

MODELLING NITROGEN AND PHOSPHORUS LOADINGS ORIGINATED FROM LAND USE/COVER IN EŞEN STREAM BASIN (TÜRKİYE) BY GIS AND REMOTE SENSING

ММОДЕЛИРОВАНИЕ НАГРУЗОК АЗОТА И ФОСФОРА, ПРОИСХОДЯЩИХ В РЕЗУЛЬТАТЕ ЗЕМЛЕПОЛЬЗОВАНИЯ/ПОКРЫТИЯ В БАССЕЙНЕ РУЧИ ЭШЕН (ТУРЦИЯ) С ПОМОЩЬЮ ГИС И ДИСТАНЦИОННОГО ЗОНДИРОВАНИЯ

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The most important environmental problems resulting from land use/cover are the nitrogen and phosphorus pollution they cause. In this study, the loads of important diffuse pollutants (N and P) resulting from land use/cover in the Eşen Stream Basin located in the South West of Turkey were calculated. Nitrogen load from land use-cover classes was listed as: agricultural areas > forest areas > water surfaces > residential-urban areas > meadows-pastures. It was determined that the nitrogen load in the study region was the most caused by agricultural areas. Phosphorus load from land use-cover classes is listed as: forest areas > agricultural areas > residential and urban areas > water surfaces > meadows-pastures. It was determined that the phosphorus load was mostly caused by forest areas. Those are the initial results of our project. N and P pollution from population and livestock will also be determined in order to total pollution in the area.

Наиболее важными экологическими проблемами, возникающими в результате землепользования/покрытия, являются азот и фосфор и вызываемые ими загрязнения. В этом исследовании были рассчитаны нагрузки важных диффузных загрязнителей (N и P), возникающих в результате землепользования/покрытия в бассейне ручья Эшен, расположенном на юго-западе Турции. Азотная нагрузка по классам землепользования была указана как: сельскохозяйственные территории > лесные массивы > водные поверхности > поселения и городские территории > луга-пастбищные земли. Установлено, что азотная нагрузка в исследуемом регионе в наибольшей степени обусловлена сельскохозяйственными угодьями. Фосфорная нагрузка по классам землепользования представлена следующим образом: лесные массивы > сельскохозяйственные территории > поселения и городские территории > водные поверхности > луга-пастбища. Установлено, что фосфорная нагрузка в основном обусловлена лесными массивами. Это первые результаты нашего проекта. Загрязнение N и P от населения и домашнего скота также будет определяться с целью определения общего загрязнения территории.

Keywords: diffuse pollutants, Eşen Stream Basin, land use/cover, nitrogen, phosphorus.

Ключевые слова: диффузные загрязнители, бассейн ручья Эсен, землепользование/покрова, азот, фосфор.

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Introduction. Among the sources of pollution arise from land use/cover, diffuse pollutants are the most detrimental group. In this group, Nitrogen (N) and Phosphorus (P), that have nutrient characteristics at the same time, have a special

importance. While nitrogen and phosphorus deteriorate the chemical structure of the soil, they also cause eutrophication in the aquatic ecosystem. For this reason, knowing the Nitrogen (N) and Phosphorus (P) loads resulting from different land use/cover is a critical need to predict how it impacts the region's water bodies. In this context, modeling of N and P transportation to lakes and basins is important to develop models for the management of diffuse pollutants [1-3].

The aim of this study is to estimate and map the loads of important diffuse pollutants (Nitrogen and Phosphorus) for the Eşen Stream Basin located in the South West of Türkiye, using Geographic Information Systems (GIS) and Remote Sensing (RS) techniques.

Materials and methods. The study area is the Eşençayı Subbasin located in the Western Mediterranean Main Basin in Türkiye. Basically, this area is located in a place where agriculture, animal husbandry, forestry and tourism activities gain importance. In the study, digital maps of the Eşen Stream Basin containing current land use/cover classes were created using Coordination of Information on the Environment (CORINE-2018) database. This downloaded database was updated by utilizing Landsat-9 (Landsat Level 2) up-to-date (2023) images. The area covered by each land use-cover class of the study region in the CORINE Level-II updated map was determined as hectare (ha) by spatial analysis in ARCGIS software. In mapping Nitrogen and Phosphorus diffuse pollutants within the scope of land use-cover originated loads, unit load values ($\text{kg ha}^{-1} \text{ year}^{-1}$) that were developed by TÜBİTAK Marmara Research Center [4], Environment Institute and Ministry of Environment and Urbanization [5] and updated CORINE Level-II map were utilized. In order to carry out modeling and mapping, the land use-cover classes of the up dated CORINE Level-II map have been reclassified by adapting them to the developed Nitrogen Phosphorus (N-P) unit load classes. Finally, a map showing N and P load patterns was produced.

Results. CORINE 2023 N-P LOAD CLASSES are given in Figure 1. Cover areas and their nitrogen and phosphorus loads resulting from these classes were summarized in Table 1. As it was seen in both Figure 1 and Table 1, forest areas have the most cover area in Eşen River Basin. This land use-cover class have been followed by agricultural, residential-urban, water surface (water bodies + wetlands), and meadow & pasture areas, respectively. Nitrogen load from land use-cover classes was listed as: agricultural areas > forest areas > water surfaces > residential-urban areas > meadows-pastures. It was determined that the nitrogen load in the study region was the most caused by agricultural areas. Phosphorus load from land use-cover classes is listed as: forest areas > agricultural areas > residential and urban areas > water surfaces > meadows-pastures. It was determined that the phosphorus load was mostly caused by forest areas.

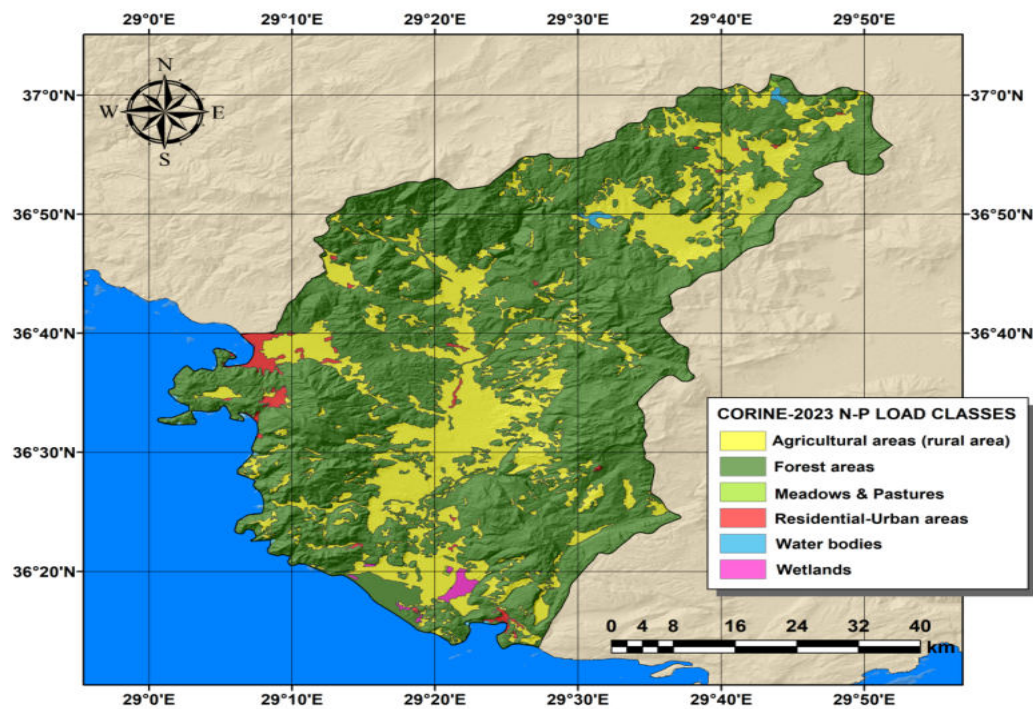


Figure 1 – CORINE 2023 N-P load classes map

Table 1

Cover areas and N-P loads from CORINE 2023 N-P load classes

CORINE-2023 N-P UNIT LOAD CLASSES	Cover Area (ha)	N Loads, kg/ha.year	P Loads, kg/ha.year
Forest Areas	229196,17	458392,34	11459,81
Agricultural areas	83613,27	794326,11	9197,46
Residential-Urban areas	3344,51	10033,52	1672,25
Water Surfaces (Water Bodies +Wetlands)	2142,22	51413,28	535,56
Meadows-Pastures	719,65	3598,26	71,97

Discussion and conclusion. Among the sources of pollution arising from land use/cover, diffuse pollutant sources are the most detrimental group [6-7]. Nitrogen (N) and phosphorus (P), which have nutrient characteristics at the same time, have a special importance within this group [1-3]. Both N and P cause pollution by infiltrating water and soil, and trigger the disappearance of fish and plant populations by causing eutrophication in wetlands. Therefore, there is a need to model the nitrogen and phosphorus pollution that is defined as diffuse pollutants. Developing a new methodology integrated with Geographic Information Systems (GIS) and Remote Sensing (RS) techniques in order to make the modeling and mapping activities of diffuse pollutions more economical and faster. Important for public and private sector organizations. Coordination on Environmental Information (CORINE) database of European Environment Agency (EAA) developed a good classification system that defines land use/cover classes within three levels. This database is available for European Countries and Turkey. However, it is possible to produce land use/cover maps for the countries where this database is unavailable by utilizing CORINE classification system, LANDSAT-8 OLI images, and geo-referenced field data in an image processing software.

Within this context, here we shared the initial results of our project that we have been still carrying out. Our results so far were shown that phosphorus load source in study area is the atmosphere - precipitation, agriculture and forest and it has been noticed that the source of nitrogen load is agriculture and forest. These results are shown that agricultural activities and forest in the region constitute the basis of nitrogen and phosphorus load. These results are also compatible with literature data. Agricultural lands release the greatest amount of nutrients per unit area, while Forests generally have very good nutrient retention capacity [3]. Additionally, this study will provide useful information for decision-makers for local nutrient load reduction and control.

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REFERENCES

1. Campbell N, D'Arcy B, Frost A, Novotny V, Sansom A, 2005. Diffuse Pollution An Introduction to the Problems and Solutions. IWA Publishing, 328 pp.
2. Heathwaite AL, Quinn PF, Hewett CJM, 2005. Modelling and managing critical source areas of diffuse pollution from agricultural land using flow connectivity simulation. Journal of Hydrology, 304: 446-461.
3. Han, B., Reidy, A., Li, A. 2021 . Modeling nutrient release with compiled data in a typical Midwest watershed. Ecological Indicators 121 (2021) 107213. doi.org/10.1016/j.ecolind.2020.107213http://dx.doi.org/10.1016/j.jhydrol.2004.07.043.
4. TÜBİTAK MAM, 2010. Havza Koruma Eylem Planlarının Hazırlanması Projesi Yeşilirmak Havzası 5098115 (ÇE.10.49) Proje Nihai Raporu Cilt I. TÜBİTAK Marmara Araştırma Merkezi, Çevre Enstitüsü, Aralık-2010 Gebze, Kocaeli.
5. ÇŞB, 2016. Ceyhan Havzası Kirlilik Önleme Eylem Planı. Çevre ve Şehircilik Bakanlığı Çevre Yönetimi Genel Müdürlüğü, Ekim-2016, Ankara.
6. Ritter WF, Shirmohammadi A, 2000. Agricultural Nonpoint Source Pollution: Watershed Management and Hydrology. CRC Press, 352 pp.
7. Novotny V, 2002. Water Quality: Diffuse Pollution and Watershed Management, 2nd Edition. Wiley, 888 pp.

ОПЫТ РЕАЛИЗАЦИИ ПРОЕКТА «ЗЕЛЕНый КОД ИЖЕВСКА» EXPERIENCE OF IMPLEMENTATION OF «THE IZHEVSK GREEN CODE» PROJECT

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В статье представлен опыт реализации проекта «Зеленый код Ижевска». Показаны цель и задачи проекта, основные итоги реализации проекта. При реализации проекта использованы цифровые технологии, разработана и зарегистрирована «Геоинформационная система управления зелеными насаждениями города «Зеленый код», которая за два года наполнена оцифрованным материалом по 17 тысяч древесных растений.

The article presents the experience of implementing the “Green Code of Izhevsk” project. The purpose and objectives of the project, the main results of the project implementation are shown. During the implementation of the project, digital technologies were used, the “Geographic information system for managing green spaces in the city “Green Code” was developed and registered, which over two years was filled with digitized material of 17 thousand woody plants.

Ключевые слова: зеленые насаждения, древесные растения, мониторинг, таксация, информационные системы.

Keywords: green spaces, woody plants, monitoring, taxation, information systems.

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