www.jates.org

Journal of Applied
Technical and Educational Sciences
Engineering, Vocational and Environmental Aspects

ISSN 2560-5429

JATES
Journal of Applied
Technical and
Educational Sciences

doi: 10.24368/jates.v7i4.15
https://doi.org/10.24368/jates.v7i4.15

Review of Ecosystem Services of Headwater Catchments by J. Křeček et. al.

Lívia Kürti

Eszterházy Károly University, Eger, Leányka 6, H-3300, Hungary
e-mail: kurti.livia@uni-eszterhazy.hu

Abstract

This new scientific book was published by Springer in this year 2017. It is not just a new work about headwater catchments in general, but a good summary of the different applications and methodology faces the stakeholders and attendants of catchment services around the world. As it is well known any changes in headwater and mountain watersheds have major impacts on not the development of its own region, but also those of downstream. As the climate change is already in reality, we feel this change regularly, it is important to stay for a minute and reconsider the eco-service practices. Do we get the best answer to the challenges of this changing environment?

Keywords: review; headwater; mountain watersheds

1. Review

The book contains 23 chapters, divided in 4 greater parts. Since the scope of this review does not allow for a detailed presentation of each chapter, I will mention some of the major sub-units without any completeness. Each part starts a general outlook of the title and also it gives some concept explications as well. The different international convention and programme are also shown in this part.

The first great session title is *Headwater environment and natural resources*. In this session there are five studies from *Japan, Poland, Turkey, Finland and Spain*. Different aspects of the forest management and water management are presented in different climate conditions.

The ecosystem services are defined as the functions and the products of ecosystems that benefits humans, or yield welfare to society. So it is a wide range of activities. This holistic point of view is crucial in all type of landscape management, but maybe the most important in headwater catchment as it is the source of water supplies, refugees for biodiversity, main life supports. As Springay says they are „foundation pillars of our planet". It is mentioned in its work that mountains provide freshwater to over 50 % of world population. Headwater catchments are

fragile ecosystems due to their slope, altitude etc. At Paris, In the frame of Agenda 2030 Sustainable Development Goals were accepted to push integrated management and increased recognition of ecosystem services. Also an action plan was also accepted by FAO regarding these efforts. It demands multi-disciplinary approach to the watershed catchments. These aspects and approaches can be found in every paper in this book.

As catchments are in mountainous, forestry regions the water resources are controlled by not only the precipitation and runoff, but also by the type of forest management. For example in Poland a very precise and interesting study was made in 2007-2015 period. In the frame of this work more than 3500 measures were realized by the „Counteracting the effects of rainwater runoff in mountainous areas" project. The aim was to apply technical and ecological techniques to increase retention capacity and reduce sheet, rill, gully- and stream channel erosion. Their experiences showed that the combination of ecological oriented and technical acquisitions had good evaluation. They used for example small-scale retention structures in forest areas used by local and natural materials (wood, stones, cohesive soils) to reduce risk of sheet erosion and direct flow acceleration.

In the study by Görücü simulation were shown in the Ceyhan watershed, 58 % forest covered catchment. The scenarios were calculated on long term (30, 40, 50 and 60 years) with different interest rates (4,5,6%) and different allowable cut levels at 85 000m^3, 105 000m^3, and 140000m^3. The paper concluded that there is a need at this side to widen water cost in the catchment, to develop integrated resource management between forest and water sectors, and strongly cooperation among stakeholders. This last one appears in almost all of the study presented in this book.

It is also important that such a responsible management needs also political and civil support, not only to green the legislation and economy, but also to form the civil green behaviour.

In Finland the long term effects of clear-cutting and side preparation were analyzed and shown, exactly in boreal zone. It was clearly proven that after clear-cutting in the following 4-5 years the nitrate concentration were growing to 500µg/l in groundwater and after 17 years is still higher than the pre-treatment values. It means also, that forest management can cause long term disturbances in groundwater quality.

In a research done at Tedori River basin in Japan shows an increasing trend during the winter period in temperature and river discharge, and decreasing trend in the early spring period. This analysis was mad by studying the long-term observation data of air temperature and water discharge also. They were used hydrological model simulations to estimate future trends in water cycle due to climate change.

In Spain the forest management's important question is to reduce the fire number in drought periods. Or, in Africa, the role of „dumbos" in water regime was clarified.

The *second part* is focusing on *enhancing environmental services in headwaters*. According to this title the 6 studies presented in this part try to ameliorate the quality and quantity of ecosystem services. For an effective future, some of them started to collect all the experience from the past and present.

E.g. in Israel, where the status of Kinneret lake is very complex and crucial in the country life. As it is the only fresh water lake of this country, it is very valuable, not only for agriculture and industry but for the ecosystem, as well. The anthropogenic pressure is very high on this region. Although several project and study were figured out and mentioned in this paper. The conclusion was that long-term investigations, learning from the past management are very important to reduce pollutant fluxes, to prepare the water scarcity, follow-up on mitigation of water and nutrients in ground- and soil-water environments.

For example in a Japan paper presented in this issue summarize, and analysed natural hazards (mainly landslides) phenomena in mountain watershed context. As Japan is a densely populated country, a significant part of the population lives in a dreary area. To mitigate their impacts the researchers, stake holders try to develop technologies to predict and avoid landslides. Although it is a very difficult task, and complex question, relatively wide knowledge were accumulated. The article concluded that it is urgent to develop more precise prediction methodology and also mentioned that *comprehensive watershed* management would be the only possible solution.

It was interesting to read the study about the agro-environmental sustainability of the Yuanyang Rice terraces in Yunnan Province. It shows very clearly the millennial traditions of rice cultivation and in this form a very positive example of sustainable agriculture and also land use. During this study soil samples were taken along to terrace's deeper section also, to see if the organic matter concentration was changed. It is important that the upslope rocks are mainly impervious gneiss and schist, and the main valley structure is syncline. So there is an important groundwater reservoir, which is greater than the physiographic catchment. Terraces are used not only for rice cultivation, but also ancillary food production e.g. ducks, fish, grogs and snails, mushrooms and bee cultures etc. This example might extend and encourage other agricultural managements to develop their own sustainable systems.

In the *third part* of the book (Environmental Services in the Changing World) we can read 6 studies. As in the earlier parts, this chapter is begins with a general overview to environmental services, mainly in mountainous regions, in which Schreier writes that mountain areas warming up faster than lowland areas, but there is a lot of uncertainty of this studies due to the many

microclimatic effects in this environment. Also mentioned that mountain watersheds are the water towers of humanity and forests here moderate the hydrological cycle by evapotranspiring precipitation by 20-30%, and allows the intercepted rain to enter soil and groundwater, and trees can also moderate the summer temperature in the stream water. With climate change the new stress situations appeared such higher temperature, extended droughts and these can encouraged also pest and disease events in trees and forests. So in the future, environmental forest management will be essential to protect our watersheds in mountain areas.

That is what says also the next study about Alp. But it mentions also that environmental services have to be linked also with climate change adaptations. So there is a need to analyze environmental system relevance, sensitivity and impacts for specific regions. In this paper the author said that the environmental approach to adaption is valuable for communities, municipalities or regional governments as they have to know their possibilities and resources to give a good answer to changes. They also concluded that in water related services there is an urgent need to develop and implement adaptation methods in Alps.

But other European mountain region in Jizera Mountains (Czech Republic) faces also the long-term effects of acid atmospheric depositions. In this study the acidification has already economic consequences, for example the rising costs by the treatment of drinking water or the reconstruction of the water treatment plant in Bedřichov. J. Křeček and L. Palán clarify that “in Czech Republic water catchments, a system structured forestry practices should respect five main priorities: protection of surface waters, conservation of biodiversity, soil protection (slopes over 30%), fog drip maintenance and evapotranspiration control (the rest of the catchment).” They also concluded that more study needs to be taken to understand the role of the herbaceous vegetation or soil conditions in hydrology.

The next study was written about Serbia, where water and wind erosion affects huge part of the country, and lot of torrent event is registered. In the last decades increasing frequency of torrential events was observed. The authors advise to create a national strategy for erosion and torrent control, an erosion map, torrent cadastre, and also cadastre the erosion control works in the country. It helps to achieve better security of people living in the mountain region or in the lowland cities. Population needs to be adequately prepared for emerging emergencies and prevention, which places a significant educational burden on the topic's experts. This latter process can involve the various civic organizations and educational institutions.

The last part of the book is about the new challenges for Environmental education and active citizenship with five studies. In which we find a severe work about the European Union politics, ecosystem services and stakeholders’ participation. As headwater catchments are drivers of key

ecological processes, but also natural places in the same time with natural and spiritual values." Since the early 2000 European Union started a process from the nature and water legislation to the biodiversity strategy towards the integrated management of natural resources, with and for people, with their cultural diversity, following the ecosystem approach" declare the authors. The European Union tries to develop its own MAES and CBD (Convention on Biological Diversity)projects, as well as EU Water Framework Directive, which help to introduce ecological services in management systems also. Some of them have been implemented at national level, but there is also a need for localization. It is similar in the case of Finnish firm, which produces energy and environmental peat, forest fuel and pellets for heat, steam and electricity customers in Finland and the Baltic countries. As peat production is related to in a certain way to water protection, the company has built several water treatment solutions. They started an environmental program in which they aim to use the BAT (Best available Technology advised by EU). They measures 14000 water samples in every year and the information get from this process is published on the website also. They also introduced a programme for sustainable, responsible peat production; include also the land use after the end of the production. They also have a unique know-how about water treatments, and they started a program "CLEAR-WATER" business line to offer natural water treatment solutions to different land users. Their example shows that it is possible to create new, ecologically sustainable business opportunities from a traditional business area.

The next studies show the active programmes in Austria and Canada to involve owners and educators in ecosystem services. In the last one Québec has been building a strategy for active environmental citizenship, with a programme named 'Action Research for Community Problem Solving". The method encourages learners to become actors in, for and with their communities. As it uses 13 steps for developing community projects that integrate social, physical, or biophysical environment. During this processes the students become partners of decision-makers, and gradually take all or part of the project management. Their teachers have a role as a guide, resource person, a mentor. During the project learners write journals, containing their feelings, new insight on their problems, their learning, understanding and experimentations with participation strategies. This programme offer benefits to all involved: teachers to discover their students, for example. This model could be widely applicable not only across USA and Canada, but also in the European, Asian, and African countries. It could be applied in different ages from 4-5 five years until adults sector.

Also can be adaptable in Hungary where environment education can be found in several levels of academic programmes. As E. Pénzesné Kónya mentions in her article, after completing a

certain academic programme, the student should know the basic biotic and abiotic components of watersheds, and how watershed structure and functions may vary in time and space. In this little country those who want to study about watersheds can choose studies at natural sciences, Engineering and Technology and Agriculture. But it also appears in teacher training programmes as there are a lot of eco-schools, and programmes for biodiversity conservation and environmental protection.

As you can see the attitudes and activities of residents will have key role in managing future changes in watershed region. In this book we find several good examples from which we can apply the good element in our watersheds.

The last chapter summarizes and presents international programs dealing with the management of river basins. It emphasizes the vital role these regions play in human life. E.g. headwaters supply society with water, peat, timber, grazing land, and locally aesthetic, cultural, recreational and educational benefits to local communities. It details also the results of the Nairobi declaration for the International Year of Freshwater (2003) also.

But declare also the effective headwater management should be to maximize the benefits of headwater catchments to their stakeholders. It requires also the best available technologies, better policy frameworks, changes is land husbandry patterns and direct engineering interventions. It is clear, in the future research on headwaters catchment will be used with long term data, and environmental monitoring is needed also. It is required to supervise our concept of sustainable watershed management with wider meaning and embodiments, too.

That is why this new collection of research and papers is very valuable. It can lead to better, holistic management in different watersheds in different regions.

References

Josef Křeček, Martin Haigh, Thomas Hofer, Eero Kubin, Catrin Promper Editors (2017): Ecosystem Services of Headwater Catchments Co-published by Springer International Publishing, Cham, Switzerland, with Capital Publishing Company, New Delhi, India. 308 p. ISBN 978-3-319-57945-0 ISBN 978-3-319-57946-7 (eBook), DOI 10.1007/978-3-319-57946-7