

agriCULTURAL landscapes

30 years of landscape
architecture education
in Nitra

BOOK OF ABSTRACTS

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Managing Editor

ATTILA TÓTH, Assoc. Prof. Dr.
Slovak University of Agriculture in Nitra, Slovakia

Design and Production Editor, Cover Design

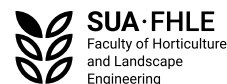
MIROSLAV ČIBIK, Dr.
Slovak University of Agriculture in Nitra, Slovakia

Visual Concept Authors

ATTILA TÓTH, SOŇA BELLÉROVÁ, MIROSLAV ČIBIK and BRANISLAV KRÁLIK
Slovak University of Agriculture in Nitra, Slovakia

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ANA MEDEIROS

BIOPOLIS/CIBIO - Research Centre in Biodiversity and Genetic Resources, Vairão, Portugal
University of Porto, Portugal

CLÁUDIA FERNANDES

BIOPOLIS/CIBIO - Research Centre in Biodiversity and Genetic Resources, Vairão, Portugal
University of Porto, Portugal

JOÃO F. GONÇALVES

BIOPOLIS/CIBIO - Research Centre in Biodiversity and Genetic Resources, Vairão, Portugal
proMetheus—Research Unit in Materials, Energy and Environment for Sustainability,
Viana do Castelo, Portugal

PAULO FARINHA-MARQUES

BIOPOLIS/CIBIO - Research Centre in Biodiversity and Genetic Resources, Vairão, Portugal
University of Porto, Portugal

**AGRICULTURAL LANDSCAPES BETWEEN
ECOLOGICAL AND ECONOMICAL
PERFORMANCES: A SPECTRUM-BASED
APPROACH TO SUSTAINABILITY**

Agricultural landscapes are often shaped by the tension between economic revenue and biodiversity preservation, commonly viewed as opposing forces. Intensive farming prioritizes short-term economic gains, leading to biodiversity loss, soil degradation, and reduced ecosystem resilience. Conversely, conservation-oriented approaches enhance ecological quality but may limit economic viability, making them less attractive to farmers. This study proposes the BIO-PROD Gradient, a spectrum-based framework that reconciles economic and ecological priorities by positioning landscapes along a continuum rather than a binary divide.

The framework was tested in six visual basins (~500 ha each) in the Alto Douro Wine Region, a UNESCO site where steep slopes result in low productivity and high production costs. The Biodiversity Potential Index (BIO) was developed based on expert ratings (1–7 scale), evaluating land use compatibility with biodiversity. The Economic Revenue Index (PROD) was estimated by calculating grape yield multiplied by the price. Using RStudio, both indices were calculated per land-use area and summed for each landscape. ArcGIS Pro was used to map and visually compare spatial patterns of both indexes.

Results indicate a strong negative correlation ($R^2 \approx 0.80$) between the BIO and PROD indices, reinforcing the trade-off between economic revenue and biodiversity conservation. Two main clusters emerged near the extremes, but one landscape—Mesão Frio—stood out as a balanced case, demonstrating how agricultural landscapes can achieve economic and ecological sustainability. A deeper analysis identified five key factors promoting coexistence: 1) Complex, compartmentalized mosaics; 2) Structurally diverse semi-natural habitats; 3) Multifunctional landscapes with diverse land uses; 4) A balance between cultivated and semi-natural areas; and 5) Integration of traditional and modern plantation systems.

Mesão Frio also contains specific landscape elements that enhance biodiversity. Buffer strips with native plants support pollinators, while riparian vegetation prevents soil erosion and improves water retention. Tree rows and hedgerows offer habitat for farmland birds, reduce wind damage, and limit pesticide dispersion. Stone walls further increase habitat diversity and landscape resilience. These features align with the suggested measures by the UN Convention on Biological Diversity (CBD) and the EU Biodiversity Strategy for 2030, though regional adaptation remains challenging.

The BIO-PROD Gradient offers a flexible and strategic tool for land management. It can successfully identify landscapes that balance economic and biodiversity conservation performances, serving as models for sustainable agriculture. Alternatively, it helps prioritize interventions for landscapes at the extremes—where intensive farming requires biodiversity restoration, and biodiversity-rich but low-income areas may need economic incentives like eco-tourism or crop diversification.

By providing a more nuanced understanding of agricultural sustainability, the BIO-PROD Gradient can potentially serve as a valuable tool for land-use planning, policy-making, and conservation strategies. Future research should refine the framework by integrating additional indicators and enhancing mapping techniques better to capture the complexities of biodiversity and agricultural productivity. Ultimately, this study demonstrates that reconciling nature and economic sustainability in agricultural landscapes is not an impossible ideal. Instead, it underscores the need for landscape planners to develop better strategies while continuously seeking win-win solutions that promote ecological and economic resilience.