

**Review Article**

**PERFORMANCE ORIENTATION TOWARDS BIODIVERSITY IMPACTS OF ENERGY CROP PRODUCTION ON AGRICULTURAL LAND USE AND FARMLAND HABITATS IN EUROPE**

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**Abstract**

Energy plants for biomass cause significant changes to land use in agriculture and marginal land to reduce the dependency on fossil fuels. Several studies analyse the impact on the biodiversity of energy crops and especially perennial grasses, but few studies of their interaction with farmland, especially mammals, exist. Energy crops cultivation can lead to conflicts with land use, including the loss of agricultural biodiversity. Understanding the ecological impact of bioenergy planting schemes is essential to mitigate the potential adverse effects of these structurally diverse crops on already declining agricultural land biodiversity and to maximize their benefit. Throughout our research, we concentrate throughout particular on the association of energy crops with food crops and the influence of energy crops on agricultural birds and examine the disparity between the consequences of these practices on birds with several ecological conditions. The first comprehensive review of the published impacts of bioenergy crop production on biodiversity is presented in this article, the drivers are evaluated and the pressures are assessed, and the current trends and impacts are summarised. The review offers insight into the types of biodiversity indicators used in a variety of conditions, and the mitigating actions proposed to reduce negative effects or achieve benefits to biodiversity.

**Keywords:** Agricultural, Biomass, Biodiversity, Renewable Energy, Europe, Sources of Energy, Energy Crops, Environment, Sustainability.

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**INTRODUCTION**

Europe faces a growing demand for energy, high costs, and supply disruptions. The environmental impact of the energy sector must be rising in Europe. A clear EU energy strategy is essential to address these problems. EU energy policy, therefore, has three main objectives: security of supply, competitiveness and sustainability. The Commission has introduced plans for a European Energy Union. This will provide EU citizens and companies with safe, affordable and climate-friendly energy. In global energy matters, the energy union will also help Europe to talk with one voice. Energy Union builds on current EU energy policies and includes the 2030 Energy and Climate Framework (EC 2014). Shrinking greenhouse gas emissions, and hence the Paris Agreement of 2015, also depends on meeting the EU's renewable energy and energy policy targets and the need for a stable long-term regulatory framework, including binding renewable energy targeting in line with the Union's more efficient long-term climate targets (2050) related to renewable energy targets. The present 2020 energy strategy and energy objectives would not be enough to achieve the 2050 decarbonisation goal, and thus the European Commission would propose a more ambitious climate and energy package for 2030 which would raise the EU renewable energy target to at least 30% utilizing individual national targets (EC 2016). The Paris Convention (COP21), which should include transparent and verifiable commitments on emissions and power to prevent global warming above 2 degrees, should be accompanied by national carbon plans. This highlights that the advances made demonstrate the merits of the Union's national binding target-based renewables policy, which the European Union repeatedly

called for, providing long-term certainty for industry and investors to invest in both the production capacity and the transport and distribution infrastructure [1].

The European Commission emphasizes that, in the development of payment mechanisms for surplus production and grid use, the new renewable energy systems, such as home consumption, in conjunction with new technologies, can contribute significantly to the achievement of Renewable Energy Objectives. The renewable energy can increase consumer awareness of its consumption of energy, thereby helping to achieve the goal of creating an Energy Union that is consumer-centered, and can boost jobs, also in low population-density areas, and invest in and protect decentralized renewable energy. The EU's current target is for renewable sources to account for 20% of the energy consumed within the EU by 2020 and at least 27% by 2030. Promoting the target in Europe has contributed to a dramatic increase in renewable energy production efficiency. Renewable energies are also part of a growing green technology industry with an increasing number of people working in Europe [2].

In 2011, there were 1.2 million people in employment related to renewable energy. By 2020, more than 4 million people are expected to work in the EU renewables and energy efficiency sector (EC 2016). Europe's long-term energy strategy focuses on renewable energy, as it contributes to reducing greenhouse gas emissions and reducing European imports of energy, thus making Europe more independent. This booming economy contributes to the European leadership in technology by providing new green jobs and high added value exports to EU countries and their

regions. In summary, the only sustainable solution for the future is a valid common European energy policy.

#### REVIEW OF LITERATURE

The literature synthesised and deliberates on the impact on the biodiversity of agricultural biomass output, the scenarios of land usage dependent on food and energy plant separation, culture structures of biomass, the conservation biodiversity-ecosystem and biodiversity and land-use changes.

#### Impact on Biodiversity of Agricultural Biomass Output:

The word biodiversity demonstrates how abundant life is on earth. Biodiversity includes the variance between living organisms from every source, including terrestrial, marine, and waters or the ecological complexes of which they are part, according to the 1992 United Nations Convention on Biological Diversity includes diversity among species (genetic), between species and ecosystems. Both plants and animals used in agriculture are dependent on biological diversity. Biodiversity is well known for contributing to the maintenance of numerous "ecological services" such as erosion prevention, regulatory processes of hydrology, nutrient recycling, local microclimate management, pollutants detoxification, etc. Thanks to indiscriminate degradation of large natural regions and the limited approach taken by agricultural policy policies, increasing productivity around the world and, subsequently, growing and focusing agricultural production processes, biodiversity has been drastically reduced over recent decades. Changes in biodiversity as a result of human activities (agricultural and industrial) have been much faster in the past 50 years than ever before in human history, and there is no evidence of a decrease or an increase in biodiversity causes over time [3].

A scenario of new scarcity is evident from instability in agricultural commodities and food, population growth and dietary changes, environmental restrictions on food production, and consequences of climate change [4]. Many studies over the last 20 years have shown the critical drivers for decreasing the planet's biodiversity. Habitat transition, (such as land-use shifts, structural alteration of wetlands or water drain from streams, depletion of coral reefs, and disruption to sea floors due to trawling), climate change, invasive alien organisms, excess degradation and contamination are the most significant primary causes for loss of biological diversity and improvements to ecosystem services. Changes in land use can affect biodiversity, and the increase in agricultural production and growth in industrial crops, mainly tropical sugar cane and palm oil, and in other US and European monoculture is now linked to loss of biodiversity [5][6].

Right from the start, attention was given to the large production and use of land and cultivation for food and energy purposes. The advantages of biomass production, on the one hand, involve environmental risks that include its potential impact on biodiversity. The implications of the development of biofuel feedstock on biodiversity and ecosystem services are still being addressed, to preserve biodiversity and ecosystem services, through introducing local management of biofuel feedstock production systems. The resources of biodiversity are distributed unevenly worldwide. Due to the asymmetrical geographic distribution of species, any assessment is expected to be biome, site and context-specific for the impact of biofuels on biodiversity. Deep-seated agricultural cultivation also contributes to the homogenisation of ecosystems and the short introduction and heavy land intrusion have exacerbated the invasion of alien species. The use of biomass is the only cause of the outcome. On the other side, there is more room for environmental intensification in terms of the future incorporation of food and energy crop production systems on the farm to scale, although there are gaps with the traditional goals for preservation of biodiversity [7].

#### Scenarios of Land Usage Dependent on Food and Energy Plant Separation:

Although the exact land area needed for bioenergy crops can hardly be estimated, it is clear that the pressure on land will significantly increase under increasing biomass demand [8]. It can lead to adverse biodiversity effects, as it may lead to increased use of existing land in agricultural and forest lands as well as to the transformation of non-cropped, rich in biodiversity into forested or cultivated land [9]. A sustainable scheme for biofuels introduced under the Directive on renewable energy, for example, is to ensure that we do not convert the rich grasslands of biodiversity. Existing arable land for the processing of wood is gradually opposed to the cost of food, as it can have substantial negative impacts on the environment.

Security of foodstuffs, especially in developing countries, can be impaired and the development of bioenergy will drive food and feed into uncultivated areas destroying precious biodiversity (e.g., rain forest and savannah) and significant greenhouse gas emissions (GHG) from soils [10-13]. This may also be the product of the increasingly dependent EU nations on imported bioenergy biomass [14].

The "pre-bioenergy" scenario defines Dauber and Miyake's study of the distribution of predominant coverage of the land in all three categories. The most important agricultural land grows food crops. On that land, crop yields are high due to high soil fertility, high external input and full production systems. Biodiversity levels are therefore very low on this land. As land becomes more marginal and crop yields fall, management options are being reduced economically and production systems are thus becoming less intense. On this property, permanent grasslands become the dominant shelter. Land with low intensity, sometimes traditional agriculture, dominates in some areas with economically marginal land [15]. The biodiversity of agricultural land in these areas is high in terms of agricultural land in terms of production [15][16]. The large percentages of abandoned agricultural land exist for primarily commercial purposes on poor soil unsuitable for food production, and environmental factors often induce large proportions of farmland, not for agriculture. On that land, there may be extensive pastoral systems. We expect to find high levels of biodiversity within the yield-biodiversity relationship here. "Human" land excluded from agricultural production is expected to achieve the highest level of biodiversity.

#### Culture Structures of Biomass and Conservation of Biodiversity and Ecosystem:

In recent years there have been more and more scientific papers discussing the impact on the biodiversity of biomass energy cultivation [10-13]. The following can be described momentarily as to general processes influencing ecosystems are influenced by a multitude of bioenergy cropping systems. Intensification resulting from conversion to annual management and harvest practice of long-term or permanent crops. If the energy crop is multi-annual, then it will generally benefit ecosystems by incorporating energy crops into a current intense annual plant scheme [17]. The result will improve biodiversity if management does not offset the increased use of pesticides or harvest disturbances. Many animals will always profit from land-use planning, but their depletion of habitat abundance is higher than that of opportunistic organisms. Since management practices consist of several different techniques, the combination defines the net impact on biodiversity. This includes landscape practices such as corridors, hedgerows, and so on [18]. Organic soil inventories, as was shown for miscanthus, were impaired [19].

A global problem in farming has to date been to align food and energy production with the conservation of ecosystems and ecosystem functions. The ability of marginal land to promote bioenergy development is becoming mainly centered on

minimizing impacts on ecosystem services and biodiversity. There is an improvement in the general idea of using minimal or less efficient regions for power purposes. Situated in relatively small areas within general productive or broader landscapes, where conditions generally limit agricultural productivity, the biodiversity activities in these areas are increasing. Such areas may also be less optimal for food production. Indeed, it is increasingly evident that those lands already have several useful functions and could reduce these services if they are converted into bioenergy crops [20].

A few research in the USA, including the Conservation Reserve System Lands, have shown a negative impact on the environment of animals and water quality of the marginal croplands in the annual crop production [21-23]. The impact of perennial plants on mid-season production and crop allotment in the US was shown in a recent study [24]. When native grass and restored prairie systems, the analysis underlined that in both areas over the years, excellent root development was progressively closer to that in the first regeneration systems than miscanthi, switchgrass and poplar systems. These are mostly similar findings to those of studies in less versus diverse forests for fine root production [25-28]. In comparison, researchers have found that species mixtures have 28 percent more fine root biomass than monoculture schemes in natural woods, cultivated grasslands, cropland or pot systems [29]. Alternatively, marginal croplands will be converted to perennial celluloses for annual cultivation [30][31]. In the Midwest of the United States, perennial grasses and neglected forbs may provide up to 25% of national cellulosic biofuel goals and significant benefits for greenhouse gases [32]. However, it is predicted that a variety of species and ecological roles, contributing to substantial synergies that are yet to notify ongoing bioenergy debates, will have a positive impact on the field of perpetual cover for the environment [33]. Here we provide the most comprehensive empirical evaluation of this hypothesis so far, reporting on the impacts on a wide range of organisms and their ecosystem functions of the different bioenergy cropping systems. Previous studies have explored the capacity of select organic farmers, without recognizing trade-offs or synergies that may occur while contemplating the whole suites of species and ecosystem functions, to support specific taxa [34] or individual products such as energy production or GHG mitigation [32][35]. In a unique, multidisciplinary analysis, we discuss matching species and ecological services and demonstrate that the synergistic enhancement of the variety of different organisms and the scales of the services that they provide in perennial grass crops (switchgrass, combining grass and field plantings). In turn, we measure the value and the viability of both food and energy development as a strategy that promotes the deliberate layout of bioenergy ecosystems.

#### **Biodiversity and Land Use Changes:**

The bioenergy sector covers all continents except the Antarctic. However, there are different types of bioenergy planting and biofuel production, which are constrained by both the natural and the economic and technical conditions. Biofuels are mostly currently being developed in Europe, the USA and some tropical countries. In the United States and Brazil, the EU is the world's biggest manufacturer of biodiesel. There are also vast biofuel resources available to many developing countries. A study of the convergence of food and energy cultures with the size of the

environment scenarios revealed various potential scenarios (as shown in figure 2) about the addition of food and energy crops [7]. The detailed description of nine development intensities and processes (A1-C3) scenarios helps us to define, within the respective scenarios, threats and opportunities correlated with the protection of biodiversity. No consideration is given to the possible effects of changes in land use caused by integration into energy crops across the scenarios. Both simulations (Fig. 2) are carried out in an agriculture sense or evaluated in prototype systems at the lowest.

Another study conducted on a global analysis of the impact of biofuels plantations on biodiversity has revealed considerable differences between tropical and temperate regions in land use and environmental, cultural management of biofuel plants. There were three types of biomass energy generation, with significant effects on biodiversity from different generations. Biofuels of the first generation generate direct threats to biodiversity while concentrated. Random harvest patterns, multi-aging field agglomeration or mixed rotation of different plant species may have a positive effect of its planting on biodiversity. Mixed plantings of local perennial farmland biofuels or traditional plants on marginal land are a practical way to sustain biodiversity, reduce net greenhouse gas emissions by slowing the global climate change, reduce SOX emissions to improve air quality and preserve biodiversity through maintenance of the impact of a global climate change crisis. The SOX emissions to improve air quality. Biofuels of the second generation are found less harmful than those of the first generation and ultimately positively influenced. Biofuels of second-generation may reduce competition for land and water supplies with conventional crops. The energy conversion value of these plants, however, is very high. The impact on biodiversity is still in doubt for third-generation biofuels. A case study shows that large-scale algal cultivation can put coastal biodiversity at significant risk. Although the production costs for biofuels of the third generation have high energy content and little pressure on land use, they are very high [36].

#### **METHODOLOGY**

This research has adopted the method of data collection with survey, official reports of the government departments and previous research work done for further synthesis, analysis and interpretation.

#### **ANALYSIS AND RESULTS**

The results of research into the influence of bioenergy plants on biodiversity have been very minimal, and most work has concentrated on increasing energy crops on the current agricultural land rather than on the substitution of crops on abandoned or fallow soil by substituting some semi-natural habitat (particularly those mentioned in Annex I to the Direct Habitats). However, in such habitats (e.g., hay meadows or scrump and heathland habitats) the use of biomass harvested from semi-natural vegetation could, in some cases, be environmentally acceptable or even beneficial. Research studying the environmental consequences of the farm or fallow land disposal will make generalizations and deduce environmental impacts. A detailed review of literature on the biodiverse effects of land in the various forms of agricultural management without any control [37].

**Table 1: Farmland offers a broad range of human ecosystem services**

Ecosystem Service	Value of Service to Humans	Impacts of Bioenergy
<b>Provision of Food, Fuel, and Fiber</b>	Grains, fruit, and vegetables from farmland and feeding stuff are harvested. Plant fibers are used for paper or wood processing. Plant material may be processed or combusted for energy into liquid fuels.	The plants of bioenergy may compete with food, the plants for productive land. The development of marginal cropland bioenergy may contribute to fuel production and minimization of impacts on food production
<b>Water Purification</b>	Before it enters rivers, rivers, and groundwater, wetlands, forests and grasslands are removing contaminants from the water.	Intensive fertilizer and the use of pesticides are needed for bioenergy crops to reduce water pollution. Annual crops may lead to a reduction in natural water purification in the irrigation of woods, wetlands, and grasslands. Perennial bioenergy crops can be used for buffer flux edges and to minimize surface fluid (for example, native grasses, etc.)
<b>Erosion Regulation</b>	Wind erosion and erosion-prone heathlands, wild forests, and deep-rooted, perennial crops.	Annual crop stabilization soils could be produced from bioenergy.
<b>Climate Regulation</b>	Greenhouse gasses are generated and obtained from farm soils. Cultures sequester carbon dioxide sequester (CO <sub>2</sub> ) of greenhouse gasses.	Bioenergy crops may be highly fertilized, and soil pollution can increase. Diverse communities of soil bacteria absorbing greenhouse gasses can support seasonal plants than annual ones. Perennial, deep-rooted bioenergy plants can sequester and store long-term emissions of coal.
<b>Pollination and Pest Regulation</b>	The growth of a variety of food crops is subject to insect pollination. Insects, spiders and birds, insect pests, eating, and killing, reducing crop pollinating substances and predators.	Low-diversity dominated landscapes, and annual bioenergy crops will give pollinators and predators little habitat. Varied, perennial crops planting on agricultural land can provide damage to nesting and food resources.
<b>Soil Nutrient Cycling</b>	Dead plant bacteria and fungi decompose the soil. Symbiotic fungal plants and bacteria improve the organic matter in the soil.	Annual bioenergy plant tillage traditional and making available nutrients will reduce organic soil matter in crops. Woody plants and annual grasses may restore nitrogen. Legumes can be incorporated as nitrogen to the soil in perennial or annual bioenergy crops.
<b>Biodiversity Conservation</b>	The farmland consists of multiple ecosystem forms that are inclusive of several various cultivar plants, of which some are endangered.	The annual planting of permanent ecosystems may be increasing the biodiversity of the agricultural land. Diverse perennial bioenergy crops will add diversity and a vital refuge to agricultural ecosystems, providing leisure and preservation incentives for rare species.

The controlled grassland mowing and brush clearing may help to alleviate the loss of livestock pastureland and hay development where partial or complete abandonment takes place. Nevertheless, it should be noted the presence of livestock in these semi-natural habitats can be useful in many ecological areas, such as seed dispersion, and therefore only as a last resort should vegetation be harvested when grassing is not sufficient for the conservation of the environmentally friendly conditions of the habitat. Many semi-natural grasslands suffer from deposits of significant atmospheric nitrogen levels, which cause eutrophication in comparison to the poor conditions in natural nutrients, changes in vegetation, and significant decreases in biodiversity [38]. However, the impact of under-grassing on, for example, slow-rising light which needs vulnerable flowerers and closely associated butterflies is intensified by this eutrophication. Excess nutrients from wetlands that rinse streams and lakes can also be removed. Cutting plants for bioenergy purposes could therefore also help to mitigate such impacts, even if more research is needed in this field. These applications would have to be monitored carefully in order to maintain safe and managed adequately (e.g., no growing fertilizer use and cutting at appropriate times and with the use of appropriate equipment, etc.). Where semi-natural habitats are or are in danger of being abandoned, then biomass harvesting can help to reduce or reverse the impact of land abandonment.

As has already been stated many reports, the destruction of semi-natural habitats in the EU is a significant challenge to biodiversity, especially in the Natura-classified areas, but also in other High Value (HNV) regions, because the diverse semi-natural and related fauna is starting to be replaced by lower, high and grade grassland and scrub, and generalist species. In other situations, land abandoned will generally have a lower value for biodiversity; in particular, large-scale abandonment was previously achieved in connection with a decrease in habitat heterogeneity and landscape biodiversity [37]. There is fallow ground in certain regions, which may be disproportionate for current agronomic or environmental criteria. Cultivation of

fallow areas with bio-energy plants would have a significant impact on biodiversity as these fall areas could provide valuable habitats of bird, small mammal and invertebrate breeding and feeding, as demonstrated by reserve studies [39].

The ecological effects of land-use changes on EU-level farmland birds are of particular relevance. This suggests that the primary source of the decline in the population of the most widespread agricultural bird species shifts in the supply of foodstuffs and, to a lesser extent, suitable breeding sites linked to plant areas within agricultural ecosystems [37].

#### FINDINGS AND DISCUSSION

The biomass of specific non-crop habitats such as greasy tampers, seed-rich crops for birds and floral plants could be used to produce bioenergy if carefully conceived and regulated. However, it is essential to ensure that agri-environmental objectives and the basis for payment calculations are not compromised. There may also be energy crops that could play a role in particular environmental behaviour, especially the SRC as buffer strip along with the watercourses, which could minimize soil erosion and trap flux and which, if demonstrated, could provide an active spray drift monitor. This will benefit aquatic biodiversity if the SRC is not too close to the watercourse to be distinguished and confined to other habitats. Another potential concern for plants, such as eucalyptus, that foster deficient levels of biodiversity is the presence of foreign animals [40]. In short, most perennial energy crops like the ones considered in this study are shown in most cases to have less adverse effects on existing farmlands than annual crops.

The research on the effect on unused, fallow and polluted land for energy crop production, however, is minimal. With the available information and based on our understanding of the dynamics of the ecosystem, we are confident that semi-natural habitat cultivation of dedicated power plants 47 would have a significant adverse environmental effect on most places. Environmental impacts will be less prominent on presently cultivated land, but the ecological impacts in fallow areas could be substantial and

could well result in further environmental impacts based on the farming approaches used. Some authors, therefore, believe that there should be a hierarchy on alternative land uses: priority should be given to resources of water and biodiversity under ideal conditions; and second, primary production of food and other raw materials (fibers, wood, forage, etc.) should be guaranteed, after all, waste is made room, and other waste and, ultimately, land use should be predicted. Decisions on energy plants should only be taken later and residually in this context, as are those reserved for the protection of natural resources and biodiversity and the supply of food, not for raw substances. The degree of science can at this moment, however, endorse one rather than another stance with due seriousness on the relation between energy goal crops and agrobiodiversity, and only some advice on the positive and negative externalities of bioenergy development can be obtained from the current bibliography in that regard [41][42].

Several experiments carried out in the United Kingdom have shown how the growing physical nature of the agricultural environment, when woody plants have come into the SRF, has fostered the development of fauna. It is also claimed that the plant absorbs more than 60 percent of the nutrients through leaf falling to the ground, is recycled, stored in organic matter and gradually discharged into the soil solution, with positive impacts upon fauna, microbial activity and soil structure. Besides, investigations document positive effects of perennial herbal plant productivity, leading to the enhancement of the chemical and physical soil characteristics and the development of communities of aquatic, symbiotic, root spreads, my carried fungi and systems like a seed. Likewise, the number of wild plant species, invertebrates, mammals and birds increased compared to annual cereal crops was observed form is can thus and reed [43][44].

Moreover, it is also known that the cultivation of plants intended for first-generation biofuels (oil, sugar, and starch) often involves the use of far more in-depth cropping and can define a degree of biodiversity which does not differ from traditional food crops. Consequently, aggressive plant cultivation has the potential to have adverse effects on ecosystems, irrespective of the blended crops (varieties and species) characterizing the company's production system. Finally, the widespread introduction of biomass, woody as well as grass, will change the scale of the landscape with a regional impact also on biodiversity. Whereas the biomass that feeds a plant potential should be found to keep supply costs as near as possible, more additional crop species should be employed to prevent a drastic decrease in the biodiversity level [45]. The incorporation of the combination of various species may be a way to maintain ecosystems, while simultaneously reducing animal and plant issues with soil productivity. An innovative approach is feasible. In that respect to the experimented in North America in the absence of plants in degraded soils (sandy and low in nitrogen) compared to the monoculture of panic with a congregation of more perennial herbaceous plants [46]. The use of the mixtures has in turn, brought about a much better balance of development than the pure monoculture [47]. The rise in variation (morphological, biological, and physiological) is associated with this and the sophistication of the cultural system.

## CONCLUSION

As can be shown in this text, lasting bioenergy offers the community the opportunity to create multipurpose ecosystems, providing food and energy and maintaining other ecosystem services such as wildlife, soil and water. Buffer strips of seasonal agricultural fields, for instance, can be established on wetlands, mitigate drainage into rivers, create wildlife corridors to pass through the woods and increase water quality (e.g., phytoremediation). To order to reduce wind degradation and provide predator ecosystems for crop insects, permanent plant bioenergy could also be cultivated to open areas. Traditional no-

till schemes may supplement traditional tillage, and plants could be used to encourage predatory insects and spider control predators, mitigate deforestation, and enhance the quality of the soil. To order to raise nutrients and provide shelter for bees, birds and predatory insects, sub-optimal agricultural land such as seedy sections of the pivot fields or poor soils can be planted with seasonal grasslands. The long-term construction of these landscape areas may increase the profitability of agriculture in addition to supporting numerous other value-added products, through promoting plant pollination and natural pest management. Finally, bioenergy production offers an opportunity to shape farmland in order to provide food and fuel while promoting a variety of services.

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