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ANALYSIS OF SMART SOLUTIONS AND BEHAVIORAL NUDGES: STRATEGIES FOR INCREASING PUBLIC INVOLVEMENT IN EUROPEAN BIODIVERSITY CONSERVATION

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Abstract
This study investigates the application of smart solutions and behavioral nudges to enhance public involvement in biodiversity conservation across the European Union. Smart solutions, such as protected areas, national biodiversity strategies, and regulatory frameworks, are direct interventions that provide a strong policy foundation for conservation. In contrast, nudges, including public awareness campaigns, eco-labeling, and citizen science projects, subtly influence public behavior without mandating specific actions, fostering voluntary engagement. The descriptive and comparative analysis reveals that integrating both approaches leads to more effective conservation outcomes by combining regulatory strength with public participation. Countries that successfully implement a mix of smart solutions and nudges, such as Germany and the Netherlands, achieve higher levels of public engagement and better biodiversity outcomes. The research underscores the imperative for intersectoral cooperation, heightened public consciousness, and comprehensive oversight mechanisms to maximize conservation initiatives. The findings provide valuable insights for policymakers, conservationists, and community leaders seeking to enhance public involvement in biodiversity conservation and promote sustainable practices across Europe.

Keywords: *biodiversity conservation, smart solutions, nudges, public involvement, sustainable practices.*
JEL Codes: *Q57, Q01, P43, M29.*

Introduction

Biodiversity conservation represents a critical concern in environmental science and policy, directly impacting ecological stability, species preservation, and human well-being (Wang, 2024 and Brockett, 2023). Public involvement is widely recognized as a cornerstone for the effective conservation of biodiversity, as it enhances the sustainability and acceptability of conservation measures (Parr, 2009). Despite its importance, engaging the public effectively remains a challenging endeavor, fraught with various social, economic, and psychological barriers (Truong, 2022). This paper aims to explore the key factors influencing public involvement in biodiversity conservation and propose innovative approaches through smart solutions and behavioral nudges to address these challenges.

Recent studies highlight several factors that impede public engagement in biodiversity initiatives (Berkes, 2004; Ryo, 2015 and Ferraro, 2022). First and foremost, there is often a significant knowledge gap among the

general population regarding the urgency of biodiversity loss and the specific actions that can mitigate this trend (Frank, 2019). This lack of awareness can lead to apathy or skepticism towards conservation efforts. Furthermore, economic concerns, such as the perceived costs of participating in or supporting biodiversity conservation, also deter public involvement (White, 2023; Rode et al., 2013. And White, 2022). These financial considerations are particularly pronounced in communities where immediate economic survival overshadows environmental concerns.

Psychological factors also play a pivotal role. The "bystander effect," where individuals are less likely to take action when others are present, can reduce personal accountability and participation in community-led conservation efforts (Assaf, 2023; Johanson, 2011 and Eylering, 2024). Additionally, the complexity of biodiversity issues often leads to cognitive overload, where the public feels overwhelmed by the scale of the problem and therefore disengaged (de Jong, 2010; Bibiana, 2023).

Addressing these barriers requires a multifaceted approach. Smart solutions, such as leveraging technology for better information dissemination and participant engagement, offer promising avenues. For instance, mobile applications that gamify species tracking or habitat conservation tasks can both educate and incentivize public involvement (Torres-Toukoumidis, 2022). Similarly, social media platforms can be harnessed to build community awareness and foster a sense of collective responsibility towards local biodiversity conservation projects (Wu, 2018).

Moreover, the application of behavioral nudges offers a strategic complement to technological innovations. Nudges that simplify complex biodiversity information into actionable and relatable actions can empower individuals to make conservation-friendly decisions in their daily lives (Wendel, 2016). For example, default options in community landscaping that favor native flora can subtly steer public preferences towards biodiversity-supportive behaviors without curtailing personal choice.

In synthesizing the body of literature pertaining to these subjects, this manuscript will present an exhaustive examination of the impediments to public engagement in the realm of biodiversity conservation and elucidate how the incorporation of intelligent solutions and behavioral nudges can proficiently surmount these obstacles. By pursuing this objective, it aspires to delineate a forward trajectory that not only amplifies public participation but also augments the effectiveness and sustainability of conservation outcomes. To effectively conserve biodiversity, a critical aspect of global environmental policy, it is essential to explore diverse strategies that can be tailored to varying ecological, social, and economic contexts (Zinngrebe, 2023; Leadley, 2014; Gavin, 2018; Doak, 2014; Kopnina, 2024; Hooper, 2005).

The European Union (EU), with its rich biodiversity and diverse member states, has employed a range of approaches to safeguard natural habitats and species. These approaches include smart solutions, such as the establishment of protected areas, regulatory frameworks, and national biodiversity strategies, which provide a solid legal and policy foundation for conservation efforts. However, while these top-down interventions are necessary for setting conservation goals and ensuring compliance, they often lack the flexibility to adapt to local contexts and may not fully engage the public in meaningful ways (Grimm, 2019; Hrabanski, 2015; Peterson, 2018; Dalton, 2023; Coad, 2015).

In contrast, nudges—subtle behavioral interventions strategically formulated to promote voluntary pro-environmental behaviors—have emerged as a supplementary approach that can augment public engagement in biodiversity conservation efforts. Nudges, exemplified by public awareness campaigns, eco-labeling initiatives, and citizen science projects, utilize principles derived from behavioral science to effectuate changes in public behavior through non-coercive mechanisms. By endorsing voluntary actions that are congruent with conservation objectives,

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nudges contribute to the establishment of a culture of environmental stewardship and cultivate broader community support.

Notwithstanding the promise of these methodologies, there persists a necessity for a more integrated strategy that amalgamates the advantages of both intelligent solutions and nudges. This study endeavors to address this gap by scrutinizing the efficacy of these strategies in promoting public participation in biodiversity conservation throughout the European Union. It aims to elucidate how various countries reconcile regulatory mandates with voluntary engagement initiatives and to delineate best practices that can be amplified or tailored to diverse contexts. This analysis holds significance for the formulation of more comprehensive and effective conservation strategies that are attuned to both ecological imperatives and social dynamics.

Methodology

The methodology employed in this study aims to analyze the application of smart solutions and behavioral nudges to enhance public involvement in biodiversity conservation across the European Union, focusing on current implementation trends and future perspectives. In order to attain a holistic comprehension of the subject matter, the investigation employed qualitative research methodologies for the purposes of data acquisition and subsequent analysis, thereby facilitating an exhaustive exploration of the methodologies employed to safeguard biodiversity as well as their relative efficacy.

The central aim of the investigation was to evaluate the present application of intelligent solutions and behavioral nudges in the context of biodiversity conservation throughout Europe. Data was collected from a variety of sources, including Government and Non-Governmental Organization (NGO) reports, projects and initiatives implemented across different parts of Europe.

These documents provided insights into the policies and frameworks supporting biodiversity conservation and the extent of their application. Also, we have analyzed academic and industry publications, research articles, conference papers, and industry publications were reviewed to evaluate the effectiveness of smart solutions and conservation efforts. These sources provided scientific evaluations and discussions on the implementation strategies and their outcomes, allowing for a comparison of different approaches. Data from platforms like MDPI.com, ScienceDirect.com, and other scientific databases were utilized to gather relevant information on biodiversity conservation initiatives. These platforms offered access to a wide range of studies and data sets that supported the analysis of current trends and the effectiveness of various strategies.

After data collection, a rigorous process of data cleaning was conducted to ensure accuracy and usability. Following the cleaning process, the data were organized into relevant categories for analysis. This categorization facilitated a structured approach to examining the various aspects of biodiversity conservation strategies, focusing on the types of interventions and their respective impacts.

The study employed both descriptive and comparative analysis methods to achieve its research goals. These methods enabled a comprehensive evaluation of the current state of biodiversity conservation initiatives and a comparative assessment of different strategies across European regions and habitats.

Descriptive analysis approach was used to describe the current situation of biodiversity conservation initiatives across Europe. It provided an overview of the various strategies being implemented, such as the establishment of protected areas, national biodiversity strategies, and regulatory frameworks. The descriptive analysis helped in understanding the reach and impact of these strategies, highlighting the trends in their adoption and effectiveness.

Comparative analysis was conducted to measure the tangible outcomes of biodiversity

conservation strategies. This framework allowed for a detailed comparison of the effects of smart solutions and nudges in different European regions and habitats. The analysis focused on extent of implementation and effectiveness of Strategies. Comparative analysis of smart Solutions and nudges and analysis of Implementation and effectiveness was chosen to study the extent of implementation and effectiveness of both smart solutions and nudges.

The study also analyzed the responsibilities of various ministries across European countries in shaping, implementing, and enforcing biodiversity policies. Ministries were identified as key players in biodiversity conservation. Their roles in policy development, enforcement, and public engagement were crucial in understanding the success of smart solutions and nudges in different contexts.

Results and Discussion

An analysis of the scientific literature reveled two complementary approaches to biodiversity conservation: smart solutions and nudges. Each has its strengths and limitations. Solutions provide the necessary regulatory and structural backbone needed for large-scale, impactful conservation efforts, ensuring compliance and rapid implementation. Nudges complement these efforts by fostering a culture of conservation and promoting voluntary engagement. An effective biodiversity conservation strategy would integrate both approaches, leveraging the strengths of each to achieve sustainable and inclusive outcomes. This integrated approach allows for both robust enforcements where necessary and widespread public engagement and support, essential for long-term conservation success. Differences between solutions and nudges are compared in the table 1 below.

Table 1. Differences between solutions and nudges

Aspect	Solutions	Nudges
Nature of the Intervention	Direct interventions aimed at solving a problem with clear, often mandatory actions or policies.	Subtle changes in environment or context that encourage certain decisions without restricting choice.
Degree of Compulsion	Involves some level of compulsion or enforcement, with consequences for non-compliance.	Maintains individual autonomy, guiding towards a preferred option while leaving all choices available.
Scope and Impact	Broader and more impactful in a direct sense, often changing rules or structure.	More limited in scope, subtly influencing behavior, often complementing larger solutions.
Psychological Mechanism	Does not rely heavily on psychology, focusing on policy or structural changes.	Leverages behavioral economics and psychology, exploiting cognitive biases to influence behavior.
Examples	Government regulations, policy changes, infrastructure projects, legal mandates.	Behavioral cues, default settings, reminders, framing effects.

**Sources: Lin, 2017; Ashcroft, 2013; Felsen, 2013; Hansen, 2013; Mols, 2015; Kosters, 2015; Sunstein, 2014; Butler, 2024; Almeida, 2024; Broers, 2017; Kwan.*

After comparing the collected information, it became clear that Each approach has unique characteristics that shape their effectiveness, scope, and impact on biodiversity conservation efforts. The fundamental difference between the two lies in their approach: while solutions are prescriptive and often mandatory, nudges are suggestive and maintain individual freedom of choice. Solutions provide a clear directive path, while nudges create an enabling environment for voluntary behavior change. The degree of compulsion is another significant differentiator. Solutions often mandate action through enforceable policies, making them effective in scenarios requiring urgent

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or large-scale intervention. Nudges, however, leverage personal choice, making them suitable for fostering long-term behavioral change and engagement. Solutions are more suitable for achieving broad, systemic changes and ensuring compliance with conservation goals on a large scale. Nudges, while less extensive in their immediate scope, are crucial for creating a supportive culture of conservation and reinforcing broader strategies through individual and community engagement. The psychological underpinning of nudges makes them effective tools for promoting voluntary behavior change, as they align with how people naturally make decisions. Solutions, lacking this psychological component, are more straightforward in application but less flexible in engaging with the public's behavioral motivations.

According to the chosen methodology of our research, analyzing the responsibilities of ministries is crucial because ministries are key players in shaping, implementing, and enforcing biodiversity policies. Understanding their roles helps contextualize data collected from government and NGO reports, academic publications, and industry sources.

Data in the Table 1 shows that smart solutions require enforcement and structured governance, which are provided by the ministries outlined in Table 2. Meanwhile, nudges rely on public engagement and behavioral influence, which ministries can facilitate through targeted communication and education campaigns. Together, these tables demonstrate that successful biodiversity conservation depends on a balanced approach that integrates regulatory frameworks with public engagement strategies, coordinated effectively across multiple ministries to achieve comprehensive and sustainable outcomes.

The identification of different possible ministries in European countries and the allocation of responsibilities for biodiversity conservation is presented in Table 2 below.

Table 2. Government Ministries and Their Roles in Biodiversity Conservation

Ministry	Responsibilities
Ministry of Environment or Ecology	• Natural resource management • National parks and protected areas • Pollution control • Wildlife protection • Environmental impact assessments
Ministry of Agriculture	• Management of rural landscapes • Agri-environmental schemes • Forestry management
Ministry of Fisheries and Maritime Affairs	• Marine biodiversity • Fisheries management • Protection of marine ecosystems
Ministry of Planning or Regional Development	• Land use planning • Urban development • Infrastructure projects
Ministry of Foreign Affairs	• Implementation of international agreements like the Convention on Biological Diversity (CBD) • Collaboration with EU directives and regulations
Ministry of Education and Research	• Educational programs • Research funding • Public awareness campaigns

**Sources: This table is based on information sourced from the official government websites of all European Union member states, including Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.*

Table 2 reveals that these ministries are not only responsible for policy development but also for enforcement and coordination across various sectors. This interdisciplinary collaboration is imperative for tackling the interrelated issues pertaining to biodiversity preservation, including habitat fragmentation, environmental pollution, and excessive resource exploitation. By examining the roles of different ministries, the analysis identifies how national strategies are operationalized and the extent to which policies are effectively enforced. Table 2 also sheds light on the enforcement capabilities and challenges faced by ministries in implementing biodiversity policies. Effective enforcement requires adequate resources, clear mandates, and robust governance structures. However, challenges such as limited funding, lack of technical expertise, and bureaucratic inefficiencies can impede the successful implementation of conservation strategies. Analyzing the roles of ministries helps to reveal these enforcement challenges, which are vital for assessing the overall success of biodiversity policies and identifying areas for improvement.

Table 2 also suggests that ministries that actively engage in public communication efforts contribute significantly to the success of nudges by increasing public involvement in biodiversity conservation. This engagement is essential for building a culture of conservation and encouraging voluntary actions that support biodiversity goals. Understanding the role of ministries in public communication helps evaluate the impact of strategies designed to increase public involvement and optimize the use of nudges in conservation efforts.

The comprehensive table presents a detailed overview of the biodiversity solutions and nudges implemented across all EU countries. The data highlights various sectors, including Environment or Ecology, Agriculture, Fisheries and Maritime, Planning or Regional Development, Foreign Affairs, and Education and Research. The diversity of approaches adopted by each country reflects the multi-faceted nature of biodiversity conservation in Europe, demonstrating the continent's commitment to addressing ecological challenges through both standardized and innovative strategies.

Overview of biodiversity solutions and nudges across EU countries are presented in the table 3 below.

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Table 3. Overview of biodiversity solutions and nudges in EU countries

Country	Solutions / nudges in Environment or Ecology	Solutions / nudges in Agriculture	Solutions / nudges in Fisheries and Maritime	Solutions / nudges in Planning or Regional Development	Solutions / nudges in Foreign Affairs	Solutions / nudges in Education and Research
Austria	National Biodiversity Strategy, Protected Areas expansion	Agri-environmental schemes promoting biodiversity-friendly practices	Sustainable fisheries management policies in line with EU directives	Spatial planning incorporating green infrastructure	Participation in international biodiversity agreements	Research programs in universities focused on biodiversity conservation
Belgium	Eco-labeling for biodiversity, Natura 2000 network management	Organic farming subsidies and pollinator-friendly farming practices	Marine protected areas designation	Urban green spaces development strategies	Bilateral agreements on migratory species protection	Public awareness campaigns and school education programs
Bulgaria	Forest management plans to enhance biodiversity	Promotion of crop diversification and organic farming	Fishing quotas and marine biodiversity conservation efforts	Regional development plans integrating biodiversity conservation	Cooperation with neighboring countries on transboundary ecosystems	Biodiversity research grants and student programs
Croatia	Implementation of EU Birds and Habitats Directives	Incentives for organic agriculture and biodiversity-friendly farming	Coastal and marine biodiversity action plans	Sustainable urban development integrating nature-based solutions	Cross-border cooperation on biodiversity conservation projects	Universities leading in biodiversity monitoring and research
Cyprus	Habitat restoration initiatives	Support for sustainable land use practices	Marine conservation zones establishment	Integration of biodiversity in urban development plans	Collaboration with regional conservation efforts	Environmental science programs and public engagement activities
Czech Republic	Expansion of protected areas, Natura 2000 sites management	Agri-environment schemes supporting biodiversity	Freshwater and fish habitat restoration	Incorporation of green infrastructure in urban planning	Participation in cross-border biodiversity initiatives	Focus on ecological education in schools and universities
Denmark	National park expansions, marine biodiversity initiatives	Support for sustainable agricultural practices	Marine spatial planning and fishery restrictions	Integration of biodiversity in urban planning	Active role in Arctic biodiversity conservation agreements	Innovative educational programs on biodiversity and climate impact
Estonia	Protected area network expansion, wetland restoration	Promotion of organic farming and habitat-friendly agriculture	Sustainable coastal management and marine conservation	Green urban planning initiatives	Transnational cooperation on biodiversity protection	Education programs focused on local biodiversity and conservation methods
Finland	Forest biodiversity conservation plans	Agri-environmental support for landscape preservation	Protection of marine habitats in the Baltic Sea	Biodiversity considerations in regional planning	Nordic cooperation on biodiversity issues	Research and citizen science projects on biodiversity

France	National Biodiversity Plan, Natura 2000 management	Agroecology practices promotion	Marine biodiversity protection in the Mediterranean and Atlantic	Biodiversity corridors in regional development plans	International agreements on migratory species	Educational reforms to include biodiversity studies
Germany	National Strategy on Biological Diversity	Support for sustainable agricultural practices	Marine protected areas and fishery management reforms	Integration of biodiversity in urban and regional planning	Active participation in EU and global biodiversity policies	Extensive research funding for biodiversity projects
Greece	Implementation of the EU Habitats and Birds Directives	Promotion of traditional farming that supports biodiversity	Sustainable management of marine resources	Integration of biodiversity into national spatial planning	Bilateral cooperation on Mediterranean biodiversity	Increased focus on biodiversity in educational curriculum
Hungary	Biodiversity action plans, protected area management	Agri-environment measures supporting biodiversity	Conservation of Danube River biodiversity	Biodiversity strategies in regional planning	Partnerships in regional biodiversity projects	Education and public awareness campaigns on biodiversity
Ireland	National Biodiversity Action Plan	Promotion of low-intensity farming practices	Marine biodiversity and fisheries management	Green infrastructure in regional planning	Collaboration on Atlantic Ocean biodiversity	Biodiversity education and awareness programs
Italy	Biodiversity monitoring and protected areas network	Support for traditional farming and agroforestry	Marine biodiversity conservation in Mediterranean	Incorporating biodiversity in urban planning policies	Engagement in transnational biodiversity conservation efforts	University-led biodiversity research initiatives
Latvia	Nature conservation policy, protected areas	Support for diverse and sustainable agriculture	Marine spatial planning for biodiversity	Integration of biodiversity in development planning	Cross-border conservation cooperation in the Baltic region	Biodiversity-focused courses in higher education
Lithuania	Management of Natura 2000 network	Agri-environmental schemes for biodiversity	Marine and coastal biodiversity initiatives	Incorporation of biodiversity in land-use planning	Regional cooperation on transboundary conservation	Public involvement in biodiversity research projects
Luxembourg	National Nature Conservation Plan	Promotion of biodiversity-friendly agricultural practices	Management of freshwater ecosystems	Urban biodiversity enhancement projects	Participation in EU biodiversity frameworks	Programs linking biodiversity with educational activities
Malta	Conservation strategies for endemic species	Support for sustainable agriculture	Marine protected area management	Biodiversity aspects in urban planning	Cooperation on Mediterranean biodiversity issues	Public awareness campaigns and educational programs
Netherlands	National Ecological Network (NEN) development	Encouragement of sustainable farming practices	Marine biodiversity action plans in the North Sea	Urban planning with a focus on green spaces	Participation in international biodiversity conventions	Research and innovation in biodiversity conservation
Poland	National Biodiversity Strategy and Action Plan	Promotion of biodiversity-friendly agriculture	Conservation efforts in the Baltic Sea	Green infrastructure in urban planning	Bilateral agreements on conservation with neighboring countries	Educational programs on conservation in schools

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Portugal	Biodiversity conservation programs in protected areas	Agroforestry and sustainable agriculture promotion	Marine biodiversity initiatives in the Atlantic	Biodiversity considerations in urban planning	International cooperation on marine biodiversity	Research projects on biodiversity conservation and climate change
Romania	Management of protected areas and Natura 2000 sites	Support for sustainable and traditional farming	Biodiversity protection in the Danube Delta	Integration of biodiversity into regional development plans	Participation in EU and regional biodiversity programs	University programs focused on conservation science
Slovakia	National Biodiversity Strategy	Agri-environment schemes promoting biodiversity	Management of freshwater and mountain biodiversity	Inclusion of biodiversity in land use planning	Regional cooperation on Carpathian biodiversity	Educational initiatives promoting biodiversity awareness
Slovenia	Protected area management and biodiversity monitoring	Support for diverse and traditional farming systems	Sustainable management of marine resources	Green infrastructure planning and development	Collaboration with neighboring countries on biodiversity projects	Public involvement and educational programs on biodiversity
Spain	National Biodiversity Strategies, Natura 2000 sites management	Promotion of sustainable and organic farming	Marine biodiversity conservation in Atlantic and Mediterranean	Biodiversity integration in regional planning policies	International agreements on migratory species conservation	Biodiversity research and education initiatives
Sweden	National parks and nature reserves expansion	Agri-environmental support for sustainable farming	Marine spatial planning for biodiversity conservation	Integration of green infrastructure in regional planning	Active participation in Arctic biodiversity conservation	Educational programs and public engagement on biodiversity

**Sources: This table is based on information sourced from the official government websites of all European Union member states, including Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden. Also official sites dedicated for biodiversity as: European Union, Biodiversa, Food and Agriculture Organization, World Wide Fund For Nature, Institute for European Environmental Policy, Europarc Federation.*

The analysis of Table 3 provides a detailed comparison of the use of smart solutions and nudges to enhance public involvement in biodiversity conservation across the European Union (EU). This research highlights how different countries employ a combination of regulatory measures (smart solutions) and behavioral interventions (nudges) to effectively conserve biodiversity, reflecting diverse ecological, social, and economic contexts.

1. Environment or Ecology

Across the EU, most countries have implemented national biodiversity strategies and plans that align with EU directives, such as the Habitats Directive and Birds Directive. These strategies represent a form of smart solutions aimed at creating a robust regulatory framework for biodiversity conservation. For example, Germany's "National Strategy on Biological Diversity" and France's "National Biodiversity Plan" illustrate strong national commitments to achieving conservation goals through structured policy frameworks.

In addition to these broad regulatory measures, many countries, including Austria, Croatia, and Latvia, have focused on expanding protected areas and managing existing Natura 2000 sites, indicating a shared strategy of habitat preservation as a cornerstone of biodiversity conservation. Such smart solutions are often complemented by nudges, such as public awareness campaigns that inform citizens about the importance of protected areas and encourage voluntary

support for conservation efforts.

Countries like Denmark and Estonia have further invested in expanding their national parks and enhancing wetland restoration, highlighting the importance of maintaining diverse habitats. The creation of green corridors, as seen in Finland and the Netherlands, aims to connect fragmented habitats, which is critical for maintaining viable populations of various species. These efforts reflect an integrated approach, combining smart solutions with nudges to foster both regulatory compliance and voluntary public engagement.

2. Agriculture

Agricultural practices significantly impact biodiversity, making sustainable farming a key focus area for conservation efforts in Europe. Many EU countries, such as Belgium, Italy, and Ireland, have introduced agri-environmental schemes and subsidies to promote organic farming and biodiversity-friendly practices. These smart solutions involve regulatory frameworks that reduce pesticide use, encourage crop diversification, and support traditional farming practices beneficial to local ecosystems.

The emphasis on agroecology, as seen in France, or the promotion of traditional farming methods, highlighted by Greece and Italy, indicates a growing recognition of sustainable agriculture's role in preserving biodiversity. These strategies are often supported by nudges, such as eco-labeling and consumer awareness campaigns that encourage the purchase of organic and sustainably produced food products. This dual approach helps enhance soil health and water quality while supporting local species, contributing to overall ecosystem resilience.

3. Fisheries and Maritime

The conservation of marine biodiversity is another critical focus across the EU, with many countries establishing Marine Protected Areas (MPAs) and adopting sustainable fisheries management practices. Smart solutions like these provide a strong regulatory foundation for conserving marine resources. For instance, Spain and Portugal have developed marine biodiversity initiatives in the Atlantic, while countries like Sweden and Denmark have focused on marine spatial planning to safeguard coastal waters.

Complementing these regulatory efforts, countries employ nudges such as public education campaigns and community-led initiatives to reduce bycatch and promote sustainable fishing practices. Fishing quotas and sustainable coastal management, as practiced in Bulgaria and Belgium, reflect an integrated approach to marine conservation that combines mandatory regulations with behavioral nudges. This strategy helps protect marine habitats and ensure the long-term sustainability of fish stocks, which are vital for both biodiversity and the fishing industry.

4. Planning or Regional Development

The integration of biodiversity into urban and regional planning is manifest in numerous EU nations, reflecting a comprehensive approach to conservation. Nations such as Belgium, Croatia, and Slovenia have formulated strategies to incorporate green infrastructure into urban planning, exemplified by the establishment of urban green spaces and the integration of nature-based solutions within city development. These initiatives epitomize intelligent solutions designed to alleviate the adverse effects of urbanization on biodiversity.

Nudges complement these strategies by actively involving local communities in the planning process and enhancing awareness regarding the advantages of urban biodiversity. For instance, public campaigns and educational initiatives in Denmark and Finland underscore the significance of green infrastructure, motivating citizens to engage in conservation endeavors and embrace sustainable urban practices. This amalgamation of intelligent solutions and nudges contributes to the enhancement of urban biodiversity, the improvement of residents' quality of life, and the mitigation of climate change impacts.

International cooperation and adherence to global biodiversity agreements are imperative for effective conservation. Numerous EU nations, including Germany and

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France, actively engage in EU and global biodiversity policies, exemplifying a commitment to international collaboration. Intelligent solutions in this context encompass cross-border conservation projects and transboundary ecosystem management, which address ecological challenges that extend beyond national frontiers.

Nudges assume a crucial role in cultivating a culture of international cooperation. For example, public awareness campaigns regarding the significance of transnational conservation efforts foster support for international agreements and stimulate public engagement in cross-border initiatives. The Nordic collaboration on biodiversity issues led by Finland illustrates the necessity for collective action in tackling shared ecological challenges, such as those impacting the Baltic Sea and the Danube River.

5. Education and Research

Education and research are integral components of biodiversity conservation strategies across the EU, serving as both smart solutions and nudges. Countries like Austria, Spain, and Portugal have invested in educational programs and public awareness campaigns to foster a culture of conservation among citizens. Universities and research institutions in Germany, France, and Italy lead biodiversity monitoring and research, contributing to scientific knowledge and informing policy decisions.

Nudges in this domain include citizen science projects and the integration of biodiversity studies into school curricula, as seen in Estonia and Sweden. These initiatives engage the public directly in conservation efforts, building a more informed and active citizenry. By promoting public understanding of biodiversity issues and encouraging sustainable behaviors, these strategies help ensure long-term support for conservation efforts.

Table 4. Aspects of smart solutions and nudges for enhancing public involvement in biodiversity conservation across the European Union

Aspect	Solutions	Nudges
Examples Specific to Biodiversity Conservation	Protected area designations (e.g., Natura 2000 sites), enforcement of fishing quotas, national biodiversity strategies, marine spatial planning.	Eco-labeling for biodiversity-friendly products, public awareness campaigns, citizen science projects, educational programs.
Implementation Challenges	Requires significant government coordination, funding, and enforcement. May face resistance from stakeholders affected by regulations.	May require continuous engagement efforts and can be influenced by cultural, social, and economic factors affecting public perception and participation.
Effectiveness in Different Contexts	Highly effective in regions with strong governance and regulatory frameworks. Impact may vary in areas with limited enforcement capacity.	Effective in regions with high public awareness and environmental education. Impactful when combined with local cultural practices and community values.

The table provides a comprehensive overview of the use of smart solutions and nudges to enhance public involvement in biodiversity conservation across the European Union (EU). These strategies are categorized based on their nature, degree of compulsion, and psychological mechanisms, highlighting how they contribute differently yet complementarily to conservation efforts.

Smart Solutions are direct interventions aimed at solving biodiversity conservation problems through mandatory actions, policies, and regulations. Examples include National Biodiversity Strategies and Action Plans (e.g., Austria, Germany, Romania), Marine Protected Areas (MPAs) (e.g., Belgium, Spain, Portugal), and the integration of biodiversity in urban planning (e.g., Croatia, Denmark, Slovenia). These solutions are government-led, involve a high degree of compulsion, and typically require adherence to specific guidelines or rules. Their broad scope and significant impact are achieved through structured policy frameworks and regulatory enforcement, ensuring the protection of critical areas and species. However, these strategies also require substantial resources, coordination, and enforcement capabilities.

Nudges are subtler interventions that encourage public involvement without imposing mandatory actions. They leverage behavioral economics and psychology to influence decisions through subtle cues, reminders, or default settings, maintaining individual autonomy while guiding behaviors toward conservation goals. Examples include public awareness campaigns and educational programs (e.g., Belgium, Estonia, Sweden), eco-labeling for biodiversity-friendly products (e.g., Belgium, France), and support for sustainable agricultural practices (e.g., Italy, Hungary). Nudges are flexible, less resource-intensive, and can be quickly adapted to changing circumstances. They effectively engage the public by appealing to values, norms, or convenience, fostering a sense of stewardship and voluntary participation in conservation efforts.

The table highlights that many EU countries effectively integrate both smart solutions and nudges to achieve a balanced strategy for biodiversity conservation. This integrated approach ensures comprehensive coverage by providing a regulatory backbone through smart solutions while enhancing public engagement through nudges. The combination allows for adaptive management, where regulatory mandates are complemented by behavioral incentives, fostering a culture of conservation and promoting sustainable behaviors essential for long-term biodiversity goals. The data underscores the importance of leveraging the strengths of both approaches to foster greater public involvement and achieve more effective and sustainable conservation outcomes across Europe.

The comparative analysis of biodiversity conservation strategies across EU countries reveals the importance of integrating both smart solutions and nudges to maximize conservation effectiveness. Smart solutions, such as national biodiversity strategies, protected areas, and marine protected areas (MPAs), are widely implemented and provide a strong regulatory framework that directly regulates human activities to protect ecosystems. These measures are consistent across EU countries, reflecting a coordinated effort to meet international biodiversity goals. In contrast, nudges—including public awareness campaigns, educational programs, eco-labeling, and incentives for sustainable practices—are more localized and flexible. They are tailored to specific cultural, social, and economic contexts, enabling a diverse range of approaches to enhance public involvement. Countries like Germany, France, and the Netherlands, which employ a balanced mix of both strategies, show high levels of public engagement and achieve more positive biodiversity outcomes. This integrated approach promotes ecological resilience by combining regulatory enforcement with voluntary public participation.

However, countries that rely primarily on smart solutions without significant public engagement, such as Bulgaria and Romania, often face challenges in achieving long-term conservation goals. The analysis emphasizes the need for context-specific strategies and

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enhanced public involvement through community engagement, education, and citizen science.

To enhance the robustness of the comparative analysis, future studies could incorporate quantitative data from surveys, national reports, and databases to provide precise measures of both implementation and public involvement. By using specific metrics such as participation rates, funding levels, and policy coverage, researchers can more accurately assess the effectiveness of biodiversity conservation strategies and the role of public engagement across different contexts.

Future efforts should focus on strengthening policy frameworks, expanding the range of nudges, and promoting inclusive, participatory approaches. Enhancing cross-border cooperation and investing in community-led initiatives will also be crucial. Further research should explore the use of emerging technologies and conduct cost-benefit analyses to optimize the effectiveness of conservation strategies and enhance public involvement in preserving biodiversity.

Conclusions

This study has explored the application of smart solutions and behavioral nudges to enhance public involvement in biodiversity conservation across the European Union. The analysis underscores the importance of integrating both approaches to maximize conservation effectiveness. Smart solutions, such as protected areas, national biodiversity strategies, and regulatory frameworks, provide a strong foundation for biodiversity conservation by setting clear policies and mandates. These measures are crucial for large-scale impact and ensure compliance with biodiversity goals. However, they often require substantial governmental resources, coordination, and enforcement capabilities.

Conversely, nudges — subtle interventions designed to influence public behavior without mandating actions — play a vital role in fostering community engagement and voluntary participation. Strategies like public awareness campaigns, eco-labeling, and citizen science projects empower individuals and communities to take ownership of conservation efforts. Nudges are particularly effective when tailored to local cultural and socio-economic contexts, where they can build a culture of conservation and enhance the sustainability of biodiversity initiatives.

The study finds that the most successful biodiversity conservation outcomes are achieved when smart solutions are complemented by nudges, creating a balanced and adaptive strategy that addresses both policy goals and behavioral change. This integrated approach not only enhances ecological resilience but also promotes a more inclusive and participatory conservation process.

Moving forward, it is imperative for policymakers and conservation practitioners to investigate innovative methodologies for the synergistic integration of these strategies. Subsequent research endeavors should prioritize the assessment of the long-term ramifications of these approaches, elucidating their efficacy in varied contexts, and ascertaining exemplary practices for their execution. Furthermore, enhancing transnational collaboration and promoting augmented public-private alliances may effectively bolster biodiversity conservation initiatives throughout Europe. By capitalizing on the advantages inherent in both intelligent solutions and behavioral nudges, EU member states can guarantee more holistic, sustainable, and efficacious conservation outcomes, thereby making substantial contributions to global biodiversity objectives.

Recommendations

To enhance biodiversity conservation, the study recommends integrating smart solutions with nudges to create a more effective and comprehensive approach. Policymakers should combine regulatory measures, such as protected area management, with behavioral interventions like public

awareness campaigns to foster a culture of conservation and increase compliance.

Public awareness and education should be prioritized, with investments in educational programs and digital campaigns to reach diverse demographics and build long-term support for conservation initiatives. Tailoring nudges to local cultural, social, and economic contexts will also enhance their effectiveness. Engaging communities in designing these interventions ensures they are relevant and impactful. Enhancing intersectoral collaboration is imperative for harmonizing policies among the domains of environmental management, agriculture, fisheries, and urban development. The establishment of intersectoral working groups has the potential to optimize resource allocation and mitigate conflicts. Comprehensive monitoring and evaluation frameworks are indispensable for gauging the efficacy of conservation initiatives, employing tools such as Geographic Information Systems (GIS) to augment data analysis.

Facilitating cross-border and international collaboration is essential for addressing conservation challenges that transcend national boundaries and for disseminating exemplary practices. Creative funding mechanisms, such as biodiversity bonds and public-private partnerships, warrant exploration to ensure the sustainability of conservation initiatives. Fostering collaborations among governmental entities, private enterprises, and civil society organizations can effectively mobilize supplementary resources and expertise.

Further research on behavioral insights will help design more effective nudges, while adapting conservation strategies to address climate change challenges will enhance ecosystem resilience and mitigate future risk

References

Ashcroft, R. E. (2013). Doing good by stealth: Comments on “Salvaging the concept of nudge”. Journal of Medical Ethics, 39(8), 494. doi:10.1136/medethics-2012-101109

Assaf Shwartz, Maya Tzunz, Lee Gafter, Agathe Colléony, One size does not fit all: The complex relationship between biodiversity and psychological well-being, Urban Forestry & Urban Greening, Volume 86, 2023, 128008, ISSN 1618-8667, https://doi.org/10.1016/j.ufug.2023.128008.

Berkes, F. (2004). “Rethinking Community-Based Conservation.” Conservation Biology, 18(3), pp. 621-630.

Bibiana Giudice da Silva Cezar, Antônio Carlos Gastaud Maçada Cognitive Overload, Anxiety, Cognitive Fatigue, Avoidance Behavior and Data Literacy in Big Data environments, Information Processing & Management, Volume 60, Issue 6, 2023, 103482, ISSN 0306-4573, https://doi.org/10.1016/j.ipm.2023.103482.

Biodiversa. https://www.biodiversa.eu/ (accessed on 4 August 2024)

Biodiversity Information System for Europe. https://biodiversity.europa.eu/ (accessed on 5 August 2024).

Brockett, Callum & Woolaston, Katie & Deane, Felicity & Humphries, Fran & Kumar, Ethan & Kennedy, Amanda & Bell-James, Justine. (2023). Best Practice Mechanisms for Biodiversity Conservation Law and Policy. Cambridge Prisms: Extinction. 1. 1-20. 10.1017/ext.2023.14.

Broers, V. J. V., De Breucker, C., Van den Broucke, S., & Luminet, O. (2017). A systematic review and meta-analysis of the effectiveness of nudging to increase fruit and vegetable choice. European Journal of Public Health, 27(5), 912–920. https://doi.org/ 10.1093/eurpub/ckx085

Butler, L.H., Prike, T. & Ecker, U.K.H. Nudge-based misinformation interventions are effective in information environments with low misinformation prevalence. Sci Rep 14, 11495 (2024). https://doi.org/10.1038/s41598-024-62286-7

Carla Almeida, José Azevedo, Adriana Fogel, Eduarda Lopes, Catarina Vale, Patrícia Padrão, Effectiveness of nudge interventions to promote fruit and vegetables’ selection, purchase, or consumption: A systematic review, Food Quality and Preference, Volume 116, 2024, 105122, ISSN 0950-3293, https://doi.org/10.1016/j.foodqual.2024.105122.

Coad, L.; Leverington, F.; Knights, K.; Geldmann, J.; Eassom, A.; Kapos, V.; Kingston, N.; de Lima, M.; Zamora, C.; Cuardros, I.; et al. Measuring impact of protected area management interventions: Current and future use of the Global Database of Protected Area Management Effectiveness. Philos. Trans. R. Soc. Lond. Ser. B Biol. Sci. 2015, 370, 20140281.

Dalton, D.T.; Berger, V.; Adams, V.; Botha, J.; Halloy, S.; Kirchmeir, H.; Sovinc, A.; Steinbauer, K.; Švara, V.; Jungmeier, M. A Conceptual Framework for Biodiversity Monitoring Programs in Conservation Areas. Sustainability 2023, 15, 6779. https://doi.org/10.3390/su15086779

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Management Theory and Studies for Rural Business and Infrastructure Development
eISSN 2345-0355. 2024. Vol. 46. No. 3: 393-408
Article DOI: https://doi.org/10.15544/mts.2024.37

De Jong, T. Cognitive load theory, educational research, and instructional design: some food for thought. Instr Sci 38, 105–134 (2010). https://doi.org/10.1007/s11251-009-9110-0

Doak, D.F.; Bakker, V.J.; Goldstein, B.E.; Hale, B. What is the future of conservation? Trends Ecol. Evol. 2014, 29, 77–81.

Europarc Federation. https://www.europarc.org/european-policy/eu-biodiversity-strategy-protected-areas/eu-2030-biodiversity-strategy/ (accessed on 3 August 2024)

Eylering, Annike & Hölzl, Corinna & Fiebelkorn, Florian. (2024). Psychological factors affecting the perception of biodiversity loss: A comparative study in three European countries.

Felsen, G., Castelo, N., & Reiner, P. B. (2013). Decisional enhancement and autonomy: Public attitudes towards overt and covert nudges. Judgement and Decision Making, 8(3), 202–213. doi:10.1177/2332858416674007

Ferraro, G.; Failler, P. Biodiversity Conservation and the Role of Policy Resources: The Case of Saint Helena. Sustainability 2022, 14, 1250. https://doi.org/10.3390/su14031250

Food and Agriculture Organization. https://www.fao.org/faolex/results/details/en/c/LEX-FAOC198188/ (accessed on 2 August 2024)

Frank, A.S.K.; Schäffler, L. Identifying Key Knowledge Gaps to Better Protect Biodiversity and Simultaneously Secure Livelihoods in a Priority Conservation Area. Sustainability 2019, 11, 5695. https://doi.org/10.3390/su11205695

Gavin, M.C.; McCarter, J.; Berkes, F.; Mead, A.T.P.; Sterling, E.J.; Tang, R.; Turner, N.J. Effective Biodiversity Conservation Requires Dynamic, Pluralistic, Partnership-Based Approaches. Sustainability 2018, 10, 1846. https://doi.org/10.3390/su10061846

Grimm, M.; Köppel, J. Biodiversity Offset Program Design and Implementation. Sustainability 2019, 11, 6903. https://doi.org/10.3390/su11246903

Hansen, P. G., & Jespersen, A. M. (2013). Nudge and the manipulation of choice a framework for the responsible use of the nudge approach to behaviour change in public policy. European Journal of Risk Regulation, 1, 3–28.

Helen Kopnina, Scarlett Ruopiao Zhang, Sam Anthony, Abeer Hassan, Warren Maroun, The inclusion of biodiversity into Environmental, Social, and Governance (ESG) framework: A strategic integration of ecocentric extinction accounting, Journal of Environmental Management, Volume 351, 2024, 119808, ISSN 0301-4797, https://doi.org/10.1016/j.jenvman.2023.119808.

Hooper, David & Chapin III, F Stuart & Ewel, J.J. & Hector, Andy & Inchausti, Pablo & Lavorel, Sandra & Lawton, J.H. & Lodge, David & Loreau, Michel & Naeem, Shahid & Schmid, Bernhard & Setälä, Heikki & Symstad, Amy & J.J., Vandermeer & Wardle, David. (2005). Effects Of Biodiversity On Ecosystem Functioning: A Consensus Of Current Knowledge. Ecological Monographs. 75. 3-35. 10.1890/04-0922.

Hrabanski, M. The biodiversity offsets as market-based instruments in global governance: Origins, success and controversies. Ecosyst. Serv. 2015, 15, 143–151.

Institute for European Environmental Policy. https://ieep.eu/eu-biodiversity-policy-and-instruments/ (accessed on 5 August 2024)

Johansson, Maria & Henningsson, Marianne. (2011). Social-Psychological Factors in Public Support for Local Biodiversity Conservation. Society and Natural Resources. 24. 717-733. 10.1080/08941920903530925.

Kosters, M., & Van der Heijden, J. (2015). From mechanism to virtue: Evaluating Nudge theory. Evaluation, 21, 276–291. doi:10.1177/1356389015590218

Kwan, Y.H.; Cheng, T.Y.; Yoon, S.; Ho, L.Y.C.; Huang, C.W.; Chew, E.H.; Thumboo, J.; Østbye, T.; Low, L.L. A Systematic Review of Nudge Theories and Strategies Used to Influence Adult Health Behaviour and Outcome in Diabetes Management. Diabetes Metab. 2020, 46, 450–460.

Leadley, P.W.; Krug, C.B.; Alkemade, R.; Pereira, H.M.; Sumaila, U.R.; Walpole, M.; Marques, A.; Newbold, T.; Teh, L.S.L.; van Kolck, J.; et al. Progress towards the Aichi Biodiversity Targets: An Assessment of Biodiversity Trends, Policy Scenarios and Key Actions; Secretariat of the Convention on Biological Diversity: Montreal, QC, Canada, 2014; Technical Series 78; 500p. Available online: https://www.cbd.int/doc/publications/cbd-ts-78-en.pdf

Lin, Yiling & Osman, Magda & Ashcroft, Richard. (2017). Nudge: Concept, Effectiveness, and Ethics. Basic and Applied Social Psychology. 39. 1-14. 10.1080/01973533.2017.1356304.

Mols, F., Haslam, S. A., Jetten, J., & Steffens, N. K. (2015).

Parr, Catherine & Woinarski, John & Pienaar, Danie. (2009). Cornerstones of biodiversity conservation? Comparing the management effectiveness of Kruger and Kakadu National Parks, two key savanna reserves. Biodiversity and Conservation. 18. 3643-3662. 10.1007/s10531-009-9669-4.

Peterson, I.; Maron, M.; Moillanen, A.; Bekessy, S.; Gordon, A. A quantitative framework for evaluating the impact of biodiversity offset policies. Biol. Conserv. 2018, 224, 162–169.

Rode, Julian; Gómez-Baggethun, Erik; Krause, Torsten (2013): Economic incentives for biodiversity conservation: What is the evidence for motivation crowding?, UFZ Discussion Paper, No. 19/2013, Helmholtz-Zentrum für Umweltforschung (UFZ), Leipzig

Ryo Sakurai, Hiromi Kobori, Masako Nakamura, Takahiro Kikuchi, Factors influencing public participation in

conservation activities in urban areas: A case study in Yokohama, Japan, Biological Conservation, Volume 184, 2015, Pages 424-430, ISSN 0006-3207, https://doi.org/10.1016/j.biocon.2015.02.012.

Sunstein, C. R. (2014). Why nudge? The politics of libertarian paternalism. New Haven, CT: Yale University Press.

Torres-Toukoumidis, Angel & Vintimilla-Leon, Diego & De-Santis, Andrea & López-López, Paulo Carlos. (2022). Gamification in Ecology-Oriented Mobile Applications—Typologies and Purposes. Societies. 12. 1-12. 10.3390/soc12020042.

TRUONG, DINH. (2022). Community awareness and participation in biodiversity conservation at Phong Nha-Ke Bang National Park, Vietnam. Biodiversitas Journal of Biological Diversity. 23. 10.13057/biodiv/d230163.

Wendel, Steve. (2016). Behavioral Nudges and Consumer Technology. 10.1007/978-3-319-31319-1_5.

White, Thomas & Petrovan, Silviu & Booth, Hollie & Correa, Roberto & Gatt, Yasmine & Martin, Phil & Newell, Helena & Worthington, Thomas & Sutherland, William. (2022). Determining the economic costs and benefits of conservation actions: A decision support framework. Conservation Science and Practice. 4. 10.1111/csp2.12840.

White, Thomas. (2023). Understanding and improving the cost-effectiveness of biodiversity conservation. 10.17863/CAM.100259.

Why a nudge is not enough: A social identity critique of governance by stealth. European Journal of Political Research, 54(1), 195. doi:10.1111/1475-6765.12073

World Wide Fund For Nature. https://www.wwf.eu/what_we_do/biodiversity/ (accessed on 1 August 2024)

Wu, Yinglin & Xie, Ling & Huang, Shiang-Lin & Li, Ping & Yuan, Zengwei & Liu, Wenhua. (2018). Using social media to strengthen public awareness of wildlife conservation. Ocean and Coastal Management. 153. 76-83. 10.1016/j.ocecoaman.2017.12.010.

Zhirong Wang, Tongxin Wang, Xiujuan Zhang, Junbang Wang, Yongsheng Yang, Yu Sun, Xiaohua Guo, Qinghua Wu, Eugenie Nepovimova, Alan E. Watson, Kamil Kuca, Biodiversity conservation in the context of climate change: Facing challenges and management strategies, Science of The Total Environment, Volume 937, 2024, 173377, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2024.173377.

Zinngrebe, Y. Planning for Implementation: Shifting the Focus of National Biodiversity Strategies to Local Narratives, Existing Institutional Settings and Social Capital. Sustainability 2023, 15, 9774. https://doi.org/10.3390/su15129774