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Opportunities for bioenergy in the Baltic Sea Region

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Abstract

Security of energy supply, promotion of the bio-economy, nutrient recycling, and innovation are prioritized policy areas in the EU Strategy for the Baltic Sea Region (EUBSR). The Baltic Sea Region (BSR) has a great bioenergy potential worth exploring in this context. This paper explores the state-of-art of bioenergy systems and synergies with eco-systems services in the BSR region in the context of developing the region's bio-economy. In this brief assessment, we consider 8 countries (i.e. Sweden, Finland, Estonia, Latvia, Lithuania, Poland, Denmark, and Belarus) in the region. While the production and use of modern bioenergy can help reduce greenhouse gas (GHG) emissions, promote energy security, diversify energy resources, and contribute to a successful circular economy and rural development, it is important to find a balance between the exploration of resources and the management of eco-systems services. In addition, both climate change vulnerability and bioenergy production may affect the environment and the capacity of the BSR to deliver ecosystem services (ESS). We recommend integrated strategies for optimal use of bioresources in the region. Bioeconomy can be realized by innovative approaches, establishing cross-cutting institutional and policy linkages for increased prosperity and green growth in the Baltic Sea Region.

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1. Introduction

Security of energy supply, promotion of the bio-economy, nutrient recycling, and innovation are prioritized policy areas in the EU Strategy for the Baltic Sea Region (EUBSR) [1]. The EUBSR aims at conserving the sea, connecting the region, and increasing the economic prosperity of its inhabitants. Bioenergy is an abundant renewable resource in the BSR which can be deployed to explore multiple environmental and socio-economic benefits, thus supporting the stated priorities. Biomass feedstocks are available in the form of energy crops, agro-forest residues, by-products from industries, and biogenic municipal waste. This biomass can be used for multiple purposes (e.g. food, fibre, fodder, biofuel, and bio-materials) in bio-refineries [2].

Recently, the concept of a bio-based economy, so-called 'bioeconomy', is guiding the search for alternatives to substitute the 'fossil-based economy'. Bioeconomy primarily includes: (a) sustainable production of renewable bioresources with the aim to reduce both anthropogenic climate impacts and the dependency on fossil-based products, and (b) increased added value of biomass materials considering a reduced consumption of natural resources. In this context, it is important to evaluate the bioresources potential, conversion into multiple products (biofuels, food, bio-materials, etc.), nutrient recycling, and synergies for climate mitigation and adaptation strategies. Within this background it is crucial to assess sustainable bioeconomy development scenarios based on holistic and multidisciplinary approach.

Bioenergy can play an important role in providing energy security and diversifying energy sources, as well as mitigating climate change. Bioenergy pathways can help develop a bioeconomy in the BSR, promoting sustainable development and prosperity. The bioeconomy concept implies efficient utilization of renewable bioresources from land and sea as inputs for food, feed, and non-food products. However, the concept of biotechonomy is the utilization of bioresources for creation of products with high added value that are competitive to replace existing products in the market [3]. The use of bio-waste and bio-based processes, for example, can provide starting points for an innovative approach to substitute fossil-based products. The Baltic Sea is being polluted by industrial effluents, sewage discharge, and other municipal/industry waste [4]. Without proper treatment, this creates serious environmental and ecological problems such as algae blooming and loss of biodiversity. Many effluents could be used for the production of biogas and organic fertilizer. Waste-to-biogas technologies can provide multiple benefits such as waste management, renewable energy production for fossil energy substitution, and nutrient recycling.

Degraded land can be used for energy crop cultivation and this can help improve soil and water conservation which, in turn, can contribute to expansion of eco-system services and capacity to adapt to climate change. Yet, despite recent expansion in the use of bioenergy and international trade in the region, only a small portion of the existing potential has been harnessed for energy generation. Worldwide, negative effects have been observed as a result of increased bioenergy/biofuels production, including deforestation, biodiversity loss, water scarcity, competition between food and fuel, direct and indirect land use emissions, and destruction of natural ecosystems services [5–7]. These negative impacts explain to a great extent why debates are still ongoing on the merits of bioenergy, creating insecurity about the sustainability of bioenergy development over time. At the same time, the absence of strategies to develop bioenergy are not any guarantee for preservation of natural environments and related eco-systems services, but rather could pose a threat to their long term protection.

The establishment of a bio-based economy faces several challenges related to sustainability of natural resources management, food security, mitigation and adaptation to climate change, and maintenance of competitiveness [8]. The use of agricultural crops for biofuel may limit food and feed production. Therefore, a coherent and integrated approach for the utilization of bioresources is required when dealing with the challenges of climate change, resource efficiency, economic prosperity and food security. Innovative planning methods, policies and economic instruments are required for exploring the opportunities at hand so as to capture the potential multiple benefits of a bioeconomy in which also bioenergy has a role to play. The need for climate change mitigation (reduction of GHG emissions), improved security

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