

MEASURE OF LANDSCAPE HETEROGENEITY BY AGENT-BASED METHODOLOGY

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ABSTRACT:

With the rapid increase of the world's population, the efficient food production is one of the key factors of the human survival. Since biodiversity and heterogeneity is the basis of the sustainable agriculture, the authors tried to measure the heterogeneity of a chosen landscape. The EU farming and subsidizing policies (EEA, 2014) support landscape heterogeneity and diversity, nevertheless exact measurements and calculations apart from statistical parameters (standard deviation, mean), do not really exist. In the present paper the authors' goal is to find an objective, dynamic method that measures landscape heterogeneity. It is achieved with the so called agent-based modelling, where randomly dispatched dynamic scouts record the observed land cover parameters and sum up the features of a new type of land. During the simulation the agents collect a Monte Carlo integral as a diversity landscape potential which can be considered as the unit of the 'greening' measure. As a final product of the ABM method, a landscape potential map is obtained that can serve as a tool for objective decision making to support agricultural diversity.

1. INTRODUCTION

1.1 Greening and EU agriculture

The agricultural sector is an important player in everybody's life due to increased demands of food, fibre and energy. Since arable land covers roughly half of Europe's territory, agriculture has a substantial impact on soils, water and air quality, biodiversity and landscape resource capacity. The on-going reform of the Common Agricultural Policy (CAP) is an opportunity to improve the sector's resource efficiency and environmental performance. (EEA, 2014) The European Commission has proposed a number of 'greening measures', including obligatory crop rotation, grassland maintenance, and EU has supported climate change mitigation and biodiversity conservation. (EEA, 2014).

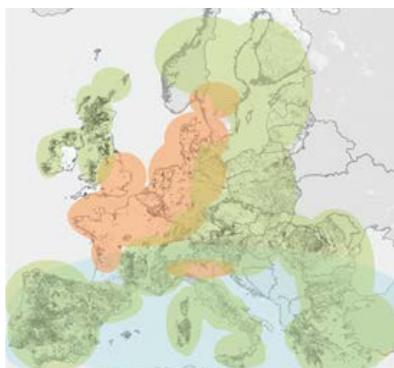


Figure 1. Environmental challenges for European agriculture (EEA, 2012)

On Figure 1. the most substantial agricultural areas are shown with green colour, displaying the main challenges as follows: it is important to maintain on-field biodiversity, stimulate

favourable practices, increase profitability without intensifying agricultural activities. (EEA, 2012)

In our paper we would like to propose a dynamic method with agent-based modelling to find the most problematic areas where these actions are essential.

2. MODELLING ENVIRONMENT

The outlined 'greening' policy and its solution can be successfully achieved by complex use of GIS methods and modelling tools. As opposed to the usual statistical analysis of a chosen area (a standard GIS procedure) our aim is to model the current situation and to obtain an accurate numeric potential map (landscape heterogeneity map) that can objectively show the diversity of a test area. We combined the GIS data with a high-level programming language called NetLogo, and estimated the results by simulation called agent-based modelling (ABM).

2.1 Agent-based modelling

An agent is an entity that can perceive its environment through sensors and can act upon that environment through actuators. A human agent has eyes, ears, and other organs for sensors and hands, legs, mouth, and other body parts for actuators. (Russel and Norvig, 2003)

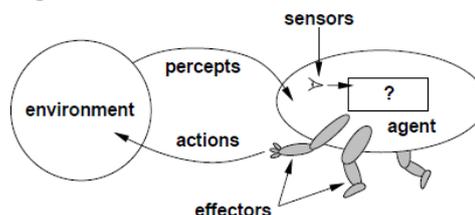


Figure 2. An intelligent agent – landscape scouts in our case - interacts with its environment

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