, kljub pozitivni vodni bilanci na območju Pomurja v tem času, še vedno primanjkuje v posamezni dekadi do 6,0 mm vode.



Slika 8: Primerjava potreb vinske trte po vodi s stanjem vodne bilance na meteorološki postaji Murska Sobota v obdobju 1961–2010.

Vir: ARSO 2014; Fenološki podatki ... 2014; Irrigation ... 1986; lastni izračuni.

Zelo podobno razporeditev potreb po vodi v rastni dobi kot jablana ima tudi hruška, katere sadove obiramo nekoliko prej, že v začetku septembra. Glede na krajšo rastno dobo je tudi njena potreba po vodi nekoliko manjša, in sicer potrebuje 445,7 mm vode. Na območju Pomurja ji v povprečno namočenem letu v rastni dobi primanjkuje 436,2 mm vode.

Primerjava potreb izbranih kmetijskih kulturnih rastlin po vodi s stanjem vodne bilance na območju Pomurja je pokazala, da so potrebe večine kmetijskih kulturnih rastlin v času največjega primanjkljaja vode v tleh med majem in julijem, precej večje od primanjkljaja. V času rastne dobe se tako večina od njih sooča s pomanjkanjem vode, le v zaključnih fenoloških fazah septembra in oktobra se potrebe večine kulturnih rastlin po vodi že toliko zmanjšajo, da so zadovoljene s presežkom vode v tleh, ki se pojavlja v tem času na območju Pomurja. Večina kmetijskih kulturnih rastlin ima največje potrebe po vodi v poletnih mesecih junij, julij in avgust, izjema so ozimna žita, ki polja zapustijo že v sredini julija. V času največjih potreb kmetijskih kulturnih rastlin po vodi so te tudi najbolj občutljive na njeno pomanjkanje. Med kmetijskimi kulturami rastlinami je največja porabnica vode koruza, večje količine potrebuje tudi različno sadno drevje, medtem ko so vrtnine, z izjemo paradižnika, na splošno manjše porabnice vode.

Preglednica 2: Potrebe izbranih kmetijskih kultur po vodi in primanjkljaj vode za izbrane kmetijske kulture v rasti dobi na območju Pomurja.

Kulturna rastlina	Potreba rastline po vodi (mm)	Primanjkljaj vode za rastlino* (mm)	Velikost primanjkljaja glede na potrebo (%)
Koruza	445,1	-413,2	92,8
Ozimna pšenica	442,7	-291,7	65,9
Krompir	406,0	-396,4	97,7
Sladkorna pesa	504,0	-463,0	91,9
Jablane	518,7	-475,5	91,7
Hruške	445,7	-436,2	97,9
Vinska trta	278,8	-254,1	91,1
Zelje	376,2	-309,6	82,3
Paprika	346,2	-329,0	95,0
Paradižnik	446,8	-414,9	92,8
Bučke	385,7	-376,4	97,6

*Primanjkljaj je izračunan na podlagi primerjave potrebe rastline po vodi s stanjem vodne bilance na meteorološki postaji M. Sobota v obdobju 1961–2010.

Vir: ARSO 2014; Fenološki podatki ... 2014; Irrigation ... 1986; lastni izračuni.

5. Posledice vodnega stresa in poškodovanost kmetijskih kulturnih rastlin

Poleg toplote je voda najpomembnejši abiotski faktor za normalno rast in razvoj rastlin. Prehodno pomanjkanje vode je za rastline običajen pojav in večina jih je razvila ustrezne mehanizme, da takšna obdobja premagajo brez večjih težav. Večji problem predstavlja za rastline dolgotrajnejša suša. Sušni stres se v rastlinah ne pojavi nenadoma, temveč se razvije postopno. Posledice suše se v rastlinah postopno akumulirajo in se lahko ohranjajo dalj časa, zato običajno težko določimo začetek in konec suše. Prve vidne posledice sušnega stresa lahko opazimo šele, ko turgor³ upade do tolikšne mere, da rastlina prične veneti, lahko pa se pojavijo tudi druge vidne posledice, kot je na primer zvijanje listov. Primanjkljaj vode spremeni metabolizem rastline, distribucijo asimilatov in mobilnost hranil že veliko prej, kot se pojavijo vidne posledice (Larcher 1995, 335). Fiziološki in biokemični odzivi kulturnih rastlin na pomanjkanje vode so zelo različni in so odvisni od vrste in sorte kulturne rastline, predhodne izpostavljenosti sušnemu stresu, jakosti stresa, sezone ter drugih okoljskih dejavnikov (Šircelj 2006, 272).

Ob pomanjkanju talne vode že v zgodnjih razvojnih fazah je oviran vznik, rastline začnejo zaostajati v rasti, kar se pozna na njihovem razvoju v sledečih razvojnih fazah. Vlažnost je eden izmed najpomembnejših dejavnikov, ki vplivajo na razvoj koreninskega sistema. Pri pomanjkanju vlage v prsti rastlina razvije večji koreninski sistem ter daljše korenine s katerimi prodre globlje v prst, da pride do potrebne vode. Ker se običajno pri rastlinah sočasno pojavi tudi toplotni stres, je moten tudi proces fotosinteze in oplodnja cvetov, zato so ti slabo oplojeni ali sploh niso, kar pomeni izpad pridelka. Primanjkljaj vode v času cvetenja, opravevanja ter polnjenja zrn večini poljščin škoduje, še posebej koruzi, soji in pšenici (Parry 2000, povz. po Kajfež Bogataj in Črepinšek 2004, 53). Če pri koruzi v fazi metličenja listna ovenelost traja 6–8 dni, se pričakovani pridelek zmanjša do 50 %, še bolj škodljiv pa je vpliv suše v

³ Turgorski tlak ali turgor je znotrajcelični tlak, ki je potreben za normalen potek fizioloških procesov. Ko rastlina več ne more vzpostaviti turgorja, četudi popolnoma omeji transpiracijo (npr. preko noči), nastopi točka venenja (Vodnik 2005).

fazi oplodnje, ko rastlina ob nezadostnih količinah vode ostane brez nastavka zrnja, kar pomeni 100 % izpad zrnja (Tanjšek et al. 1991, 66). Koruza je še vedno zelo priljubljena poljščina med pomurskimi kmetovalci, vendar potrebuje, zaradi sposobnosti oblikovanja velike količine suhe snovi, za nemoteno rast in razvoj precejšnje količine vode, zato je ob pojavu suše običajno med najbolj poškodovanimi kmetijskimi kulturami. V ekstremno sušnem letu 2003 je najvišja stopnja poškodovanosti koruze⁴ ponekod na plitvih peščeno-prodnatih prsteh znašala tudi do 80 % (Ocena poškodovanosti ... 2003 in 2007, 2011), leta 2012 in 2013 do 51 % ter silažne koruze do 62 % (Ocena poškodovanosti ... 2012 in 2013, 2014).

Sušnega leta 2003 so ozimna žita zaradi pomanjkanja vode že zelo zgodaj pričela zaostajati v razvoju, zavirano je bilo njihovo stebenje, na posameznih območjih v Pomurju se je njihova rast ustavila na višini 20 cm. Zaradi hkratnega temperaturnega stresa je bila motena fotosinteza in predvsem oplodnja cvetov ter začetek nalivanja zrnja. Žita so razvila krajše klase, večja je bila sterilnost cvetov in posledično večje število praznih klasov (Zrnec in Matajc 2003, 26). Zaradi suše in visokih temperatur so ozimna žita prisilno in hitreje dozorevala. Njihova najvišja stopnja poškodovanosti je ponekod na plitvih peščeno-prodnatih prsteh jugovzhodno od Murske Sobote znašala 70–75 %, med 61–70 % pa so ozimna žita bila poškodovana na Murskem polju, na severozahodu Dolinskega in Ravenskega ter na osrednjem in jugovzhodnem Goričkem (Ocena poškodovanosti ... 2003 in 2007, 2011). V sušnih letih 2012 in 2013 ozimna žita niso bila poškodovana saj je bila žetev opravljena pred pojavom hude suše v drugi polovici julija (Ocena poškodovanosti ... 2012 in 2013, 2014).

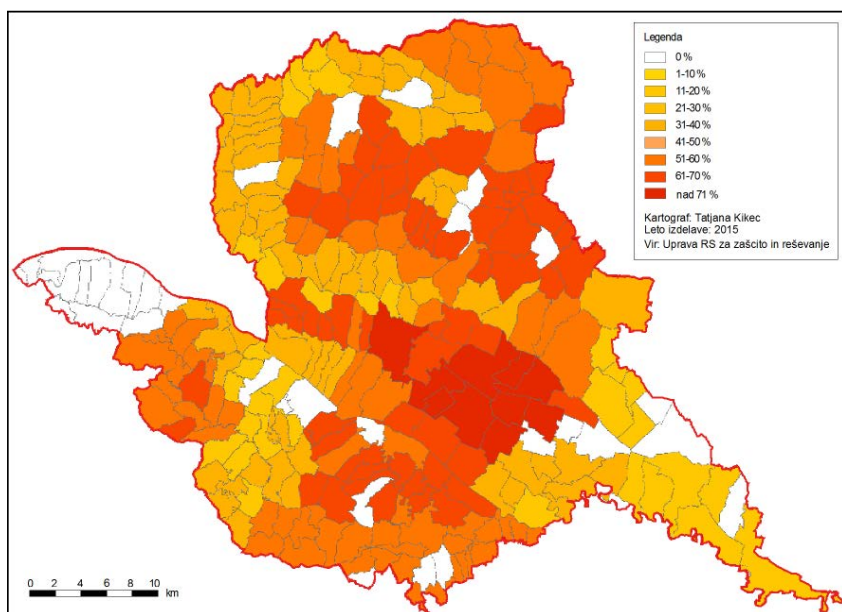
Mladi nasad krompirja si po suši hitro opomore, če pa ga suša prizadene v drugi polovici rasti, potem ko je že pričel cveteti, si ne opomore več. V vročih dneh morajo korenine nepretrgoma dovajati velike količine vode, sicer se listne reže zaprejo. Asimilacija se tako prične zmanjševati že pri neznatnem pomanjkanju vlage v tleh, kar omejuje rast nasada, še zlasti listov, ki ostanejo manjši, rastline pa se prej postarajo in odmrejo, kar zmanjšuje količino suhe snovi, torej pridelka (Kus 1987, 31, 33, 36, 159). Podobno kot pri pšenici je tudi pri krompirju najvišja stopnja poškodovanosti zaradi suše leta 2003 na plitvih peščeno-prodnatih prsteh ponekod znašala 70–75 % (Ocena poškodovanosti ... 2003 in 2007, 2011), v sušnih letih 2007, 2012 in 2013 pa najvišja stopnja poškodovanosti krompirja ni presegla 50 % (Prav tam; Ocena poškodovanosti ... 2012 in 2013, 2014).

Kljub globljemu koreninskemu sistemu tudi sadno drevje v poletnih mesecih občuti pomanjkanje vode v tleh, kar povzroča ovenelost listov in odpadanje še nedozorelih sadežev. Vinsko trto pomanjkanje vode v zgornjih horizontih prsti manj prizadene, ob večjem pomanjkanju talne vode pogosto pride le do venenja listov, ob ekstremni suši pa se upočasni njena rast, kar vpliva na slabši razvoj jagod, ki ostanejo bolj drobne.

⁴ Podatki o stopnji poškodovanosti posameznih kulturnih rastlin zaradi suše so pomemben pokazatelj prostorske razširjenosti in intenzivnosti pojava suše, vendar je pri njihovi uporabi potrebno upoštevati sledeče:

- prijava škode: za prijavo in uveljavljanje škode se je potrebno soočiti z birokratskimi postopki, ki jim zlasti manjši kmetje sami niso kos, zato škode pogosto ne prijavijo – ta se običajno pojavi v večjem obsegu kot nam kažejo podatki;
- način zbiranja podatkov: ker ne obstajajo enotni kriteriji za ocenjevanje škode, so ocene v veliki meri odvisne od subjektivne presoje članov v prvi fazi občinske in v drugi fazi regijske komisije za ocenjevanje škode;
- nivo zbiranja podatkov: podatki se zbirajo na nivoju katastrskih občin, kar je za natančnejšo prostorsko omejitev območij pojava suše prevelika enota, saj ni nujno, da se suša pojavi na celotni površini katastrske občine, poleg tega pa se v posamezni katastrski občini pojavljajo poleg njiv tudi druge oblike rabe tal, kjer se suša ne pojavi.

Največjo škodo običajno utrpijo mladi vinogradi, eno- in dvoletni trsi, ki se zaradi slabše odpornosti posušijo. Sušnega leta 2003 so tudi sadovnjaki in vinogradi utrpeli precejšnjo škodo, listje se je posušilo in odpadalo, plodovi so ostali majhni, ponekod so se celo posušili in odpadli. Izpad pridelka je bil posledica aprilske ohladike, ki je sadno drevje in vinsko trto ujela v najbolj občutljivejših fenoloških fazah odpiranja rodni brstov do cvetenja, ter poletne suše. Najvišja stopnja poškodovanosti grozdja je znašala 80–85 % in je bila ocenjena na območju Radgonsko-Kapelskih goric, najvišja stopnja poškodovanosti sadja je znašala 50–55 % (Ocena poškodovanosti ... 2003 in 2007, 2011) Leta 2012 je vinska trta dokaj dobro kljubovala suši, najvišja stopnja poškodovanosti je znašala 36 %, med sadnim drevjem so bile poškodovane le slive in češnje, ki so bile zaradi suše poškodovane tudi leta 2013, in sicer je najvišja stopnja poškodovanosti znašala 50–60 % (Ocena poškodovanosti ... 2012 in 2013, 2014).



Slika 9: Stopnja poškodovanosti pšenice v sušnem letu 2003 v Pomurju.
Vir: Uprava RS za zaščito in reševanje, 2015.

Ob dalj časa trajajočem izpadu padavin in pojavu kmetijske suše se zmanjša količina pridelka, slabša je tudi njegova kakovost. Najbolj prizadete so tiste kulturne rastline, ki se v času pomanjkanja vode nahajajo v najbolj občutljivejših razvojnih fazah, in ki so velike porabnice vode. Škoda je običajno ogromna in samo v Pomurju, kjer zavzemajo njive in vrtovi 835,5 km² oz. 62,5 % površine regije (Medmrežje 2), presega milijonske zneske.

Gledano dolgoročno ima škoda, ki jo vsakih nekaj let povzroči kmetijska suša, velike posledice tako za kmetijstvo kot za gospodarstvo Pomurja, kjer se 7,6 % delovno aktivnega prebivalstva še vedno ukvarja s kmetijstvom (SURS 2015).

Preglednica 3: Škoda zaradi poškodovanosti kulturnih rastlin zaradi suše v letih 2003, 2007, 2012 in 2013.

Škoda	2003	2007	2012	2013
Poškodovana površina (ha)	64.750,06	13.100,81	20.483,74	26.764,33
Ocenjena škoda (EUR)	31.509.395,33	7.556.610,17	11.744.366,63	25.531.136,48

Vir: Ocena poškodovanosti ... 2003 in 2007, 2011; Ocena poškodovanosti ... 2012 in 2013; 2014.

6. Zaključek

Primerjava stanja vodne bilance in potreb izbranih kmetijskih kulturnih rastlin po vodi v Pomurju je pokazala velika neskladja, kar ima ob dalj časa trajajočem izostanku padavin za posledico poškodovanost rastlin in posledično manjše količine pridelka slabše kakovosti.

Vodna bilanca je na območju Pomurja negativna med aprilom in II. dekada avgusta, torej večji del vegetacijske dobe. Primanjkljaj vode v tleh je največji maja, ko znaša v povprečju - 24,1 mm, sledi julij s povprečno -22,6 mm. Gledano prostorsko je primanjkljaj največji v vzhodnem delu Pomurja, s pomikom proti zahodu se postopno zmanjšuje in je najmanjši v zahodnem ter jugozahodnem delu območja. Razporeditev stanja vodne bilance preko leta je dokaj ugodna za ozimna žita, saj jim vode primanjkuje le v drugi polovici rastne dobe, polja pa zapustijo še pred hujšim primanjkljajem vode v tleh. Večina ostalih kmetijskih kulturnih rastlin kot so koruza, krompir, buče in drugo se s pomanjkanjem vode v tleh sooča večji del rastne dobe, v najbolj občutljivejših razvojnih fazah pa se nahajajo ravno v poletnih mesecih junij, julij, avgust, ko je primanjkljaj vode v tleh na območju Pomurja največji in jih ta najbolj prizadene. Tudi izračunani linearni trendi vodne bilance niso nič kaj spodbudni, saj se primanjkljaj vode v tleh še povečuje, in sicer najbolj v spomladanskih in poletnih mesecih, torej v večjem delu vegetacijske dobe, ko so potrebe rastlin po vodi največje.

V času nizke samooskrbe v Sloveniji zato velja razmisliti in na novo preučiti primernost pridelave posameznih kmetijskih kulturnih rastlin, prilagoditi njihov izbor in način pridelave. Velike porabnice vode bo vsaj deloma smiselno nadomestiti z bolj odpornimi kulturami in tistimi z večjimi regeneracijskimi sposobnostmi po krajših sušnih obdobjih. Možnost je tudi v sajenju bolj zgodnjih sort (s tem se sicer poveča nevarnost spomladanske pozebe), ki zorijo pred nastopom sušnega obdobja, ter zelo poznih sort. Posledice suše se da vsaj deloma omiliti tudi z določenimi agrotehničnimi ukrepi. Vsekakor pa bo potrebno z različnimi ukrepi pričeti čim prej in se tako prilagoditi razmeram, ko je pojav suše v Pomurju vse pogostejši.

Literatura

- Duden, 2001: Tematski leksikon geografija, geslo: suša. Učila, Tržič, str. 535–536.
- Fenološki podatki za izbrane kmetijske kulture za fenološke postaje na območju Pomurja za obdobje 1961–2010 (digitalna oblika). 2014, Agencija RS za okolje, Ljubljana.
- Frantar, P. (ur.) 2008: Vodna bilanca Slovenije 1971–2000. Ministrstvo za okolje in prostor, Agencija RS za okolje, Ljubljana.
- Irrigation Water Management: Irrigation water needs. 1986, FAO. Pridobljeno: <http://www.fao.org/docrep/S2022E/S2022E00.htm> (10. 7. 2013).

- Kajfež Bogataj, L. in Svet, M. M. 1993: Dinamika parametrov vodne bilance kmetijskih tal v Sloveniji v obdobju 1961–1990. V: Zbornik Biotehniške fakultete Univerze v Ljubljani, št. 61, str. 21–27.
- Kajfež Bogataj, L. in Črepinšek, Z. 2004: Možni vplivi spremenjene klime na kmetijstvo. V: Ranljivost slovenskega kmetijstva in gozdarstva na podnebno spremenljivost in ocena predvidenega vpliva. Ministrstvo RS za okolje, prostor in energijo, Agencija RS za okolje, Ljubljana, str. 47–71.
- Kajfež - Bogataj, L., Bergant, K. 2005: Podnebne spremembe v Sloveniji in suša. *Ujma*, 19, Ljubljana.
- Kikec, T. 2015: Geografska tipizacija Pomurja glede na sušo in možnosti za prilagoditev pojavi. Doktorska disertacija. Univerza v Mariboru, Filozofska fakulteta, Oddelek za geografijo, Maribor.
- Kolbezen, M. in Pristov, J. 1998: Površinski vodotoki in vodna bilanca Slovenije. Ministrstvo za okolje in prostor, Hidrometeorološki zavod RS, Ljubljana. Pridobljeno: http://www.arso.gov.si/vode/publikacije%20in%20poro%C4%8Dila/bilanca6190_2_BESEDILO.pdf (14.4.2011).
- Kus, M. 1987: Krompir. Knjižica za pospeševanje kmetijstva XVIII. ČZP, Kmečki glas, Ljubljana.
- Larcher, W. 1995: Physiological plant ecology. Ecophysiology and stress physiology of functional groups. 3rd edition, Berlin, Springer Verlag.
- Matajc, I. 1996: Vpliv sušnih in deževnih obdobj na pridelavo kmetijskih rastlin. *Ujma* 10, Ljubljana, str. 138–142.
- Ocena poškodovanosti kmetijskih kultur zaradi suše leta 2003 in 2007. Poročilo regijske komisije za ocenjevanje škode, nastale zaradi pojava suše (digitalna oblika). 2011, Uprava za zaščito in reševanje RS, Izpostava Murska Sobota.
- Ocena poškodovanosti kmetijskih kultur zaradi suše leta 2012 in 2013. Poročilo regijske komisije za ocenjevanje škode, nastale zaradi pojava suše (digitalna oblika). 2014, Uprava za zaščito in reševanje RS, Izpostava Murska Sobota.
- Podatki o oceni škode po vzroku elementarne nesreče. Statistični urad RS. Pridobljeno: <http://www.stat.si/> (20. 3. 2015).
- Podatki o višini padavin in potencialni evapotranspiraciji za izbrane meteorološke postaje na območju Pomurja za obdobje 2061–2010 (digitalna oblika), 2014. Agencija RS za okolje, Ljubljana.
- Pokrovnost tal v Sloveniji (digitalna oblika), 2014. Ministrstvo za okolje in prostor - Agencija RS za okolje, Ljubljana.
- Šircelj, H. 2006: Sušni stres v kmetijskih rastlinah. V: Novi izzivi v poljedelstvu. Zbornik prispevkov VII. simpozija v Rogaški Slatini, 7.–8. dec. 2006, Slovensko agronomsko društvo, Ljubljana, str. 271–277.
- Tanjšek, T. et al. 1991: Koruza. Knjižica za pospeševanje kmetijstva. ČZP Kmečki glas, Ljubljana.
- Vodnik, D. 2005: Fiziologija rastlin. PowerPoint prezentacija za predavanja iz predmeta Fiziologija rastlin za študijsko leto 2005/06. Univerza v Ljubljani, Biotehniška Fakulteta, Oddelek za agronomijo, Ljubljana. Pridobljeno: <http://web.bf.uni-lj.si/ag/botanika/gradiva/Voda-UNI-2005-06.pdf> (14.5.2015).
- Zrnec, C. in Matajc, I. 2003: Agrometeorologija. V: Mesečni bilten Agencije RS za okolje, julij 2003, Ljubljana, str. 25–30.
- Medmrežje 1: <http://pxweb.stat.si/pxweb/Dialog/statfile2.asp> (12.4.2015).
- Medmrežje 2: <http://rkg.gov.si/GERK/> (13. 11. 2014).

COMPARISON OF WATER BALANCE AND THE NEEDS OF SELECTED AGRICULTURAL CROPS FOR WATER IN POMURJE REGION

Summary

In addition to heat and light plants need a certain amount of water or moisture in the soil for successful growth and development. The available quantities of water at the selected location are determined by calculating the water balance and are dependent on rainfall, potential evapotranspiration, the soil's ability to retain water and previous water supplies. The water balance has been calculated on the basis of data from the Slovenian Environment Agency (ARSO) about the amount of rainfall and potential evapotranspiration for the period between 1961 and 2010 for six selected meteorological stations in Pomurje region. We deducted a daily value of potential evapotranspiration from daily precipitation. The needs of the agricultural crops for water are dependent on climatic factors, the type of crop and the level of its development. The potential evapotranspiration of plants, which means the amount of water needed for the smooth development, was expressed in mm / day or l / m² / day (Irrigation ... 1986) and was calculated using the formula of Food and Agriculture Organization of the United Nations (Chapter 2).

The water balance in Pomurje region was between 1961 and 2010 negative in spring (an average -28,3 mm) and summer (an average -42,7 mm), while in autumn (an average of 109.1 mm) and winter (an average of 88,2 mm) there was excess of water in the soil. The shortage of water in the soil occurs between April and the second decade of August - the major part of the growing season (April to September), which is in terms of agricultural crops distinctly unfavourable and has a negative impact on their growth and development. The shortage of water in the soil is the biggest in May, with the average of -24,1 mm, followed by July with an average of -22,6 mm (ARSO 2014, their own calculations). Viewed spatially, the deficit of water is the highest in the eastern and south-eastern part of Pomurje region; by moving to the west it is gradually decreasing and is the smallest in the western and south-western part of the area. The calculated water balance trends are in terms of the flourishing agricultural crops highly unfavourable, since the water deficit in the soil increases the most in spring and summer months, hence the major part of the growing season when the plant's needs for water are the greatest.

A comparison of the needs of selected agricultural crops for water with the state of the water balance in Pomurje region has shown that the needs of most agricultural crops for water during the maximum deficit of water in the soil between May and July are significantly higher than the deficit. Most crops face a shortage of water in a large part of the growth period, only in the final phenological stages in September and October are the water needs so reduced that they are already met with an excess of water in the soil, which at this time appears in Pomurje region. Allocation of the status of the water balance over the year is favourable for winter grain (Fig. 5) which in the first half of the growing season has sufficient water to ensure a smooth emergence, development and proliferation. The water lacks in the second half of the growing season from late February to mid-July, when it is harvested before the greatest water scarcity. Most other agricultural crops, corn, potatoes, pumpkins and vegetables, such as peppers and tomatoes, face a lack of water in the soil for the major part of the growth period (Fig. 6 and 7). The maximum water needs are during the summer months of June, July and August, when the largest deficit of water in the soil occurs in Pomurje region. Then the majority of agricultural crops are in the most sensitive stages of development, when water shortages affect them greatly. Even fruit trees

and vines (Fig. 8) have the greatest need for water in July and August, when they are in the stage of formation of the fruit and its growth. Unlike fruit trees, vines are smaller consumers of water and are more resistant to the lack of it, as due to the deeper root system they have access to water at greater depths, when the upper horizons of the soil have already dried out.

A transitional lack of water is normal for the plants and most of them have developed appropriate mechanisms to overcome such periods without any major problems. A bigger problem for the plants is prolonged drought. The first visible effects of drought stress appear as wilting of plants and rolling of leaves, their growth slows down, the prolonged water shortages cause irreversible damage to the plants, which is reflected in the quantity and quality of the crop. The most affected are those crops that are in a time of shortage of water in the most sensitive stages of development, and that are large consumers of water. Damage caused by agricultural drought is usually huge and only in Pomurje region, where arable land and gardens present 835,5 km² or 62,5 % of the region (Internet 2), exceeds millions of euros. At a time of low self-supply in Slovenia we should therefore consider and re-examine the adequacy of production of different agricultural crops, adapt their selection and production methods, as start with these measures as soon as possible.

CLIMATE CHANGES IN NORTH AFRICA AND THE POSSIBILITIES OF ADAPTING TO IT WITH ECOSYSTEM APPROACHES

Ana Vovk Korže

PhD., PhD.

University of Maribor

Department of Geography

Faculty of Arts

Koroška cesta 160, SI-2000 Maribor, Slovenia

e-mail: ana.vovk@um.si

Manuela Štefane

mag. prof. of Geography and mag. prof. of Pedagogy

Proti jezam 22, 2310 Slovenska Bistrica

e-mail: manuela.stefane@ gmail.com

UDK: 551.583:916

COBISS: 1.02

Abstract

Climate changes in North Africa and the possibilities of adapting to it with ecosystem approaches

The article deals with geographical characteristics of North Africa with the focus on climate changes which are reflected in particular by the increase in the average temperatures and decrease of precipitation. These conditions have a direct impact on the reduction of agriculture and on the changes in land use. Further on, this has a direct impact on the way of life of people. The use of ecosystem technologies (imitation of nature) can be an easy and effective way to contain water in the region. Water also has a significant role in survival. Therefore, the use of ecoremediation (imitation of nature) in North Africa could mitigate climate changes.

Key words

North Africa, climate changes, ecosystem technology, ecoremediation

1. Introduction

For the period 2020-2030, experts predict a decrease in rainfall for most of the area. Considering the year 2012, the lowest precipitation is predicted for south of Egypt (more than 20% lower), Morocco, central and coastal areas of Algeria, Tunisia and the central of Libya where they predict that the annual precipitation will lower for 5-15 %. In some areas, it is expected that the precipitation will increase (0-20 %). The lowest precipitation for this period is predicted for Morocco, the central and north part of Algeria and for Tunisia (Terink, Immerzeel, Droogers 2013). It is expected that the annual precipitation will lower for about 4 to 27%. Even though, it is expected that there would be more torrents. A huge issue will be a water shortage mostly because of the increase in the evaporation level. Therefore, these areas will be most affected by the lack of precipitation (Radhouane 2013).

North Africa has specific natural and social elements that have a significant effect on the abilities of adaptation to climate changes. With the aim to determine the types of areas for adaptation to climate change, we have typified North Africa to similar areas as those areas. In North Africa, the average annual precipitation is low since some areas like Libya and Egypt receive less than 25 mm of rainfall annually. Desert areas receive less than 200 mm of rainfall annually. More rainfall, up to 1000 mm a year, is received in the coastal areas of Morocco, Algeria and Tunisia (Radhouane 2013, Terink, Immerzeel, Droogers 2013). The countries in North Africa receive on average 25-1000 mm of rainfall annually. Deviations are caused by geographical location, closeness to the sea and orographic barrier. The most drought months in North Africa countries are the summer months (June, July and August). In these months, the precipitation is very low, for example, in West Sahara falls only 1,6 mm of rainfall. Precipitation is mainly concentrated in winter time (December, January and February) in the form of rain that falls mostly on the coastline. The only exception is Sudan, which receives the most rainfall during the summer months. The average monthly precipitation decreases towards the east and the hinterland area (The World Bank 2015).

2. Methodology

The purposes of the typification are to recognize similar areas in North Africa and to plan similar measures to adapt to climate changes. We have developed a new criterion for the typification. The criteria consider the current conditions of natural resources and social process. The typification takes into account the following parameters:

- Common physical-geographical characteristics
 - The reduction of the average precipitation
 - Raising of average air temperature
 - The increase in consumption of freshwater
- Common social-geographical characteristics
 - The decrease of attachment of the economy on agriculture
 - + Gross domestic production
 - + Workforce
 - Land use
 - + Cultivable areas
 - + Irrigation agriculture.

We gained the information about North Africa from African Development Bank (2015), Central Intelligence Agency (2015), Radhouane (2013), Terink, Immerzeel and Droogers (2013) and United Nations Environment Programme (2014).

3. Climate changes in North Africa

A major part of North Africa receives a low level of precipitation and that has an impact on the poor water conditions. The average total annual precipitation in North Africa is estimated at 1503 m³/annually, which is equivalent to 7 % of total annual precipitation in Africa. However, the distribution of the precipitation varies in Africa. The most rainfall, almost 7,5 %, falls in Sudan and only 3% falls in Egypt. 5,6% of precipitation falls in river networks or it is used for filling ground water. The rest is lost by evaporation, transpiration and disappearance. Availability of water per capita was 26 m³/annually in 2000 in Egypt and up to 1058 m³/annually in Morocco for the same year (United Nations Environment Programme 2014).

There are even more differences if we compare North Africa countries to countries of Sub-Saharan Africa. Total of internal renewable fresh water resources in North Africa present 2,5% of the total in Africa, but the withdrawal of it presents 46% of the total in Africa. This difference partly reflects harsh climate conditions. Renewable fresh water sources are supplied with water from hinterland river flows (alluvial aquifer Nil) or from the rainfall (coastline of the Mediterranean Sea (United Nations Environment Programme 2014).

This region heavily depends on rare winter rainfall and short rainy seasons. Agriculture has adapted to this weather conditions. Drought areas on the South of the region entirely depend on irrigation (Radhouane 2013). Climate changes and population growth will push people to marginal dry lands that are already sensitive for desertification (United Nations Environment Programme 2014).

North Africa is located in the subtropical zone, an area of constant variation of polar and tropical air masses and thus dry and wet periods (Medved 1978). Summer drought is prolonged, the more we are heading south. North Africa countries have the highest temperatures in summer months and the lowest temperatures in winter months. Data from the year 1990 to 2009 show that the average monthly air temperature rarely falls below 10°C. What is more, in the summer the average monthly temperature rises even over 30°C. In comparison to the period from 1930 to 1960 the average monthly air temperatures have increased in every country. The only exceptions are Egypt and Libya, where the average monthly temperature has decreased in some months, but only for 0,1°C (The World Bank 2015).

An annual temperature increase from 2,2°C to 5,5°C is expected for North Africa by the end of the 21st century. The temperature increase will be higher in the hinterland than by the coastline and it will be more noticeable in the summer months (2,7°C - 6,5°C) than in winter months (1,7°C - 4,6°C).

North Africa is an extremely dry country. The drought increases on the account of climate changes, in particular, due to lack of precipitation. North Africa received in average more rainfall in the period from 1930 to 1960 than in the period from 1990 to 2009. As it is shown in Tab.1 the average annual precipitation of North Africa has decreased in average for 26,3 mm in the last 20 years. During the period from 1930 to 1960, there was less precipitation in Sudan (24,4 mm/annually), Morocco (15,2

mm/annually) and West Sahara (1,3 mm/annually) in comparison to the period from 1990 to 2009. Even though, this is a small amount considering average annual precipitation the differences indicate that global climate changes are noticeable also in North Africa.

Tab. 1: The variation of rainfall amounts across North African countries in the years 1930–1960 and 1990–2009.

Country	Change of precipitation (in mm)
Western Sahara	-1,3
Morocco	-15,2
Algeria	1,6
Tunisia	8,9
Libya	2,2
Egypt	1,9
Sudan	-24,4
Northern Africa	-26,3 mm

Source: The World Bank 2015.

The position of North Africa in subtropical zone influences on the temperature of the atmosphere. North Africa is a region of extreme records. The highest air temperature in the world was 57,8°C and it was measured in 1922 in Libya (The World Bank 2015). Global climate changes also have an effect on the increase of average annual and monthly air temperature during the period from 1930 to 1960 and from 1990 to 2009. During those periods, the temperature increased the most in Sudan (1,11°C) and Tunisia (1,02°C). The temperature increased the least in Morocco (0,32°C) and Egypt (0,4°C).

3.1 Regions with increased consumption of freshwater

A total of annual consumption of freshwater in billions of cubic meters is increasing. The largest consumption of fresh water was in 1977 and 2013 in Egypt and the lowest in Tunisia. In the last 35 years, the consumption of freshwater in Africa has increased by more than 28 %. Moreover, in Libya, it has increased by 72%. Though, Tunisia has the lowest consumption of freshwater that does not neglect the fact that freshwater consumption in Tunisia has increased by 62,5% from 1977 to 2013.

Every year, the number of population is increasing and due to that the need of food and more cultivated land is also increasing. Since the few fertile soils are already cultivated, more dry soils are also being cultivated. This demands irrigation for which freshwater is used. Another issue that comes along with this is a significant water loss before water comes to the cultivated land because of old irrigation systems. Many current issues of North Africa countries are also connected to the urban wastewater treatments and industrial sewage that are being removed inappropriately. The need of renovation and water supply systems also present an issue.

3.2 Regions with the decrease of attachment of the economy on agriculture

The North African economy depends on natural conditions. Most of the cultivated land is concentrated in the coastal areas. Due to physical-geographical and socio-geographical changes like global warming and the impact of human activities on the environment, the North Africa countries have decreased the dependence on agriculture. "The gross domestic production is the value of all the finished goods and services that are produced within a country's borders in a year" (Finančni slovar 2009-2011).

In 2013, the most significant contribution to value added were service activities, followed by industry. The least value added was provided by agriculture. The contribution of services to the total gross value added was the largest in Tunisia (61,0 %) and Morocco (53,2 %). Services add the least value in Algeria (28,0 %). A significant contribution of service activities to GDP of a country is an indicator of technological progress, foreign investments, globalization, successful trade links and structural changes. Industry contributes the biggest share of gross value added in Algeria (62,6 %) and Libya (58,3 %), where the industry is strongly depended on and connected to oil and its derivatives.

The smallest part of agriculture production is in Libya (2,0 %). The biggest part of the agricultural production is contributed by Sudan because of the good climate conditions and the river Nile that enables irrigation. Agriculture in Egypt also contributes 14,5 % to GDP, this is possible in Egypt because of irrigation by the Nile river.

Agriculture requires workforce. The highest percent of persons employed in agriculture has Sudan (80,0 %), West Sahara (50,0 %) in Morocco (44,6 %). Of all North African countries, agriculture is the largest part of gross domestic production in Sudan. This is due to good climatic conditions and the river Nile that enables irrigation on the droughty north part of the country. West Sahara and Morocco also have favorable climate conditions, especially along the coastline where the Mediterranean climate allows to grow olives, wine, citrus fruits and vegetable. These are cultivated on huge fields that require workforce. Most of the harvest is exported. The exported harvest presents 33% of all exports. A vast amount of surfaces is irrigated with modern systems.

The lowest share of people employed in agriculture is in Algeria (14 %) and Libya (17 %) where they devote more attention to industry and services since they base their economy and export on oil.

Tab. 2: Percentage of employed in agriculture in 2004.

Country	Percentage of employed in agriculture (%)
Algeria	14
Egypt	29
Libya	17
Morocco	44,6
Sudan	80
Tunisia	18,3
Western Sahara	50

Source: Central Intelligence Agency. (2015). The world Factbook. Accessed February 15 2015 from <https://www.cia.gov/library/publications/the-world-factbook/>.

3.3 Regions with significant changes in the proportion of cultivated land

Cultivated land and fields in North Africa are mostly by the coastline and on the areas where irrigation agriculture is possible. The percentages of cultivated areas were the highest in 2011 in Morocco (17,79 %) and in Tunisia (17,35 %) because these two countries have the most appropriate physical-geographical and socio-geographical conditions. The cultivated areas are mostly by the coastline and in the highlands where irrigation is possible. In the last ten years, the percentages of cultivated areas have been increasing at the expense of increased number of population and the increased demand for food.

Tab. 3: The percentage of cultivable areas in North African countries in the year 2011.

Country	% of cultivable areas (1977)	% of cultivable areas (2011)	% change of cultivable areas between the years 1977 and 2011
Algeria	2,9	3,15	0,25
Egypt	2,51	2,87	0,36
Libya	0,99	0,99	0
Morocco	16,69	17,79	1,1
Sudan	5,18	6,76	1,58
Tunisia	22,7	17,35	-5,35
Western Sahara	No information available	0,02	/

Source: Central Intelligence Agency. (2015). The world Factbook. Accessed February 11 2015 on <https://www.cia.gov/library/publications/the-world-factbook/>.

Agriculture demands adjustments because of extreme weather conditions and rare fresh water supplies with the exception of the Nile in Egypt. We can find irrigation agriculture in all countries of North Africa. In Sahara water is available only deep under the surface and it can be accessed only in the oasis. In the oasis, the underground water is near the surface and it comes to the surface in springs or it is retained in hollows. However, in many places, people have to dig wells (Krušič 1992).

Tab. 4: Off irrigation farming areas.

Country	Off irrigation farming areas (km ²)
Algeria	5694
Egypt	34220
Libya	4700
Morocco	14850
Sudan	18900
Tunisia	3970
Western Sahara	No information available

Source: Central Intelligence Agency. (2015). The world Factbook. Accessed on 11. 2.2015 from <https://www.cia.gov/library/publications/the-world-factbook/>.

Common physical geographical characteristics have shown that the average precipitation is decreasing and the average air temperature is increasing in the countries of South Africa. Freshwater sources that get water from rainfall are additionally overloaded and their use is increasing.

In North Africa countries, the common social-geographical characteristic show that economy is less depended on agriculture than other economy sectors. The share of gross domestic production and employment shows that agriculture contributes only a small percentage of gross domestic production and that agriculture employs only a small amount of workforce considering other economy sectors. The main reason for this is because of foreign investors that see an important basis for future development in countries of North Africa. In some places, there is also a low-cost workforce and well-educated workforce. This shows that North African countries are in postindustrial period and that they invest in research and development. The main investments of foreign investors are services, trade, traffic infrastructure, education and medicine. Therefore, the economy does not need to depend on agriculture and the after-effect is that there are fewer people employed in agriculture. It can be said that North African countries are successfully introducing western management standards of the economy.

Nevertheless, countries in North Africa are still very attached to the land. Percentage of cultivated land has increased in all North African countries from 1977 to 2011. The number of population is increasing and with it, the need for food is increasing and the need for new land for cultivation that are expanding to droughty areas.

Cultivated lands are overloading and polluting coastline areas. This, along with big population density, the increasing number of population and the use of fertilizers or pesticides are some of the reasons for catastrophes. Some of these catastrophes are disease, social problems, desertification, soil erosion and torrential downpour. Expansion of cultivated land effects biotic diversity reduces soil coverage and influence on larger and more intensive environmental issues.

At the same time, the expansion of cultivated land is burdening irrigation systems. The cultivated lands are expanding to drought areas that need moisture and fertilizers for cultivation. This overloads irrigation systems and freshwater sources. Moreover, the irrigation systems are old and that causes unnecessary water loss. Extreme use of fertilizers and other chemicals to increase the fertility of sandy soils and to maximize the harvest are overloading and polluting the soils, underground water and freshwater sources.

Moreover, freshwater sources have been the reason for fights and disorders in the past. They could be caused because of unequal access to water or because of pollution. Current political disorders in North Africa are beginning to be a regularity. Mostly, because of diverse nationalities and the ancient people that still live there. The cause of the Arab spring was corruption, social problems and other economic factors and it took place in all countries of Northern Africa. The number of victims is enormous, but the positive consequences will not be visible for a long time.

4. The use of ecosystem technologies for adapting to climate changes

The concept of ecosystem technology or ecoremediation (ERM) means the usage of natural processes for restoration and protection of the environment (eco + remediation = »natural renewed revival«). Using ecoremediation methods we can decrease and abolish the consequences of agricultural pollution, tourism, traffic, industry, dumping grounds and settlements. Ecoremediations mean returning to nature, aiming to save and restore natural balance, where these kinds of areas can give an opportunity to develop new working places and additional activities. Ecoremediations have already been recognized as perspective and continual approach, where natural and conatural processes and systems are being used in favor of the restoration of degraded environment and protection of natural environment. In practice ERM are used as constructed wetlands, conatural sanitations of deposits, riverine vegetation zones – balancing areas, side branches, artificial lakes, noise and/or dust reducing barriers, phytoremediation of polluted sediments, purifying soil and drinking water, tertiary purifying and purifying dangerous sewage water. By using ERM methods, less money is spent on sanitation of already threatened areas and continual protection of these is emphasized, which is a big advantage in a financial sense. ERM is entirely adjusted to the newest programme documents and strategies. Using ecoremediations also opens the possibility to save energy and even gain it (usage of renewed energy sources). We only list some of the benefits of ecoremediation methods: to introduce and implement them does not require pretentious financial investments; these are environmental friendly methods, that are natural from functional and aesthetical point of view; they have multipurpose effects,

include simple, understandable and nature-friendly and acceptable procedures, that work as an addition to existing systems for preventing pollution etc. ERM are methods for integral environment handling, therefore additional studies to current environment managing plans need to be made.

Tab. 5: Systems and methods for retaining water in agriculture areas.

Water resources	Systems and methods
Surface retention (habitats)	Systems that form an appropriate structure of land use with the help of: – Systems of tillage fields, meadows, forests, ecological areas and ponds, – Afforestation, planting protection belts, bushes, arrangement of terraces – Escalation of wet surfaces (peat bog and swamps)
Retention of soil	Systems of cultivation influence on the effect that waters have on soil: – Improvement of the soil structure, agriculture drainage, liming, appropriate agriculture technics, appropriate rotation, increasing organic matter in soil
Soil and underground water	Cultivating and systems for drainage are restricting surface flow: – Restriction of surface flow – Increasing of filtration abilities of soil – Measures against erosion, fitodrainage and agriculture drainage measures – Regulations for a flow from drainage systems – Ponds and infiltration wells for containing rainfall
Surface water	Hydrotechnical systems for sorting and preservation of water – Small water ponds – Regulation of water in the system of drainage and ditches – Water retention from the drainage systems – Increasing of water retention in river valleys with building dams.

Technical measures. Under this category, we can place most of hydrotechnical and drainage measures that try to slow down the water moving from the surface. Technical measures include building small water containers, dams for lakes, watercourses, ditches and drains, drainage water retention, the use of appropriate methods of drainage from closed surfaces (roofs, squares and streets) that allows water decanting to another open surface, restoration of small watercourses and flooded valleys with the use of technical measures.

Methods of planning (non-technical). Appropriate spatial planning for water catchment areas has an important role in water management. These measures focus on spatial planning that can limit the flow of rainfall and water when the snow melts. Under this category, we can place restoration of ecological areas, including small ponds, making of appropriate structure of fields, meadows and forests and planting of protection belts.

Agrotechnical (agriculture) measures. These measures depend on land use, including the use of the appropriate methods for cultivation on fields in the catchment areas of the rivers. The main measures in this category are to improve soil structure in the fields and forests, measures against erosion, protection of appropriate forest habitats that can prevent the flow of the water into the forest and maintain infiltration surfaces in urban areas.

On the contrary, it is not desirable that the agricultural areas are intended for retaining water all though many agrotechnical measures can improve the structure of water balance in the reservoir.

Measures like the increase of organic matter in the soil, to stop making the closed layers that are the result of tillage and to improve the structure of hard soil can cause a better ability for the soil to retain water. Even a small increase in the capacity to retain water can retain a considerable amount of water. For example, the increase of the capacity to retain water for 10mm (10 l on 1 m²) can retain 100 000 m³ of water per hectare. From a water use point of view, this amount is not significant but it is a significant amount from the perspective of water retaining since this can limit the occurrence of floods.

All of the measures that are related to the increase of water retention in the river catchment area are a consequence of the changes in spatial planning and in the manner of land use and they can be a part of a non- technical form of natural water retention. These are the manners that are most similar to natural water retentions. With the limitation of surface flow of we increase the potential of retention of water in the region, the storage of water in the region and the ability to restrain water in the soil. The ability to restrain water in wetlands and forests is described below.

Wetlands. In regard to the ability to water retention of wetlands, we distinguish:

- The ability to retain soil water in the wetlands means the ability to retain water in the air parts/zones (pores in the soil);
- The ability to retain water in the wetlands means the ability to retain water on the surface of the wetlands
- The ability to retain water in levels occurs as the result of limiting the flow of the water from the surface with the formation of peat bogs on the ridge of the aquifer.

It is possible to retain rainfall in the soil pores (Air parts/zones; between the level of the land and water). The higher the water level is there is a lower ability to retain water (defined as the ability to be filled with water as the result of flood or plenty of rainfall)

Forests. Forests also have the characteristic of water retention. Many of science publications are dedicated to the role of forest on the structure of water balance in the catchment area. It is well known that forests balance water cycles with the help of water retention when it rains and with the increase of river level between the periods without rain.

Forests have a positive role in limiting floods when it rains often and when the snow is melting in the areas where there is a lot of snow to melt and where the soils are poorly drained. On the contrary, it is hard to prove that the role of the forest in the evaluation of the degree of the river flow. Forests have a significant role in the areas with a diverse surface and with weakly absorbing grounds. With water retention in the soil, we can limit the fast flow of the water from the surface.

The measures that involve building of devices and construction are causing an increase in the amount of water retention in catchment areas are called technical measures for water retention.

Water reservoir. Water reservoirs have an important role in the economy and in the environment. Depending on the role the water reservoirs have, we can divide them into the following categories:

- Water storage reservoirs for economic purposes: water retention for agricultural irrigation and for forestry, for human and agriculture water needs, water for aquaculture, flood protection, electricity (small water power plants)
- Water reservoirs for recreation and aesthetic purposes: swimming pool complexes, aesthetic areas (parks), fishing ponds (non-commercial aquaculture);
- Ecological reservoirs: enclave of water flora and fauna, biofilters (constructed wetlands) or reservoirs that serve as the filtration for water treatment;
- Water reservoirs that are used for the improvement of water balance structure: a supply for aquifers, flood protection, limitation of erosion, retention of surface flows in closed areas.

Drainage systems. A significant number of small aquifers were designed and deepened because of intensive agriculture. Moreover, many valley drainage systems were built and as a consequence of this, a thick network of drainage systems was made. The level of underground water has decreased in the areas of wetlands. In many cases, it is a possibility and a need to increase and restore the level of underground water without damaging agriculture. The drainage system shift water when there is too much water because of field crops and usually the level of underground water decreases more than it is necessary. In general, a sufficient drainage for the purposes of agriculture production is a drainage that can provide 6-8 % of the ventilation zones in a layer of the soil. There are technical solutions that enable the excessive flow of water from the drainage. This effect can be achieved with the use of so-called regulated spill from the drainage system or with building dams (dam constructions) on the drainage ditches. Devices that can be installed in the drainage fountain allow controlling the level of the dammed water and adjust to the current weather conditions. Dam constructions with the permanent threshold are built on ditches. The level of the ditch is normally located approx. 40-60 cm below ground level.

The results of several studies suggest that limiting the amount of runoff water from drainage systems or from the trenches does not cause negative effects on agricultural production. On the contrary, this type of regulation of run-off water causes that the stored water in plants can be used in the vegetation period. In general, water conditions can improve from the perspective of agriculture. In addition, the water that outflows from the drainage system is less loaded with nitrogen and phosphorus. Therefore, the regulation of the outflow contributes to the improvement of water quality in the rivers.

Drainage systems with regulated drains can be made on relatively flat surfaces. If the landscape is more diverse (a significant denivelation of drainage pipelines), is a more efficient construction of small reservoirs for water retention on outflows of drainage systems. The water in these reservoirs can be cleaned and used for irrigation or other commercial purposes. Similar solutions can be used in the system of drainage ditches.

4.1 The importance of adapting to climate changes

The most important benefit of adopting is water retention. Water retention plays an important role in limiting the negative effects of drought. The elevation of the

groundwater level and water retention of the soil profile due to the demands of agriculture and the environment increases the groundwater sources.

The most important benefits of the water retention measures are:

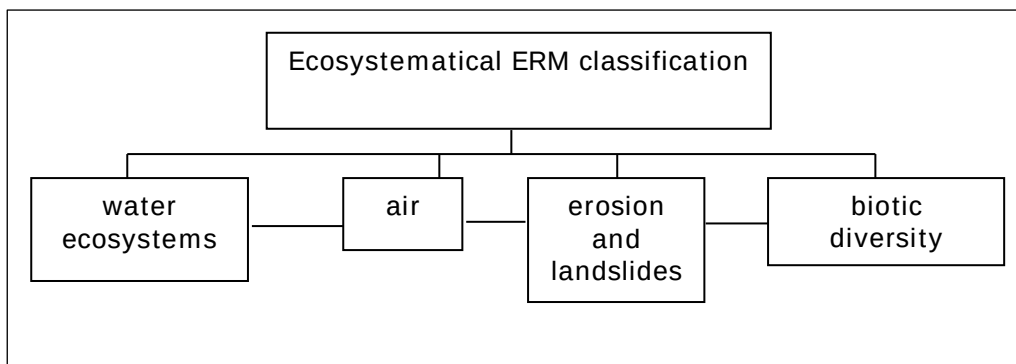
- Changes in the structure of water drainage in rivers, reducing flood wave and in some cases the improvement of low-flow conditions.
- Meet the needs of the forest and swamp ecosystems that depend on water, and improving the state of the environment as a result of the increase in the level of underground water.
- An increase in supplies of groundwater aquifers, which causes an increase in the sources of groundwater.
- To meet the need of economy. For example: water reservoirs can be used as a pumping station for firefighters, spas, extensive ponds, pumping stations for irrigation, etc.
- The improvement of the natural values of the environment, the improvement of biodiversity in the agricultural landscape by rehabilitating wetlands, small ponds, creating natural aquatic habitats for animals and plants, creating a human-friendly micro-climate.
- Protection of the quality of surface water, retention of suspended particulates, removal of nutrients (nitrogen and phosphorus) from the rainwater.

Solutions involving high technology can be effective, but they require a huge input of energy, are operationally too complex and often do not meet the goals of sustainable development. With the increasing development and knowledge of natural processes, ecology, and the relations in the ecosystems we discover the unexplored potential in nature. These are very effective for the protection and restoration of the already degraded and deprived areas. The concept of ecoremediations refers to the use of sustainable systems and processes for the rehabilitation of the environment and its protection. Ecoremediation technologies include the principles of nature, the phytoremediation (phytostabilization, phytoextraction, phytostimulation, phytodegradation, phytotransformation, and phytovolatilization) and bioremediation to restore pollution in the environment. Natural (green) approaches increase biodiversity and are returning the ecosystem to balance. Ecoremediation methods have the potential for the reduction, prevention and elimination of natural disasters (floods, droughts, avalanches), nonpoint sources of pollution (agriculture, transport) and point sources of pollution (public utilities, industrial sewage). High efficiency can be achieved by protecting habitats, in particular, water sources, streams, rivers, lakes, groundwater and sea. The basic functions of ecoremediation are the high buffer capacity, self-cleaning ability, enhancing biodiversity and water retention. With ecoremediation (phytoremediation, buffer areas and constructed wetland) we can revitalize degraded areas (quarries, periphery of roads), remove excessive levels of nutrients and clean waste water.

Ecoremediation of aquatic ecosystems during climate change is becoming more and more visible. We have some of the water at our disposal and the pressures on the use of the available water are increasing. In order to gain additional sources of water from the channel of water courses that would otherwise not have the economic, environmental or social role, we are contributing to the conservation of cultural landscapes and life in them. Although watercourses represent a small proportion of surface they significantly contribute to the well-being of the population.

Ecoremediation (ERM) are more and more used as systems not only for protection and renewal of environment but also as the way of living – symbiosis of human being with nature in underdeveloped countries. People recognize all the benefits of ERM as multipurpose, long duration, applicability, social views, economical views, but above all the fact that many problems that we have caused ourselves, can be solved only using ERM – ecosystematical technologies (Zupančič, Vrhovše, Bulc 2002). Multipurposefulness is shown and can be a great help at decreasing climate changes, lack of energy and preservation of rare and endangered species. In practice all these ecosystem characteristics can be adjusted according to needs and consequences of needs.

In North Africa ERM are used for protection of environmental components:



There is an increasing need to use ERM systems for protection environmental components.

The most important benefits of the water retention measures are:

- Changes in the structure of water drainage in rivers, reducing flood wave and in some cases the improvement of low-flow conditions.
- Meet the needs of the forest and swampy ecosystems that depend on water, and improving the state of the environment as a result of the increase in the level of underground water.
- An increase in supplies of groundwater aquifers, which causes an increase in the sources of groundwater.
- To meet the need of economy. For example: water reservoirs can be used as a pumping station for firefighters, spas, extensive ponds, pumping stations for irrigation, etc.
- The improvement of the natural values of the environment, the improvement of biodiversity in agricultural landscape by rehabilitating wetlands, small ponds, creating natural aquatic habitats for animals and plants, creating a human-friendly micro-climate.
- Protection of the quality of surface water, retention of suspended particulates, removal of nutrients (nitrogen and phosphorus) from the rainwater.

Depending on the physical geographical features and climate change, countries could use the following ERM systems.

Tab. 6: Ecoremediations systems in North Africa countries.

Country	Systems of ecoremediation
Algeria	Afforestation, planting protection belts, bushes, arrangement of terraces Restriction of surface flow Increasing of filtration abilities of soil Measures against erosion, fitodrainage and agriculture drainage measures Regulations for a flow from drainage systems
Egypt	Systems of tillage fields, meadows, forests, ecological areas and ponds Afforestation, planting protection belts, bushes, arrangement of terraces Escalation of wet surfaces (peat bog and swamps) Improvement of the soil structure, agriculture drainage, liming, appropriate agriculture technics, appropriate rotation, increasing organic matter in soil Restriction of surface flow Increasing of filtration abilities of soil Measures against erosion, fitodrainage and agriculture drainage measures Regulations for a flow from drainage systems Ponds and infiltration wells for containing rainfall Regulation of water in the system of drainage and ditches
Libya	Afforestation, planting protection belts, bushes, arrangement of terraces Increasing of filtration abilities of soil Measures against erosion, fitodrainage and agriculture drainage measures Regulations for a flow from drainage systems
Morocco	Systems of tillage fields, meadows, forests, ecological areas and ponds Improvement of the soil structure, agriculture drainage, liming, appropriate agriculture technics, appropriate rotation, increasing organic matter in soil Restriction of surface flow Measures against erosion, fitodrainage and agriculture drainage measures Regulations for a flow from drainage systems Ponds and infiltration wells for containing rainfall
Sudan	Systems of tillage fields, meadows, forests, ecological areas and ponds Afforestation, planting protection belts, bushes, arrangement of terraces Escalation of wet surfaces (peat bog and swamps) Improvement of the soil structure, agriculture drainage, liming, appropriate agriculture technics, appropriate rotation, increasing organic matter in soil Restriction of surface flow Increasing of filtration abilities of soil Measures against erosion, fitodrainage and agriculture drainage measures Regulations for a flow from drainage systems Ponds and infiltration wells for containing rainfall Regulation of water in the system of drainage and ditches

Tab. 6: Ecoremediations systems in North Africa countries (cont.).

Country	Systems of ecoremediation
Tunisia	Systems of tillage fields, meadows, forests, ecological areas and ponds Afforestation, planting protection belts, bushes, arrangement of terraces Escalation of wet surfaces (peat bog and swamps) Improvement of the soil structure, agriculture drainage, liming, appropriate agriculture technics, appropriate rotation, increasing organic matter in soil Restriction of surface flow Increasing of filtration abilities of soil Measures against erosion, fitodrainage and agriculture drainage measures Regulations for a flow from drainage systems Ponds and infiltration wells for containing rainfall Regulation of water in the system of drainage and ditches
Western Sahara	Afforestation, planting protection belts, bushes, arrangement of terraces Restriction of surface flow Measures against erosion, fitodrainage and agriculture drainage measures

Ecoremediation of aquatic ecosystems during climate change is becoming more and more visible. We have some of water in our disposal and the pressures on the use of the available water are increasing. In order to gain additional sources of water from the channel of water courses that would otherwise not have the economic, environmental or social role, we are contributing to the conservation of cultural landscapes and life in them. Although watercourses represent a small proportion of surface they significantly contribute to the well-being of the population.

5. Conclusion

Common physical-geographical features emphasized in the research have shown that the amount of rainfall during the period of 1990-2009 reduced according to the period 1930-1960. Moreover, in the countries of North Africa, in the same period of time increased the average annual air temperature by more than 0,5°C. At the same time, the effect on freshwater sources has increased. Annual consumption of freshwater in total was higher in 2013 than in 1977. It increased the most in Libya since it has increased to 72,3 %. All of this does not bring anything positive to the countries of North Africa. If annual consumption of freshwater will increase, the absence of precipitation and high temperatures will cause increased evaporation and reduce the level of water in water sources. In addition, the consequences will be disastrous for the environment. The deserts will continue to spread, biological diversity will be reduced and the soil erosion will increase. In the analysis of data, we also identified some common socio-geographical features of Northern Africa countries.

In the countries of Northern Africa, economic attachment to agriculture has decreased, which is also reflected in GDP by economic sectors. The lowest share of GDP is contributed by agriculture and the dominated share is contributed by service activities. The share of persons employed in agriculture is the lowest in the light of other economic sectors. Sudan stands out, due to a favorable climate and other influences of the favorable climate and has the biggest shares of the population employed in agriculture. This also brings it the greatest share in the gross domestic product. In 2011, according to the data from 1977 there is an increase of the proportion of cultivated land in the countries of North Africa. With this, the impact and

pressure mainly on the fertile coastal areas have increased. The cultivated areas are increasingly extending in semi-desert and desert parts of the countries, which not only overload irrigation systems, but also overload soil and biodiversity. Due to the additional cultivated areas they are overloaded with chemicals and fertilizers which also pollute water sources. For a long time, the fight for fresh water and water sources has been causing disorder and conflicts in the countries of Northern Africa.

Ecosystems have a big buffer capacity and can retain, treat or neutralize many organic and inorganic pollutants with natural processes. Ecoremediation uses natural processes in natural and partly artificial ecosystems to ensure better usage of water sources, for the elimination of harmful pollution impacts and preservation of biotic diversity.

Renewal of devaluated ecosystems using ecoremediations means, along with a more stable natural systems, also a better state of natural elements in the living environment, which improves human's and other living creatures' lives. Above all, they offer an important educational and pedagogical possibility, which is perhaps more important than technical effect. Natural sources are already exploited and because they are limited we are obliged to protect and mend them as long as it is possible.

Knowing the sustainable concept and dimensions of sustainability in local communities is essential because climate change will cause significant changes in the quality and availability of water resources, in a number of sectors, including food production, where water plays a crucial role. More than 80% of agricultural land is dependent on rainwater. Food production also depends on available water resources for irrigation.

References

- African Development Bank (2015). 15. 3. 2015 African Economic Outlook: http://www.africaneconomicoutlook.org/fileadmin/uploads/aeo/2014/PDF/RegEditions/North_Africa_EN_web.pdf.
- Bailey, R.G. 1996: Ecosystem Geography. Springer Verlag New York.
- Bergant, B. et. al. 2006: Climate change: it is not too late if farmers act now. ARSO. Ljubljana, 40.
- Bratkovič, M., Oman, T. 2013: Hoja z razgledom na Afriko. 25. 1. 2014, Gore in ljudje: <http://www.gore-ljudje.net/novosti/99329/>.
- Central Intelligence Agency 2015: The world Factbook. 2. February 2015 <https://www.cia.gov/library/publications/the-world-factbook>.
- EEA, 2008: Impacts of Europe's changing climate. Joint EEA.JRC.WHO report, EEA Report No 4/2008. EEA Copenhagen, 246.
- EC, 2009: Bela knjiga. Prilagajanje podnebnim spremembam: evropskemu okviru za ukrepanje naproti. 147.
- FAO, 2007: Adaptation to climate change in agriculture, forestry and fisheries: Perspective, framework and priorities. FAO inter-departmental working group on climate change (<ftp://ftp.fao.org/docrep/fao/009/j9271e/j9271e.pdf>, 11. 1. 2011).
- Farming, F. 2009: Enhancing sustainable development through agriculture. Applying the farming first principles to mitigate and adapt to climate change (http://www.farmingfirst.org/downloads/FarmingFirst_Climate%20change_FINAL.pdf, 11. 1. 2011).
- Finančni slovar, 2009-2011: 2. 2. 2015 - Bruto domači proizvod- BDP: <http://www.financnislovar.com/definicije/bruto-domaci-proizvod.html>

- Giger, M. 2010: Farming practices for climate change mitigation and adaptation (http://www.world-food-dialogue.ch/documents/10_04/workshop1.pdf, 12. 1. 2011).
- Hobbs, J. J. 2009: World regional geography. Australia: Brooks/Cole.
- Kokot Krajnc, M., Križan, J., Vovk Korže, A. Globovnik, N. 2011: Ecoremediation Educational Polygons in Slovenia as Good Examples of Experiential Learning of Geography. Literacy Information and Computer Education Journal, 2 (3): 481-490. <http://infonomics-society.org/LICEJ/Contents%20Page%20Volume%202%20Issue%203.pdf> (accessed January 13, 2012).
- Manfreda, P. 2015: Arab Spring Uprisings: Country Guide to Arab Uprising: <http://middleeast.about.com/od/humanrightsdemocracy/tp/Arab-Spring-Uprisings.htm>.
- Mihovec, J. 2013: Atlaška cedra- mogočen sredozemski iglavec. 25. 1. 2015 Gore in ljudje: <http://www.gore-ljudje.net/informacije/99958/>.
- The people of North Africa, 2013: 19. 4. 2014 Exploring Africa: <http://exploringafrica.matrix.msu.edu/students/curriculum/m16/activity2.php>
- Physical geography, 2014: <http://www.physicalgeography.net/>.
- United Nations Environment Programme, 2014: Africa environment outlook- Past, present and future perspectives: <http://www.grida.no/publications/other/aeo/?src=/aeo/038.htm>
- The world bank group, 2015: Climate Change Knowledge Portal. 22.3.2015, http://sdwebx.worldbank.org/climateportal/index.cfm?page=global_map_region&ThisMap=AF.
- The World Bank, 2015: <http://data.worldbank.org/country>
- Zupančič, M. Vrhovšek, D., Bulc, T. 2002: Razstrupljanje okolja z naravnimi procesi in rastlinske čistilne naprave. Proteus 4 (65): 165-172.

CLIMATE CHANGES IN NORTH AFRICA AND THE POSSIBILITIES OF ADAPTING TO IT WITH ECOSYSTEM APPROACHES

Summary

North Africa has specific natural and social elements that have a significant effect on the abilities of adaptation to climate changes. With the aim to determine the types of areas for adaptation to climate change, we have typified North Africa to similar areas as those areas.

A major part of North Africa receives a low level of precipitation and that has an impact on the poor water conditions. The average total annual precipitation in North Africa is estimated at 1503 m³/annually, which is equivalent to 7 % of total annual precipitation in Africa. However, the distribution of the precipitation varies in Africa. The most rainfall, almost 75 %, falls in Sudan and only 3 % falls in Egypt. 5,6 % of precipitation falls in river networks or it is used for filling ground water. The rest is lost by evaporation, transpiration and disappearance. Availability of water per capita was 26 m³/annually in 2000 in Egypt and up to 1058 m³/annually in Morocco for the same year (United Nations Environment Programme 2014).

There are even more differences if we compare North Africa countries to countries of Sub-Saharan Africa. Total of internal renewable fresh water resources in North Africa present 2,5% of the total in Africa, but the withdrawal of it presents 46 % of the total in Africa. This difference partly reflects harsh climate conditions. Renewable fresh water sources are supplied with water from hinterland river flows (alluvial aquifer Nil) or from the rainfall (coastline of the Mediterranean Sea (United Nations Environment Programme 2014).

A total of annual consumption of freshwater in billions of cubic meters is increasing. The largest consumption of fresh water was in 1977 and 2013 in Egypt and the lowest in Tunisia. In the last 35 years, the consumption of freshwater in Africa has increased by more than 28 %. Moreover, in Libya, it has increased by 72 %. Though, Tunisia has the lowest consumption of freshwater that does not neglect the fact that freshwater consumption in Tunisia has increased by 62,5 % from 1977 to 2013.

The North African economy depends on natural conditions. Most of the cultivated land is concentrated in the coastal areas. Due to physical-geographical and socio-geographical changes like global warming and the impact of human activities on the environment, the North Africa countries have decreased the dependence on agriculture.

Cultivated land and fields in North Africa are mostly by the coastline and on the areas where irrigation agriculture is possible. The percentages of cultivated areas were the highest in 2011 in Morocco (17,79 %) and in Tunisia (17,35 %) because these two countries have the most appropriate physical-geographical and socio-geographical conditions. The cultivated areas are mostly by the coastline and in the highlands where irrigation is possible. In the last ten years, the percentages of cultivated areas have been increasing at the expense of increased number of population and the increased demand for food.

Common physical geographical characteristics have shown that the average precipitation is decreasing and the average air temperature is increasing in the

countries of South Africa. Freshwater sources that get water from rainfall are additionally overloaded and their use is increasing.

The concept of ecosystem technology or ecoremediation (ERM) means the usage of natural processes for restoration and protection of the environment (eco + remediation = »natural renewed revival«). Using ecoremediation methods we can decrease and abolish the consequences of agricultural pollution, tourism, traffic, industry, dumping grounds and settlements. Ecoremediations mean returning to nature, aiming to save and restore natural balance, where these kinds of areas can give an opportunity to develop new working places and additional activities. Ecoremediations have already been recognized as perspective and continual approach, where natural and conatural processes and systems are being used in favor of the restoration of degraded environment and protection of natural environment. In practice ERM are used as constructed wetlands, conatural sanitations of deposits, riverine vegetation zones – balancing areas, side branches, artificial lakes, noise and/or dust reducing barriers, phytoremediation of polluted sediments, purifying soil and drinking water, tertiary purifying and purifying dangerous sewage water. By using ERM methods, less money is spent on sanitation of already threatened areas and continual protection of these is emphasized, which is a big advantage in a financial sense.

Depending on the physical geographical features and climate change, countries could use the following ERM systems.

Tab. 6: Ecoremediations systems in North Africa countries.

Country	Systems of ecoremediation
Algeria	Afforestation, planting protection belts, bushes, arrangement of terraces Restriction of surface flow Increasing of filtration abilities of soil Measures against erosion, fitodrainage and agriculture drainage measures Regulations for a flow from drainage systems
Egypt	Systems of tillage fields, meadows, forests, ecological areas and ponds Afforestation, planting protection belts, bushes, arrangement of terraces Escalation of wet surfaces (peat bog and swamps) Improvement of the soil structure, agriculture drainage, liming, appropriate agriculture technics, appropriate rotation, increasing organic matter in soil Restriction of surface flow Increasing of filtration abilities of soil Measures against erosion, fitodrainage and agriculture drainage measures Regulations for a flow from drainage systems Ponds and infiltration wells for containing rainfall Regulation of water in the system of drainage and ditches
Libya	Afforestation, planting protection belts, bushes, arrangement of terraces Increasing of filtration abilities of soil Measures against erosion, fitodrainage and agriculture drainage measures Regulations for a flow from drainage systems
Morocco	Systems of tillage fields, meadows, forests, ecological areas and ponds Improvement of the soil structure, agriculture drainage, liming, appropriate agriculture technics, appropriate rotation, increasing organic matter in soil

	Restriction of surface flow Measures against erosion, fitodrainage and agriculture drainage measures Regulations for a flow from drainage systems Ponds and infiltration wells for containing rainfall
Sudan	Systems of tillage fields, meadows, forests, ecological areas and ponds Afforestation, planting protection belts, bushes, arrangement of terraces Escalation of wet surfaces (peat bog and swamps) Improvement of the soil structure, agriculture drainage, liming, appropriate agriculture technics, appropriate rotation, increasing organic matter in soil Restriction of surface flow Increasing of filtration abilities of soil Measures against erosion, fitodrainage and agriculture drainage measures Regulations for a flow from drainage systems Ponds and infiltration wells for containing rainfall Regulation of water in the system of drainage and ditches
Tunisia	Systems of tillage fields, meadows, forests, ecological areas and ponds Afforestation, planting protection belts, bushes, arrangement of terraces Escalation of wet surfaces (peat bog and swamps) Improvement of the soil structure, agriculture drainage, liming, appropriate agriculture technics, appropriate rotation, increasing organic matter in soil Restriction of surface flow Increasing of filtration abilities of soil Measures against erosion, fitodrainage and agriculture drainage measures Regulations for a flow from drainage systems Ponds and infiltration wells for containing rainfall Regulation of water in the system of drainage and ditches
Western Sahara	Afforestation, planting protection belts, bushes, arrangement of terraces Restriction of surface flow Measures against erosion, fitodrainage and agriculture drainage measures

The most important benefits of the water retention measures are:

- Changes in the structure of water drainage in rivers, reducing flood wave and in some cases the improvement of low-flow conditions.
- Meet the needs of the forest and swampy ecosystems that depend on water, and improving the state of the environment as a result of the increase in the level of underground water.
- An increase in supplies of groundwater aquifers, which causes an increase in the sources of groundwater.
- To meet the need of economy. For example: water reservoirs can be used as a pumping station for firefighters, spas, extensive ponds, pumping stations for irrigation, etc.
- The improvement of the natural values of the environment, the improvement of biodiversity in agricultural landscape by rehabilitating wetlands, small ponds, creating natural aquatic habitats for animals and plants, creating a human-friendly micro-climate.
- Protection of the quality of surface water, retention of suspended particulates, removal of nutrients (nitrogen and phosphorus) from the rainwater.

DIVERSIFICATION OF TOURISM OFFER AS A MEANS OF ECONOMIC DEVELOPMENT OF PERIPHERAL REGIONS – CASE STUDY OF KUPRES

Ranko Mirić

Dr., assistant professor

Department of Geography

Faculty of Science

Zmaja od Bosne 33-35, 71 000 Sarajevo, Bosnia and Herzegovina

e-mail: rmiric@gmail.com

Nusret Drešković

Dr., associate professor

Department of Geography

Faculty of Science

Zmaja od Bosne 33-35, 71 000 Sarajevo, Bosnia and Herzegovina

e-mail: nusret2109@gmail.com

Boris Avdić

MA, senior assistant

Department of Geography

Faculty of Science

Zmaja od Bosne 33-35, 71 000 Sarajevo, Bosnia and Herzegovina

e-mail: borisavdicpmf@hotmail.com

UDK: 911.3:338.46

COBISS: 1.01

Abstract

Diversification of Tourism Offer as a Means of Socio-economic Development of Peripheral Regions – Case Study of Kupres

Many modern countries have significant problems with disparities in development between core and periphery. Municipality of Kupres in Bosnia and Herzegovina is one typical example of peripheral area, which is located within the sparsely populated region of Dinaric Karst Highland. It is taken for the case study in this paper, because it shows certain signs of economic activation in the field of tourism. However, its mainstream tourism offer is of seasonal character, and it is not sufficient for sustainable economic growth and significant progress in socio-economic sense. That is why tourism offer need to become more diversified. Methodology in this paper is focused on analysis of all potentials and motives that wider area of Kupres possesses, which can be valorized through systematic approach of institutions and local community. It is intended to emphasize a significance of geographical expertise in these kinds of problematic. Field research and GIS analysis are used for exploration of study area.

Key words

Kupres, periphery, tourism offer, ski resort, rural tourism, ecotourism

Uredništvo je članek prejelo 3.12.2016

1. Introduction

Development of peripheral and rural areas is a great challenge for any country, especially for transition economies. According to Hall and Boyd (2005), peripheral areas are defined as geographically remote from mass markets. This implies increased transportation and communication costs between these and core areas. One of the most obvious ways to prevent further socio-economic decline is to stimulate development of rural tourism, which is usually based on local cultural heritage, as well as natural environment. Depending on environment, it is also closely related with various sub-types of alternative tourism branches (ecotourism, adventure tourism, recreation tourism etc.). The global market for ecotourism has grown significantly, with a gradual shift in worldwide travel patterns and preferences (Nepal 2002). It is important to emphasize that this type of activity requires social, economic and political determination (Bessi re 1998). Jaafar et al. (2015) argue that even if local people regard a tourism development in their area positively, government and other stakeholders should still emphasize the benefits of community involvement.

In a post-socialist countries of Eastern, Central and Southeastern Europe, large peripheral areas are exposed to intensive depopulation, due to combined factors of economic problems, such as unemployment, massive rural-urban migrations and demographic transition. On the example of Slovenian region of Notranjski Kras, Simpson et al. (1998) proved that tourism has been identified as a catalyst to stimulate economic growth and improve the standard of living of local communities. Tourism potentials are especially noticeable in Southeastern Europe, where rural settlements in mountain regions provide a unique and attractive ambience. Bosnia and Herzegovina belongs to this group, but rural tourism here is not recognized as a means to planned economic and demographic regeneration (Antolovi  2009). Progress in this field is generally result of individual actions and lack of systematic and comprehensive approach is evident. In this paper, municipality of Kupres in the typical peripheral region (Canton 10) is taken for the case study. Geographical approach is used for analysis of tourism resources and motives in selected area.

2. Geography of Kupres

Kupres is a town and municipality in southwestern Bosnia and Herzegovina. It is a part of macroregion of Karst Highland. Even though it represents a road junction between neighboring regions, including the shortest road that connects central Dalmatia with central Bosnia, its geographical position can not be considered as particularly favorable. The reasons are distance from large urban centers in Bosnia and Herzegovina, from which it takes approximately 3 hours of car driving to get in Kupres (Tab. 1), and also unfavorable physical conditions for general human development. Primarily, that refers on geological, hypsometric, climatic and hydrological characteristics of this area. Kupres is located in Outer Dinaric Alps, where karst terrain is dominant. The largest geomorphological landform in this area is Kupre sko polje (Kupres Field), surrounded by mountains of Sto er, Plazenica, Lupoglava, Stra benica, Vitorog, Hrbine, Malovan and others. Southeast of Kupre sko polje are locations of Vukovsko polje and Ravanjsko polje – the most elevated karstic fields in Dinaric Alps. Town of Kupres is at almost 1200 meters above sea level. That makes it the highest urban settlement in Bosnia and Herzegovina. As a result, climate conditions in this region are characterized by very cold and windy winter, while summer is also relatively cool (mean July temperature is around 15 C). Kupre sko polje also represents the part of watershed between Black Sea and Adriatic drainage

basins. It is somewhat disrupted by subterranean bifurcation as a result of karst hydrology. Certain parts of the municipality have problems with water supply.

Tab. 1: Distance between Kupres and the nearest large urban centers.

City	Distance	
	km	h
Banja Luka	138	3:00
Mostar	124	2:54
Sarajevo	146	2:54
Split (Croatia)	143	2:58
Zenica	86	2:03

Source: viamichelin.com.

Contemporary social situation cannot be considered as favorable either. Wartime between 1992 and 1995 has significantly affected the number of population, demographic picture and economic development in Kupres. By the provisions of Dayton Peace Agreement, territory of pre-war municipality was split into two parts – Kupres (FBIH) and Kupres (RS), in order that by far the larger part went to entity of Federation of Bosnia and Herzegovina. Some 13% of pre-war municipal territory with only three villages and total population of 300 (according to 2013 census) went to Republika Srpska. Municipality of Kupres (FBIH) is also an administrative part of Canton 10, largest by area, but also the most sparsely populated canton in Federation of Bosnia and Herzegovina.

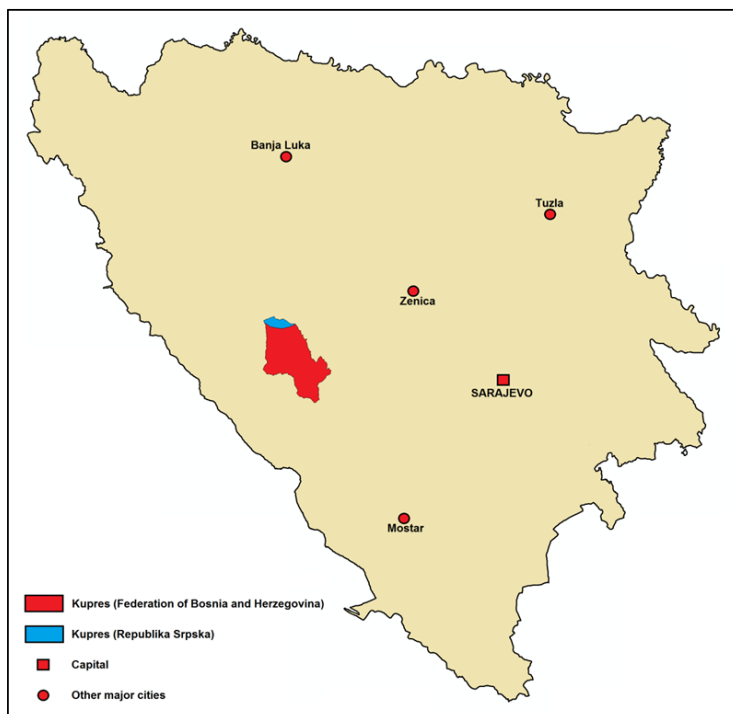


Fig. 1: Geographical position of Kupres within Bosnia and Herzegovina.

Source: Authors, 2016.

Average population density for both Kupres municipalities is only 8 people per square kilometer. Even before negative effects of war, region of Kupres was exposed to depopulation, with continuous trends of population decline through the whole second half of the 20th century. According to 1991 census, Municipality of Kupres had a population of 9618 people, while in 2013 that number is officially down to 5357 (unofficially it is significantly lower). Extremely negative natural increase and emigration of younger population indicate that these disturbing tendencies will continue in the future. More than half of the population is concentrated in urban center, and the rest of people lives on northeast margin of Kupreško polje. Its western part is not generally suitable for settlements, because of water scarcity and exposure to strong and cold winds.

3. Main tourism offer of Kupres

Aforementioned natural and historical conditions resulted in Kupres economic marginalization. Local population is traditionally oriented to cattle herding, but significance of this activity is declining in modern times. Industrial facilities that was built during the socialist period are devastated during and after the war. Forest exploitation is still economically profitable activity, but lack of adequate planning approach created some other type of (environmental) concerns. In such socio-economic circumstances, tourism emerged in post-war period as a backbone of new local development. This tertiary economic branch abruptly started to develop in Kupres in the first decade of 21st century, when were constructed numerous receptive objects, including four hotels (Knez, Maestral, Adria Ski and Kupres), as well as many apartments and cottages. Total of 700 beds comprise tourist accommodation of Kupres (Begić, Duman 2013).

Soon after that, tens of thousands of tourists are visiting Kupres annually, and it can be said that Kupres distinguish itself as one of the most visited winter destinations in Bosnia and Herzegovina. Most tourists come from Croatia, especially Dalmatia. However, economic recession caused stagnation and even decline in number of tourists. This fact emphasized a need for diversification of tourism supply on the time of whole year, not only a winter. Šiljeg et al. (2010) conducted research on tourists and local population satisfaction with various tourism elements in Kupres. Results showed that tourists are significantly more satisfied with tourism offer than local population with economic benefits.

Irrespective of alternative and wider tourism supply conception, winter and ski-tourism have remained a backbone of Kupres economic development, regarding the fact that snow cover lasts usually for five months per year. Spatial plan from 2006 has ambitiously outlined creation of 11 sport and recreation facilities on the territory of Kupres municipality – nine of them for alpine, and two for nordic skiing. Only two (Stožer-Vrana and Čajuša) have been constructed so far. Ski resort Stožer-Vrana is located on the Mount Stožer, only 1.5 kilometers northeast of Kupres. Total length of ski slopes are 4.5 kilometers, and they are differentiated according to the required level of skiing expertise. This resort has a proper infrastructure, including cable car, ski-lift, and wind protection.

Ski resort Čajuša is placed on the opposite, southwestern side of Kupreško polje, 1 kilometer north of Gornji Malovan. It is comprised of four ski slopes, with total length of 13,5 kilometers, and also has adequate infrastructure that includes ski-lifts and snow cannons. Elevation difference between the start and finish of ski slopes at Čajuša

resort is 350 meters, which is less than in the case of Stožer-Vrana, where the difference is 415 meters. There are more than 200 cottages at the foothills of Čajuša. Hotel Ski Adria is also located here, while the rest of hotels are in the urban center. Čajuša is 8 kilometers away from Kupres. According to Hamad et al. (2010), Kupres resorts occupy the position of marker niches.



Fig. 2. Ski resort of Čajuša.

Source: Google Earth, 2016.

Climate change, however, increasingly determines success of seasonal activities like winter tourism. This fact was especially visible in the 2014/15 and 2015/16 winter seasons, when lack of snow caused much lower number of tourists and nights than expected. Tourism board of Kupres has recognized this problem, and tries to mitigate negative effects of failed winter seasons through diversification of tourism offer, but the lack of higher degree of its affirmation and valorization is still evident.

The manifestation of "Dani kosidbe – Days of Mowing" (so-called Strljanica) is one significant exemption from this context, because it exists for a long period of time as one of the most famous ethnocultural events, not only in Kupres, but also in Bosnia and Herzegovina in general. The manifestation is held every first week of July, and orderly attracts tens of thousands of visitors every year, which makes it by far the biggest tourism attraction in this region outside the winter season. Cutting the grass has been part of everyday life of Kupres rural population since olden times, which eventually became tradition. This activity today does not have the same agricultural meaning as before, but represents a central motive of this tourism manifestation. Its program in contemporary context is enriched with various events. Except mowing competition, there are also horse race, football tournament, other type of competition, cattle exhibition, folklore festival etc.

4. Possibilities for tourism offer diversification

The most obvious advantage of Kupres in the context of diversified tourism offer creation is unique ambient, that is comprised of natural environment, attractive landscapes, clean air and remoteness from urban and densely populated areas. Basic element of natural environment in Kupres region is karst, with various characteristic landforms. Very specific Dinaric karst, with few exemptions, generally has not been considered seriously in the context of tourism valorization. However, example of Kupreško polje and its immediate surroundings, which represents one of the typical Dinaric karst landscape, confirms the tourism attractiveness of this ambient. Some of the most visible geomorfological landforms on the territory of Kupres region are sinkholes of various dimensions.

Largest and the most spectacular sinkholes can be found on the north side of Kupreško polje, on the locality known as Japage, next to village Rastičevo. Five large sinkholes (Topolovica, Mrnjašica, Crljenka, Kotlić and Japažica) are found here. Some 50 meters high rocky uplift is located between them, and it can serve as fantastic viewpoint to significant part of Kupreško polje and its phenomena. Diameters of these gigantic sinkholes vary between 140 and 320 meters, while their depth varies between 32 and 112 meters (Mijoč 2011; Stepišnik 2014). Sinkholes bottoms are covered with forest vegetation. Locality of Japage is extremely rare karst phenomenon, so it is very interesting to geomorphological and geological explorers, but it has not been done much on its tourism promotion for more diverse types of tourists so far.



Fig. 3. Locality of Japage.

Source: Authors, 2016.

Just north of Japage, in its immediate proximity, Rastičevo Lake is located. It is one of three natural lakes in Kupreško polje. Its length is 180 meters, width is 130 meters, and maximum depth is 10 meters. Some alternative names, like Blagaj Lake, Vilino Lake, or Crno Oko, are also in use. Two other lakes are located much more to the south, next to eastern margin of the field. These are Kukavice Lake (near the village of Kukavice) and Turjača Lake (next to village Zanaolina). Both have similar dimensions as the Rastičevo Lake. Tourism potential of these lakes is insignificantly valorized so far, partly because tourism promotion of Kupres was not focused on them. On the other hand, if it comes to higher degree of tourism exploitation of these lakes, it is necessary to consider ecological issues and preservation of original natural ambient. Lakes, however, are not the only hydrological phenomena that can be used for tourism purposes.

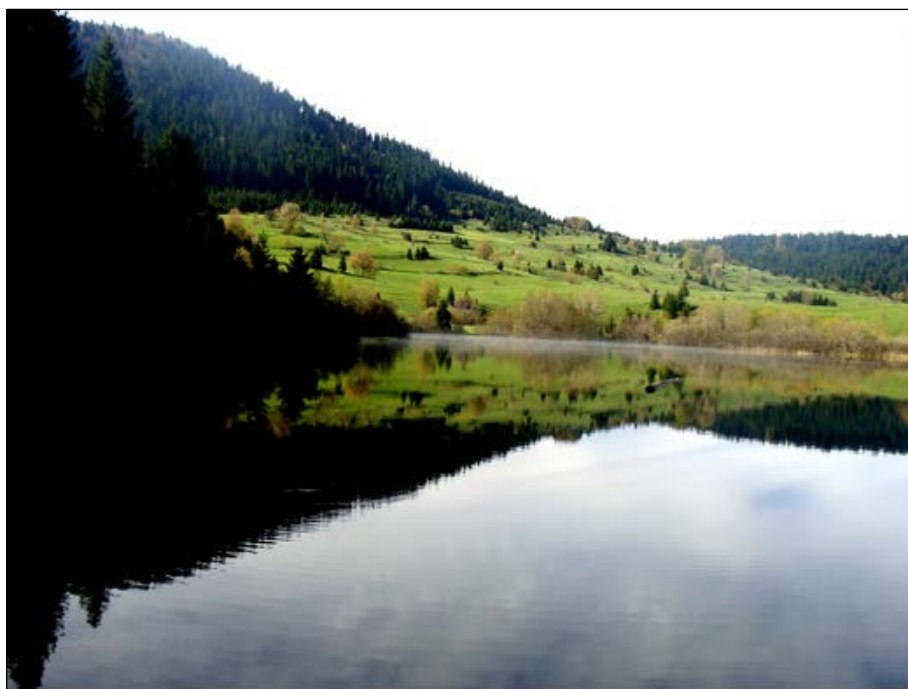


Fig. 4. Kukavice Lake.

Source: Authors, 2016.

Several streams flow through Kupreško polje – Milač, Mrtvica, Karićevac etc. Milač is recognizable by the high number of meanders, and Mrtvica is primarily known by its ponor (sinkhole) on the western side of the field, as well as by subterranean bifurcation of tic water. Bigger share of water from Kupreško polje through underground ways drains to lower karstic fields in the Outer Dinaric Alps, and further to Adriatic Sea, but the Mrtvica water partly drains to the basin of Pliva, Vrbas, Sava and Danube rivers, as well as Black Sea (hierarchical order). This karst phenomenon is also very attractive to scientists and explorers, but there is a potential for wider tourism role, especially because the main ponor zone is easily accessible to visitors.

The wider region of Kupres can be considered as a unique ecosystem, which fits well into local natural ambient. Kupres is placed in the contact zone between maritime and

continental climatic influence, which caused high level of biodiversity. Field is covered with grass vegetation, which is traditionally used for pasture, while mountains have mixed vegetation where dominate coniferous (fir) forests and meadows. All these vegetation types can be successfully valorized from the aspect of recreation, rural, adventure, hunting and ecotourism. Different species of flowers, herbs, berry fruits and mushrooms are present in this area. However, important notion about mushrooms is the need for moderation in picking, so that local species could sustain.

Many species of wild animals live in the surrounding forests, like rabbit, deer, brown bear, quail, wild cat, marten, badger, as well as certain endangered species like lynx, squirrel, black grouse, hazel grouse, heron, and many other bird species. Municipality took some effort on creating a necessary infrastructure for this type of tourism, as well as on adoption of measures in the field of hunting control. Two hunting grounds are clearly defined in territorial sense. These are Kupres-Kiprovača and Raduša-Ljubuša. Both are located in the peripheral parts of municipality. First one is located in the northern, and the second in the southern portion.

Beside aforementioned, there are many other activities that can be practised in the Kupres municipality. This is especially true for sports and recreation activities like paragliding, motocross, biking, horse riding, hiking or simply walking. Many sports teams and individuals come to Kupres for high altitude training, e. g. it is well-known destination for pre-season preparation of numerous football clubs. Kupres is known as favorite destination for paragliders, and three runways for them exist on the Mount Stožer. Because of Kupreško polje wideness, there are great possibilities for long flights and many options for safe landing place, for those who are interested in this type of adventure. Relative flatness of Kupreško polje enables good predispositions for biking and motocross, as well as horse riding. All three options are included in tourism offer of Kupres, and resources for them are provided. For those who prefer challenges of steeper terrain, there is a possibilities for recreation and exploration of surrounding mountains. In this context, fresh and clean air should be emphasized as an important tourism factor of Kupres area.

Although natural motives are primary tourism value of Kupres, neither cultural nor historical heritage of this area should not be ignored. Cultural heritage is generally perceived through aforementioned manifestation of "Dani kosidbe", but more determined orientation toward year-long rural tourism would bring a much higher economic benefits for the local population, and make a huge contribution to sustainable rural development. Most of rural settlements in this area are deeply in process of depopulation, some of them are completely abandoned, but the fact that remained rural population still has a large number of traditional elements in its everyday life, which is especially visible in typical rural landscape of Kupres surroundings, in combination with reserved natural environment represents unique potential for halting the decline of local villages through development of rural tourism. So far, this alternative did not get a systematic treatment, but certain activities in the field are the exclusive result of several families enthusiasm.

One positive example represents the farm on the periphery of municipal center, where tourists can experience rural way of life, with special emphasis on agriculture (cattle breeding in the first place), horse riding and gastronomy. Local gastronomic offer is represented by Kupres cheese and yogurt, pies, ham, lamb, veal, pura, potatoes, bread, honey and other dishes, which have exclusively domestic and organic origin. Šiljković (2009) emphasizes Kupres with its autochthonous meat and cheese

products, as one of the places that belong to the most elevated region of organic food production in Bosnia and Herzegovina. Gastronomical aspect has increasingly important role within the tourism offer. Tourists buy local products or eat in restaurants or on farms, thus representing a sizeable source of income for local communities (Bessière 1998).

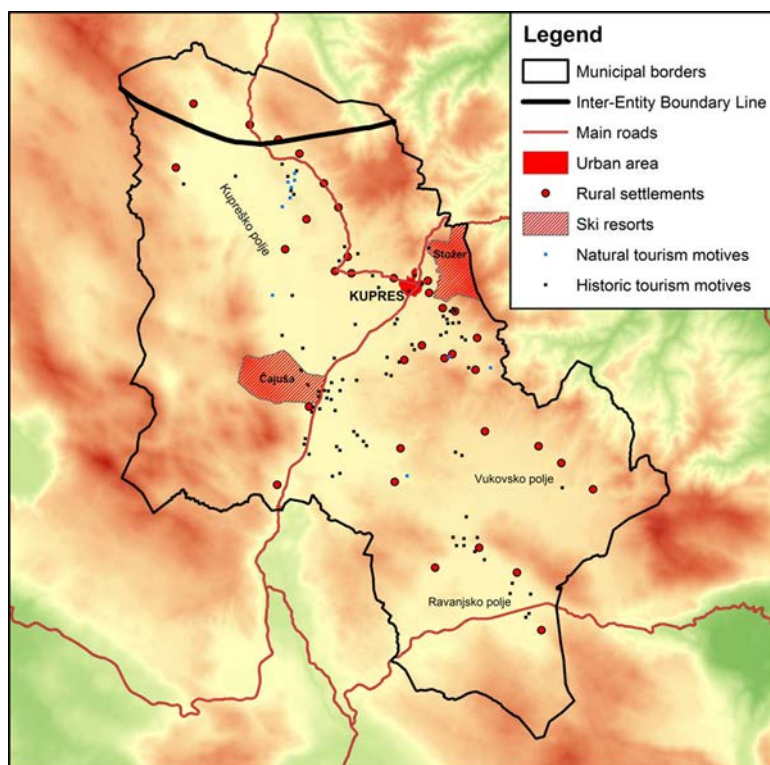


Fig. 5. Distribution of tourism motives on Kupres.

Source: Authors, 2016.

Historical buildings are one of the most crucial elements of tourism offer in many destinations. However, that is not case with Kupres, whose tourism potential is based predominantly on natural and rural landscape. Nevertheless, fact that Kupres region has a continuity of human existence since prehistory and that every historic period left certain remains that can be found in the area even today, can be used for additional diversification of tourism offer. Significant number of tumuli and hillforts from prehistoric ages can be found in the area (Benac 1990). Antique period is represented by well preserved remnants of Roman roads and basilica in Otinovci (Gudelj 2000). General direction of Roman roads in this area was north – south, in order to connect valleys of Rama River and Janj River, with the purpose of transcending the main Dinaric watershed. Medieval heritage is, as in other parts of Bosnia and Herzegovina, represented with numerous stećci (tombstones), distributed over the whole territory of Kupres municipality.

Church of John the Baptist from 19th century is located in aforementioned village of Otinovci, on the foundations of medieval church that was built under the request of Bosnian queen Catherine in 15th century. The most interesting modern building is

Church of Holy Family, which dominates the panorama of Kupres town, and represents one of the largest religious objects in the country. In the town center also exists the Ahmed Fadil-pasha Mosque, while in several villages around Kupres minor orthodox churches can be found.

5. Conclusion

Kupres is town and municipality with multiple issues related to consequences of war, economic stagnation and population decline. Considering also the distance from political, economic, social and demographic core(s) of Bosnia and Herzegovina, it is perfect example of peripheral area in socio-economic sense. However, unlike many other municipalities that are in similar situation, local people in Kupres have succeeded to create a relatively solid tourism offer and attract a significant number of tourists. This especially looks impressive when it is put in the context of whole region of High Karst or Canton 10 regarding administrative division, but the right question is whether this local orientation toward tourism is sufficient to invert the existing socio-economic decline.

Tourism in Kupres is generally associated with two branches – winter (two ski resorts) and manifestation (Dani kosidbe – Days of Mowing) tourism. Although it managed to become one of the most renowned center of winter tourism in Bosnia and Herzegovina in a relatively short period of time, Kupres do not have conditions to compete with national leaders in this tourism type – Mount Jahorina, Mount Bjelašnica and Mount Vlašić. However, its comparative advantage is possibility to diversify offer on the period of whole year. For that purpose, it is necessary to stimulate development of various alternative tourism types – rural tourism, ecotourism, adventure tourism, recreation tourism etc. Considering the fact that highest number of tourists in Kupres are from Croatia, there is also a space for better promotion of this destination within the Bosnia and Herzegovina, in order to attract more domestic tourists. As it is presented in this paper, potential for diverse tourism offer is undisputable, but planning approach, better marketing and education of local population are needed for the adequate valorization of these motives.

References

- Antolović, M. 2009: Mogućnosti obnove bosanskohercegovačkih sela. Zbornik radova Drugog kongresa geografa Bosne i Hercegovine. Geografsko društvo u Federaciji Bosne i Hercegovine, Sarajevo.
- Begić, N., Duman, T. 2013: Strategic Marketing Management of Ski-Resorts in Bosnia and Herzegovina: A Competitive Analysis. International Journal of Academic Research in Business and Social Sciences, Vol. 3. HRMARS, Bahawalpur.
- Benac, A. 1990: Recently excavated Bronze Age tumuli in Kupreško polje, Bosnia, Yugoslavia. Antiquity. Cambridge University Press, Cambridge.
- Bessière, J. 1998: Local Development and Heritage: Traditional Food and Cuisine as Tourist Attractions in Rural Areas. Sociologia Ruralis, Vol. 38. European Society for Rural Sociology. Blackwell Publishers, Oxford.
- Gudelj, L. 2000: Ranokršćanski kompleks u Otinovcima na Kupreškoj visoravni – Rezultati revizijskih istraživanja 1999. godine. Starohrvatska prosvjeta III/27. Muzej hrvatskih arheoloških spomenika, Split.
- Hall, M., Boyd, S. 2005: Nature Based Tourism in Peripheral Areas – Development or Disaster? Channel View Publications. Clevedon.

- Hamad, M. et al. 2010: A Competitive Analysis of Ski Resorts In Bosnia And Herzegovina Using Differential Advantage Proforma. 2nd International Symposium on Sustainable Development, Sarajevo.
- Jafaar, M. et al. 2015: Local Community and Tourism Development: A Study of Rural Mountainous Destinations. Modern Applied Science, Vol. 9. Canadian Centre of Science and Education, Toronto.
- Mijoč, D. 2011: Krški fenomeni Kupresa – Vrtače Japage i ponori rijeke Mrtvice. Naše šume. Udruženje inženjera i tehničara šumarstva FBiH & Hrvatsko šumarsko društvo, Mostar.
- Nepal, S. 2002: Mountain Ecotourism and Sustainable Development. Mountain Research and Development. International Mountain Society, Bern.
- Stepišnik, U. 2014: Japage: The Collapse Dolines on Kupres Polje, Bosnia and Herzegovina. Dela, Vol. 42. Znanstvena založba Filozofske fakultete Univerze v Ljubljani, Ljubljana.
- Simpson, F. et al. 1998: Partnership Approaches to Tourism and Rural Development in Post Socialist Europe – The Experience of Notranjski Kras, Slovenia. Rural Tourism Management: Sustainable Options International Conference, Auchincruive.
- Šiljeg, A. et al. 2010: Stanje i tendencije razvoja turističke ponude Općine Kupres (FBiH). Geoadria 15/2. Hrvatsko geografsko društvo, Zadar.
- Šiljković, Ž. 2009: Geografski preduvjeti razvoja organske poljoprivrede u Hercegovini i Zapadnoj Bosni. Zbornik radova Drugog kongresa geografa Bosne i Hercegovine. Geografsko društvo u Federaciji Bosne i Hercegovine, Sarajevo.
- <<https://www.viamichelin.com/>> (19th November 2016).

DIVERSIFICATION OF TOURISM OFFER AS A MEANS OF ECONOMIC DEVELOPMENT OF PERIPHERAL REGIONS – CASE STUDY OF KUPRES

Summary

Development of peripheral regions is a great challenge for any country. That is especially true for post-socialist transition countries in South East Europe. Bosnia and Herzegovina is one of them. Town and municipality of Kupres in southwestern Bosnia has been traditionally considered as a part of Dinaric Karst Highland, one typical peripheral region in socio-economic context. Its geographical position can not be considered as particularly favorable, because of distance from the political and economic core of the country, as well as harsh natural environment (high altitude, cold climate and water scarcity). In combination with the factor of turbulent recent history, this fact has effected on low population density, negative demographic trends and economic stagnation of Kupres.

In such socio-economic circumstances, tourism emerged in post-war period as a backbone of new local development. This tertiary economic branch abruptly started to develop in Kupres in the first decade of 21st century, when were constructed numerous receptive objects, including four hotels and many apartments and cottages. Tourism in Kupres is generally associated with two branches – winter and manifestation tourism. Winter tourism is mostly developed through two ski resorts – Stožer and Čajuša, while principal manifestation during summer season, which brings more than 10.000 tourists each year, is called “Dani kosidbe” (Days of Mowing). Climate change, however, increasingly determines success of seasonal activities like winter tourism, and manifestation events last too briefly, so it is concluded that tourism offer needs to be more diversified and to include the period of whole year.

This paper is primarily focused on the potential diversification of tourism offer of Kupres. Geographical analysis of natural environment, historical processes in the area and local cultural heritage is used for identification of additional tourism motives. For this purpose, field research as well as GIS analysis of available maps, aerial photos and documented data are conducted. Geomorphological (mostly karstic) landforms and hydrological objects are identified as potential tourism motives and the general terrain characteristics are analyzed in the context of existing and potential tourism activities. Historic and cultural heritage is also taken into account as an basis for rural tourism. In the end, synthetic map of tourism motives distribution is made, with the visible elements such as terrain features (hypsoetry), position of Kupres town within the municipality, distribution of rural settlements, location of two ski resorts, and distribution of numerous natural and historic tourism motives.

NAVODILA ZA PRIPRAVO ČLANKOV V REVIJI ZA GEOGRAFIJO

1. Sestavine članka

Članki morajo imeti naslednje sestavine:

- glavni naslov članka,
- ime in priimek avtorja,
- avtorjeva izobrazba in naziv (na primer: dr., mag., profesor geografije in zgodovine, izredni profesor),
- avtorjev poštni naslov (na primer: Oddelek za geografijo Filozofska fakulteta Univerza v Mariboru, Koroška 160, SI – 2000 Maribor, Slovenija),
- avtorjev elektronski naslov,
- izvleček (skupaj s presledki do 800 znakov),
- ključne besede (do 8 besed),
- abstract (angleški prevod naslova članka in slovenskega izvlečka),
- keywords (angleški prevod ključnih besed),
- članek
- summary (angleški prevod povzetka članka, skupaj s presledki do 8000 znakov).

2. Citiranje v članku

Avtorji naj pri citiranju med besedilom navedejo priimek avtorja in letnico, več citatov ločijo s podpičjem in razvrstijo po letnicah, navedbo strani pa od priimka avtorja in letnice ločijo z vejico, na primer: (Drozg 1995, 33) ali (Belec in Kert 1973, 45; Bračič 1975, 15 in 16).

Enote v poglavju Viri in literatura naj bodo navedene po abecednem redu priimkov avtorjev, enote istega avtorja pa razvrščene po letnicah. Če je v seznamu več enot istega avtorja iz istega leta, se letnicam dodajo črke (na primer 1999a in 1999b). Vsaka enota je sestavljena iz treh stavkov. V prvem stavku sta pred dvopičjem navedena avtor in letnica izida (če je avtorjev več, so ločeni z vejico, z vejico sta ločena tudi priimek avtorja in začetnica njegovega imena, med začetnico avtorja in letnico ni vejice), za njim pa naslov in morebitni podnaslov, ki sta ločena z vejico. Če je enota članek, se v drugem stavku navede publikacija, v kateri je članek natisnjen, če pa je enota samostojna knjiga, drugega stavka ni. Izdajatelja, založnika in strani se ne navaja. Če enota ni tiskana, se v drugem stavku navede vrsta enote (na primer elaborat, diplomsko, magistrsko ali doktorsko delo), za vejico pa ustanova, ki hrani to enoto. V tretjem stavku se za tiskane enote navede kraj izdaje, za netiskane pa kraj hranjenja.

3. Preglednice in slike v članku

Vse preglednice v članku so oštevilčene in imajo svoje naslove. Med številko in naslovom je dvopičje. Naslov konča pika. Primer:

Preglednica 1: Število prebivalcev Ljubljane po posameznih popisih.

Vse slike (fotografije, zemljevidi, grafi in podobno) v članku so oštevilčene enotno in imajo svoje naslove. Med številko in naslovom je dvopičje. Naslov konča pika. Primer:

Slika 1: Rast števila prebivalcev Ljubljane po posameznih popisih.

Slika 2: Izsek topografske karte v merilu 1 : 25.000, list Kranj.

Za grafične priloge, za katere avtorji nimajo avtorskih pravic, morajo avtorji od lastnika avtorskih pravic pridobiti dovoljenje za objavo. Avtorji naj ob podnapisu dopišejo tudi avtorja slike.

4. Sprejemanje prispevkov

Avtorji morajo prispevke oddati natisnjene v enem izvodu na papirju in v digitalni obliki, zapisane s programom Word. Digitalni zapis besedila naj bo povsem enostaven, brez zapletenega oblikovanja, poravnave desnega roba, deljenja besed, podčrtavanja in podobnega. Avtorji naj označijo le mastni (krepki) in ležeči tisk. Besedilo naj bo v celoti izpisano z malimi črkami (razen velikih začetnic, seveda), brez nepotrebnih krajšav, okrajšav in kratic. Zemljevidi naj bodo izdelani v digitalni vektorski obliki, grafi pa s programom. Fotografije in druge grafične priloge morajo avtorji oddati v obliki, primerni za skeniranje, ali pa v digitalni rastrski obliki z ločljivostjo vsaj 120 pik na cm oziroma 300 pik na palec, najbolje v formatu TIFF ali JPG.

Avtorji morajo za grafične priloge, za katere nimajo avtorskih pravic, priložiti fotokopijo dovoljenja za objavo, ki so ga pridobili od lastnika avtorskih pravic.

Avtorji naj prispevke pošiljajo na naslov urednika:

Igor Žiberna
Oddelek za geografijo
Filozofska fakulteta
Univerza v Mariboru
Koroška 160
2000 Maribor
e-pošta: igor.ziberna@um.si
telefon: 02 2293 654
faks: 02 251 81 80

5. Recenziranje člankov

Članki se recenzirajo. Recenzijo opravijo člani uredniškega odbora ali ustrezni strokovnjaki zunaj uredniškega odbora. Če recenziji ne zahtevata popravka ali dopolnitve članka, se avtorju članka recenzij ne pošlje. Uredniški odbor lahko na predlog urednika ali recenzenta zavrne objavo prispevka.

POROČILO RECENZENTA

1. Avtor prispevka
2. Naslov prispevka
3. Recenzent (ime in priimek, znanstveni ali strokovni naziv)
4. Pomen prispevka (ali prinaša nova znanstvena spoznanja)
 - a) da
 - b) ne
 - c) delno
5. Primernost prispevkov (ali naslov primerno poda vsebino)
 - a) da
 - b) ne
 - c) delno
6. Uporaba znanstvenega aparata, ustrezno navajanje virov in literature
 - a) da
 - b) ne (opozori na morebitne pomanjkljivosti)
 - c) delno
7. Pripombe in predlogi za izboljšanje besedila (priložite na posebnem listu)
8. Priporočam, da se prispevek sprejme:
 - a) brez pripomb
 - b) z manjšimi popravki
 - c) po temeljiti reviziji (na osnovi pripomb recenzenta)
 - d) zavrne

Datum:

Podpis recenzenta:

