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Bioeconomy starts Local – a Case study on Multi-Level Participative Governance and Circular Bioeconomy Development in Romania

This paper examines the implementation of a multi-level participative governance approach to address demographic change in rural areas, with a focus on the local rural municipality of Ghelinta. The paper will present through a case study approach, strategical responds on rural-urban challenges. The project responds to the rural exodus driven by better employment opportunities and prospects in urban areas were realized, resulting in depopulation and an aging, increasingly unskilled population in rural regions. Utilizing Circular-Bioeconomy as a tool for regional development, the Godanubio project fostered sustainable economic practices by transitioning from a fossil-resource-based economy to one that emphasizes biological resources and processes. This strategy aims to enhance value creation through new collaborations, business models, and value chains, thereby increasing the attractiveness of rural areas for young people.
In Ghelinta, several working group meetings were conducted, involving young citizens in participatory governance and developing the 2021-2030 Local Bioeconomy Development Strategy. The key objectives of this strategy include fostering cooperation among local stakeholders, involving young people in the decision-making process within the local council, creating new business ideas in the bioeconomy sector, improving public services for young people, and providing training on bioeconomy topics.
The overarching aims are to mitigate the gap between rural and urban areas, increase the visibility and attractiveness of rural areas through the development of the bioeconomy sector, and improve the overall well-being in rural regions. The long-term goal is to enhance the socio-economic status of these regions, contribute to environmental, climate, carbon sequestration and resource protection, and foster sustainable development (Sebestyen, 2024). This research highlights the importance of an ecosystem for systematic multi-level governance, engaging actors from the public, academia, industry, and political decision-making. By creating space for co-creation and integrated urban-rural cooperation, the project aims to increase institutional capacity to tackle demographic change and promote the active involvement of societal actors in the political system.
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JEL Codes: Q57, Q42, P25

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1.Introduction

The Danube regions and cities are currently undergoing significant societal transitions driven primarily by demographic changes. A predominant challenge is the (Grignoli et al., 2024) . This migration trend results in the depopulation of rural areas, leaving behind an aging population (Vaishar et al., 2020) with a dwindling workforce and a decreasing pool of skilled individuals (Anon., 2023). Consequently, these regions face the dual burden of sustaining an elderly demographic while grappling with a reduced economic base and diminished human capital (Giannakis, Bruggeman, 2019).
The demographic shift towards urban areas exacerbates several socio-economic issues in rural regions. The outflow of young, skilled labor leads to a critical imbalance, causing rural areas to

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suffer from a lack of innovation (Yin et al., 2022), entrepreneurship (Cunha et al., 2020), and economic dynamism (Havadi , 2016). This situation not only hampers local economic development but also increases the dependency on urban centers for essential services and economic support (Cattaneo et al., 2022). The resultant demographic profile, characterized by an aging and increasingly unskilled population, poses significant challenges for the sustainability and vitality of these rural communities (Castro-Arce, 2020).

Addressing these challenges necessitates a comprehensive, multi-level participative governance approach (Chatzichristos , 2023). Such an approach involves the active engagement of various stakeholders, including local communities, governmental bodies, academic institutions, and the private sector. By fostering collaboration across different levels of governance, it is possible to leverage existing competencies and development potentials effectively (Miller et al., 2023). This participative model ensures that the unique needs and perspectives of rural populations are incorporated into policy-making processes, thereby enhancing the relevance and impact of development strategies (Mantino et al., 2021).

In conjunction with participative governance, there is a pressing need to build new institutional capacities that can drive sustainable development in these regions (Diemer et al., 2022). Developing institutions capable of addressing the multifaceted challenges of demographic change involves enhancing administrative competencies, fostering innovation, and creating frameworks that support economic diversification (Adamowicz, 2021). These institutions must be equipped to implement and manage development projects that not only mitigate the adverse effects of rural depopulation but also create new opportunities for growth and revitalization (Mack et al. , 2020).

A critical component of this process is the co-creation of future strategies aimed at increasing the attractiveness of rural areas. By involving local populations, particularly the youth, in the decision-making process, it is possible to generate innovative solutions tailored to the specific contexts of these regions (Kostiukevych et al., 2020). This inclusive approach can help identify and nurture new business ideas, particularly in emerging sectors such as the circular bioeconomy, which focuses on sustainable production and the utilization of biological resources (Brandao , 2022).

The circular bioeconomy offers a promising avenue for fostering regional development by transitioning from a fossil-resource-based economy to one that emphasizes sustainability and resource efficiency (Kardung et al., 2021). By capitalizing on the circular bioeconomy's potential, rural regions can develop new value chains and business models that enhance local economic resilience and create attractive employment opportunities for the youth (Stojanova et al., 2022). This sector not only promotes environmental sustainability but also catalyzes interdisciplinary cooperation and cross-sectoral innovation, further strengthening the socio-economic fabric of rural communities (Navarro-Valverde, 2022).

In summary, the Danube regions are at a crossroads, facing profound demographic and socio-economic challenges. However, by adopting a multi-level participative governance approach and building robust institutional capacities, these regions can harness their existing strengths and co-create sustainable development strategies. The focus on the circular bioeconomy provides a viable pathway to revitalizing rural areas (Ciervo et al., 2024), fostering economic growth, and ensuring long-term resilience against demographic shifts. Through collaborative efforts and innovative thinking, the Danube regions can navigate these transitions and emerge as dynamic, thriving communities (Cattaneo et al., 2022).

The EU Strategy for the Danube Region (EUSDR), adopted by the European Union in 2011, aims to harness the economic potential of the Danube region, improve environmental conditions, and enhance the overall prosperity and quality of life for its population (Ionescu et al., 2023). Central to achieving these goals is the transition from a fossil-based to a bioeconomy, a major focus of the circular bioeconomy (Ronzon et al., 2022). This transition is particularly pertinent within the framework of the Danube Transnational Programme (DTP) 2021-2027, which emphasizes sustainable economic development, environmental stewardship, and climate resilience (Koev et al., 2023). The DTP supports smart regional and urban solutions, alongside advanced technologies related to the circular bioeconomy (Lichtner, 2023).

This paper seeks to explore how the EUSDR can better align with regional strategies, particularly focusing on the circular bioeconomy. Despite the ambitious macro-regional plans for sustainability and circular economy, there remains a significant gap between these plans and their implementation at the regional level. While regions like Baden-Württemberg and Bavaria have developed comprehensive circular bioeconomy strategies, many other regions within the Danube area lack such frameworks (Giurca et al., 2022). This disconnect hampers cross-regional cooperation and critical mass bundling, essential for the success of macro-regional strategies.
In this context, the municipality of Ghelinta serves as a case study for implementing a multi-level participative governance approach. The Godanubio project in Ghelinta involved working group meetings with young citizens, leading to the development of the 2021-2030 Local Bioeconomy Development Strategy. This strategy focuses on fostering local stakeholder cooperation (Havadi et al., 2015), involving youth in decision-making, creating new bioeconomy business ideas, improving public services, and providing bioeconomy training. Moreover, during the implementation of Godanubio project several circular bioeconomy related business ideas were created through participative interaction by involvement of business incubator house, experts from different clusters as well as policy makers and local decision maker bodies. In second stage these business ideas were put into implementation by establishment and mentoring of up to 26 startups creating over 22 new jobs on local level. The overarching aims of this initiative are to mitigate urban-rural economic disparities, enhance the visibility and attractiveness of rural areas through bioeconomy development, and improve overall well-being. By creating an ecosystem for multi-level governance and fostering integrated urban-rural cooperation, this project seeks to increase institutional capacity to address demographic changes and promote active societal engagement in the political process

2.Data and Methodology

This study employs a mixed-methods approach combining qualitative and quantitative data collection and analysis to comprehensively evaluate the implementation and impact of the multi-level participative governance approach and circular bioeconomy strategies in the Danube regions, specifically focusing on the region in which municipality of Ghelinta is also located.
The municipality of Ghelinta was selected as the focal case study due to its active involvement in the Godanubio project and the development of the 2021-2030 Local Bioeconomy Development Strategy. This selection allows for an in-depth analysis of the participative governance approach and its effectiveness in fostering local stakeholder cooperation, youth involvement in decision-making, and the creation of new bioeconomy business ideas.
The document analysis covered the assessment of relevant policy documents, reports, and strategic plans from the EU Strategy for the Danube Region (EUSDR), the Danube Transnational Programme (DTP) 2021-2027, as well as National and Regional Development Strategy. Review of project documentation from the Godanubio project, including meeting minutes, action plans, and progress reports.
In the second step was distributed a structured questionnaire to local stakeholders, including young citizens, local government officials, businesses, regional cluster experts, policy makers as well as to the general public.
The sample size of the survey was realized based on the following random sampling approach:

- Population size represents the total number of people in the researched municipality was 5000 inhabitants
- Confidence level was 96 %, which means measures how sure can be that the population choose an answer within a certain range.
- Margin of error which is a percentage that shows how accurately survey results reflect the opinions of the whole population was 7 %
- Sample size was 208, as it was crucial to reflect the overall population accurately.

The survey aimed to gather data on perceptions of governance effectiveness, stakeholder engagement, and the impact of bioeconomy initiatives.
In the third step semi-structured interviews were conducted with key informants, including project coordinators, local decision-makers, business owners of the newly established startups, and representatives from regional cluster experts, academic institutions and private sectors. These interviews provided qualitative insights into the challenges and successes of the participative governance approach and bioeconomy strategies.
In forth step field observation was realized in Ghelinta municipality to observe the implementation of bioeconomy-related business ideas, public service improvements, and training programs. Field observations helped to verify the data collected from other methods and provide a contextual understanding of the local environment.
Last but not least a quantitative assessment of local economic environment, especially the newly established startups was done, highlighting the changes in local employment, economic turnover, investment return, market demand and bioeconomy market outlook, profitability, etc.
The triangulation, namely the use of multiple data sources and methods (documents, surveys, interviews, focus groups, observations) ensured the validity and reliability of the findings. By employing this comprehensive methodology, the study aims to provide a detailed evaluation of the participative governance approach and circular bioeconomy strategies in the Danube regions, offering insights and recommendations for policy makers, practitioners, and researchers.

3.Results and Discussion

3.1. Topdown Bioeconomy Development Strategies from National to Local

Romania's strategic directives for bioeconomy development align closely with the European Union's broader goals of sustainability, innovation, and economic resilience (Fritsche et al., 2020). The Romanian Bioeconomy Strategy emphasizes the transition from a fossil-based economy to a bioeconomy, promoting sustainable agricultural practices (Cristea, 2020), forestry, and the utilization of biological resources for energy (Sebestyen, 2019), materials, and food production (Bara, 2023). The key objectives include:

- Sustainable Agriculture and Forestry: Enhancing the sustainability of agricultural and forestry practices through the use of advanced technologies and sustainable resource management.
- Bio-based Industries: Promoting the development of bio-based industries that utilize renewable biological resources to produce materials, chemicals, and energy.
- Research and Innovation: Investing in research and innovation to develop new bio-based products and processes, fostering collaboration between academia, industry, and government.
- Circular Economy Principles: Integrating circular economy principles to reduce waste, enhance resource efficiency, and promote recycling and reuse of biological materials.
- Rural Development: Leveraging bioeconomy initiatives to drive rural development, create jobs, and improve the quality of life in rural areas (Dumitru et al, 2021), (Voicilas, 2023).

The Central Development Region of Romania has tailored its bioeconomy strategy to address specific regional challenges and opportunities.
This region's strategy focuses mostly on:

- Regional Innovation Hubs: Establishing innovation hubs to foster research and development in bio-based sectors, encouraging collaboration between local universities, research institutes, and businesses.
- Sustainable Resource Management: Implementing sustainable management practices for regional natural resources, including forests and agricultural land, to ensure long-term productivity and environmental protection.
- Bio-based Enterprises: Supporting the creation and growth of bio-based enterprises, particularly small and medium-sized enterprises (SMEs), through funding, training, and business development services.

- Local Stakeholder Engagement: Engaging local stakeholders, including community groups, farmers, and entrepreneurs, in the development and implementation of bioeconomy projects to ensure their relevance and sustainability.
- Education and Training: Providing education and training programs to develop the skills needed for the bioeconomy, targeting both the current workforce and future generations (Sakellaris, 2021).

The Godanubio project was funded by Interreg Danube Transnational Programme, implemented by the involvement of the Municipality of Ghelinta, serves as a practical example of implementing bioeconomy strategies through a multi-level participative governance approach. The project discovered the and provide insights into the effectiveness of the participative governance model and the impact of bioeconomy initiatives on local development.

On the working group meetings during this project implementation were involved the local stakeholders, including young citizens, local government officials, and business representatives. These actions highlight the collaborative decision-making process and the contributions of various participants.

In Ghelinta was elaborated a long-term bioeconomy development strategy, in which comprehensive action plans detailing the steps needed to achieve the goals, including timelines, responsible parties, and resource requirements.

The periodic diagnoses made to monitor, identify challenges and making necessary adjustments to the strategy by involvement of regional and national policy makers.

In conclusion, the integration of bioeconomy strategies in Romania, particularly in the Central Development Region, is driven by a commitment to sustainability, innovation, and regional development. The Godanubio project exemplifies how participative governance and collaborative efforts can successfully translate strategic directives into tangible local benefits, fostering economic resilience and environmental sustainability.

3.2. Surveying Stakeholder Perceptions: Evaluating Governance, Engagement, and Bioeconomy Impact

In the second step, a structured questionnaire was distributed to local stakeholders, including young citizens, local government officials, businesses, regional cluster experts, policymakers as well as to the general public. The survey aimed to gather data on perceptions of governance effectiveness, stakeholder engagement, and the impact of bioeconomy initiatives. This comprehensive approach facilitated the collection of diverse perspectives, providing valuable insights into the strengths and areas for improvement in the implementation of bioeconomy strategies within the region.

According to the results, 37% or 77 out of 208 respondents have no knowledge on bioeconomy and related issues, while 35% or 73 out of 208 respondents have limited knowledge. Only 18% of the respondents (37 respondents) have some general knowledge and 7% have detailed knowledge or 3% have consolidated technical and professional knowledge on bioeconomy topics (Figure 1).

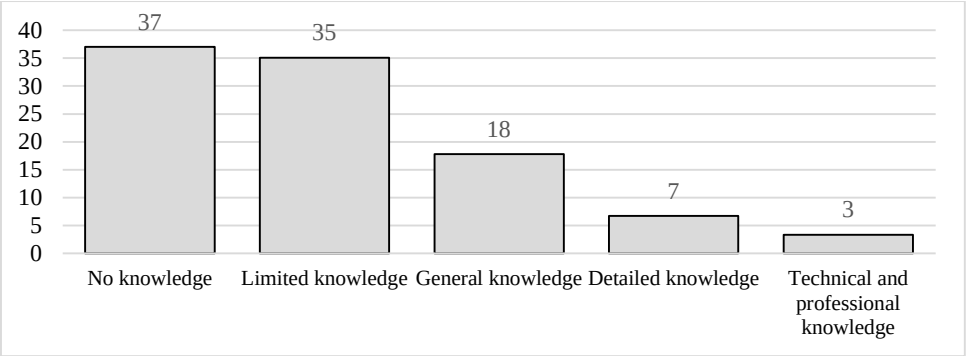

Figure 2 Knowledge levels related to bioeconomy concept
Source: Own compilation

The 2 Figure illustrates the results of a survey question regarding the participation of public institutions in informing stakeholders about the bioeconomy. The local inhabitants responded as follows:
Definitely no support from central or decentralized institutions (1): The highest number of respondents, totaling 101 – 49% of the respondents, indicated that central or local public institutions definitely do not participate in informing stakeholders about the bioeconomy. No support: 49 respondents (24%) reported that there is no support from public institutions in this regard. Neutral: 34 respondents (16%) were neutral, suggesting an ambivalence or lack of clear opinion on the matter. Some support: 18 respondents (9%) acknowledged that there is some support from central or local public institutions. Serious support: The least number of respondents, totaling 6 (3%), indicated that public institutions definitely participate in informing stakeholders about the bioeconomy.
The data indicates a significant lack of perceived participation by public institutions in educating stakeholders about the bioeconomy, with the majority of respondents selecting the lowest levels of support.

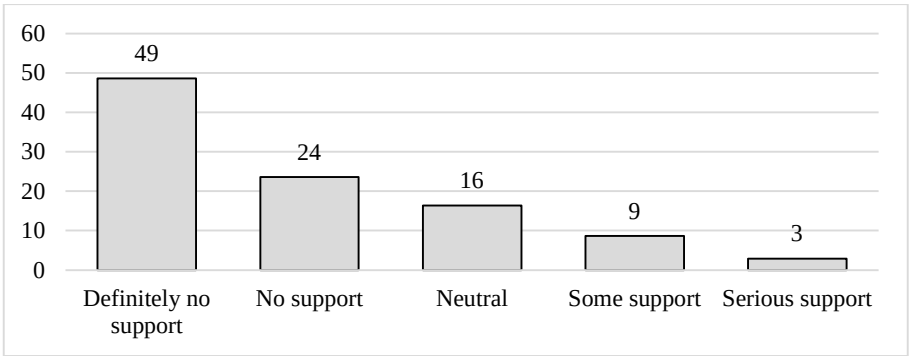

Figure 3 Support from public institutions in development of bioeconomy sector
Source: Own compilation

The Figure 3 represents the expectations of respondents regarding the development of the bioeconomy while the results are categorized into five distinct areas. Only 12% of the respondents (25 out of 208 respondents) expressed concerns that the bioeconomy might slow down the local economic progress. In the same time, 24% of the respondents (50 out of 208) think that the bioeconomy development could ensure sustainable development in rural areas. Even though the environmental assets in rural and mountain region is significant, the benefits on environmental protection is considered only by 9% of the respondents (19 out of 208), expecting that the

bioeconomy will provide environmental benefits. As new opportunity to local youth, 42% of the respondents (87 out of 208) believe that the bioeconomy will create new opportunities for local youth and it will slow down or stop the emigration from rural areas. The equilibration in society was selected by 13% respondents (27 out of 208) foresee that the bioeconomy will help achieve equilibration in society.

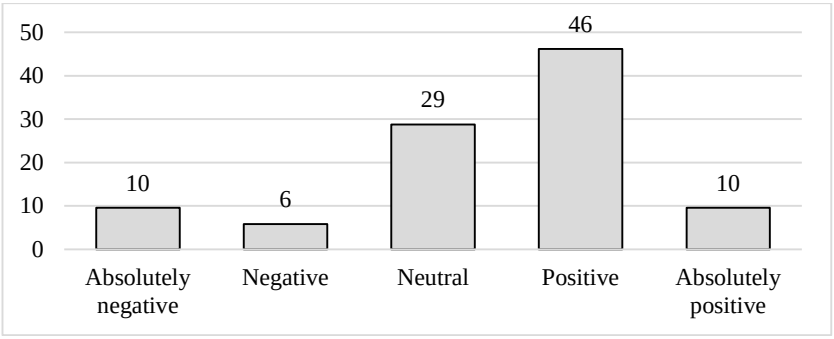

Figure 4 Expectations regarding the development of the bioeconomy
Source: Own compilation

The general public was also asked about their thoughts on bioeconomy development in their settlement. According to the results, 46% (96 out of 208) respondents think that it will positively influencing the local environmental, societal and economy dimensions, while 10% (20 our ot 208) respondents are convinced that absolutely positive impacts will realized. Since the knowledge on bioeconomy is lacking or very limited, a significant number of respondents, 29% (60 out of 208) are neutral regarding to this domain, while 6% (12 out of 208) respondents think this will bring negative impacts and 10% (20 out of 208) think that this developments and investments will bring absolutely negative impacts (Figure 4).

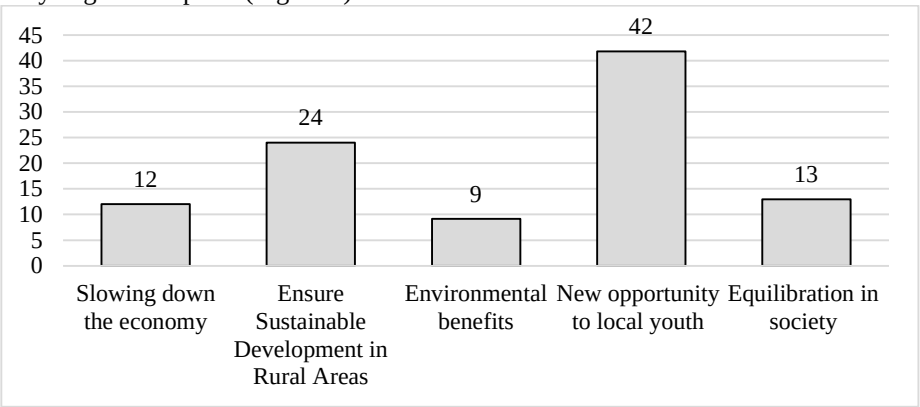

Figure 5 Opinion on environmental, societal and economic impact of bioeconomy developments on local level
Source: Own compilation

The survey results indicate a robust engagement in bioeconomy practices within Ghelinta rural municipality. Most areas show a high prevalence of good practices and consolidated habits, particularly in energy efficiency, valorization of renewable energies, and waste management (Sebestyén et al., 2019). These findings suggest that the bioeconomy development project has been effective in promoting sustainable practices within the community. Future efforts can focus on further enhancing the initiatives where the responses indicate lower engagement, such as the switch from fossil fuels to organic materials. Figure 5 represents the results from the questionnaire

survey, assessing the prevalence and maturity of various bioeconomy practices within the community. The data is categorized into seven key areas: upcycling old products, energy efficiency, raw material and energy savings, switch from fossil fuels to organic materials, valorization of renewable energies, recycling municipal waste, and collecting municipal waste. Each area is evaluated based on a five-point scale, ranging from "1. Not typical at all" to "5. Consolidated habit".

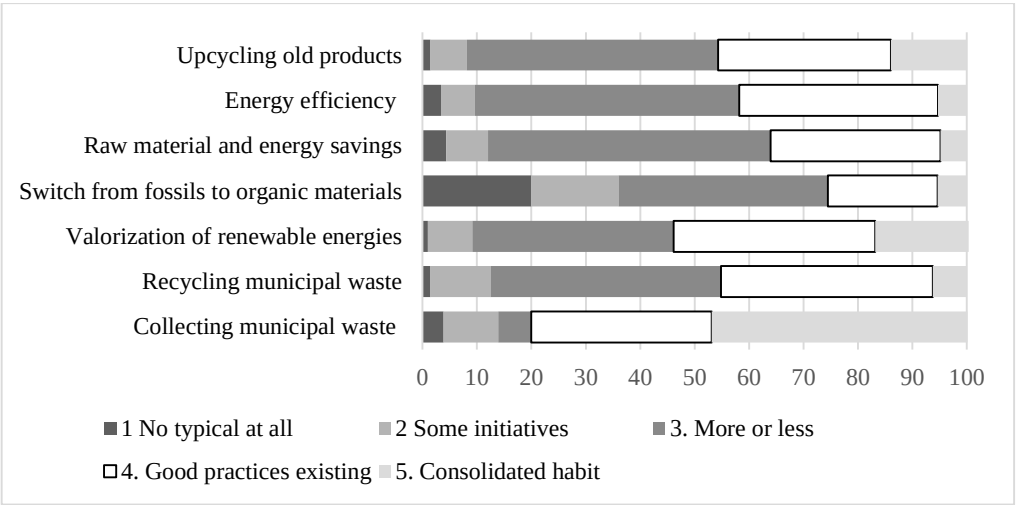

Figure 6 Analysis of Bioeconomy Practices in Ghelinta Rural Municipality
Source: Own compilation

The involvement rate in decision making process was also analyzed across different educational degrees among respondents in Ghelinta rural municipality. In Figure 6, the y-axis represents the level of involvement in decision-making on a scale from 1 to 5, with higher values indicating greater involvement. The x-axis categorizes the respondents based on their highest level of education degree. The key observations are the followings: all respondents who have post-university degree are involved in local decision-making process, the interquartile range (IQR) is 4. very narrow, indicating high consistency among respondents, while there are no outliers, suggesting most respondents in this category are highly involved in decision-making processes. Regarding to respondents with university degree, the median involvement score is approximately 3, with wide IQR, indicating substantial variability among respondents, while several outliers appeared, suggesting diverse levels of involvement in decision-making. Those with higher education show a wider distribution of involvement scores with a median of approximately 3. The substantial interquartile range and presence of outliers suggest that higher education does not uniformly translate to higher involvement in decision-making; rather, it varies significantly among individuals. In case of respondents with high school involvement the median is 2, the IQR is moderate, indicating a wider range of involvement levels among respondents, with the presence of several outliers at both low and high ends, suggesting varied experiences in decision-making involvement. Even if the vast majority of respondents have elementary school degree in Ghelinta, the median involvement is up to 2, with similar IQR to the High School category, indicating a moderate range of responses, with a few outliers. Respondents with only high school or elementary school education tend to have lower median involvement scores, around 2, with moderate interquartile ranges. This suggests that individuals with lower levels of formal education are less involved in decision-making processes.

The involvement in decision-making processes appears to be strongly influenced by the level of academic achievement. The findings suggest that individuals with higher education, particularly those involved in research and development, are more engaged in decision-making within the bioeconomy project. This could imply that education and specialized knowledge play critical roles

in facilitating active participation in community-driven projects. Conversely, the lower involvement scores among those with elementary and high school education highlight the need for targeted interventions to increase engagement and inclusivity among less formally educated community members.
Overall, these insights can inform strategies to enhance participatory decision-making by fostering educational opportunities and inclusive practices within the bioeconomy development framework in Ghelinta rural municipality (Maier et al., 2019).

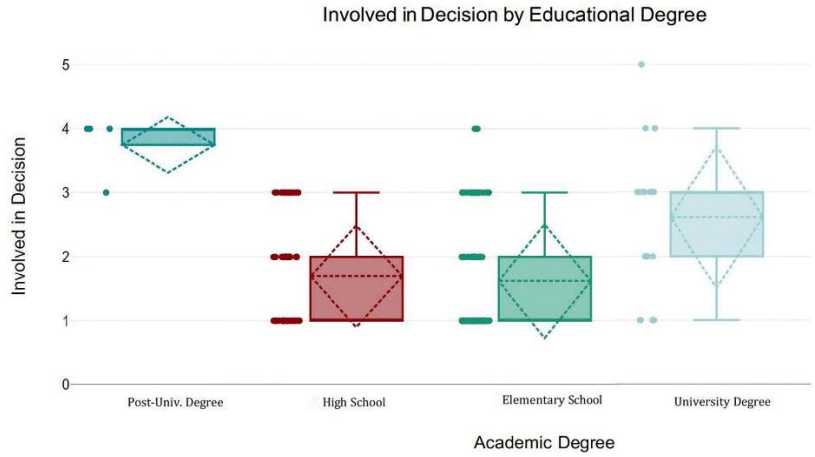

Figure 7 Involvement rate in decision making process across different educational degrees in Ghelinta
Source: Own compilation

The Figure 7 presents the distribution of responses from a questionnaire survey, aiming to identify the types of support needed for the development of the bioeconomy. The responses are categorized into five types of support: dissemination, financial support, technical support, mentoring in entrepreneurship, and involvement in Local Action Groups (LAGs). The largest segment, 38% (79 out of 208 respondents), indicates a strong need for dissemination activities. This suggests that the community places high importance on the spread of information, knowledge sharing, and communication strategies to enhance understanding and engagement in bioeconomy initiatives. Financial support is a close second, with 30% (62 out of 208 respondents) indicating its necessity. This highlights the critical role of funding and financial resources in enabling the community to develop and sustain bio-based projects, suggesting that economic constraints are a significant barrier to progress especially in a rural region.
Technical support is the third most requested type of assistance, with 25% (53 out of 208 respondents) highlighting its importance. This reflects a significant demand for expertise and technological resources to aid in the implementation and maintenance of bioeconomy activities.
The mentoring in entrepreneurship is noted by 5% of respondents. Since such approaches are not common in rural areas, this is a smaller segment, but it underscores the need for guidance and mentorship to foster entrepreneurial skills and business acumen within the bioeconomy sector. The smallest segment, 2%, represents the need for involvement in Local Action Groups. This may indicate that while some respondents see value in collective community actions and local governance, it is not as pressing as the other types of support.
The survey results provide a clear indication of the community's priorities in terms of support needed for developing the bioeconomy in Ghelinta rural municipality. Dissemination of information, technical and financial support are the foremost needs, underscoring the importance of education, resources, and funding in fostering sustainable bioeconomic growth. Addressing

these areas through targeted interventions could significantly enhance the efficacy and impact of the bioeconomy development project in the region.

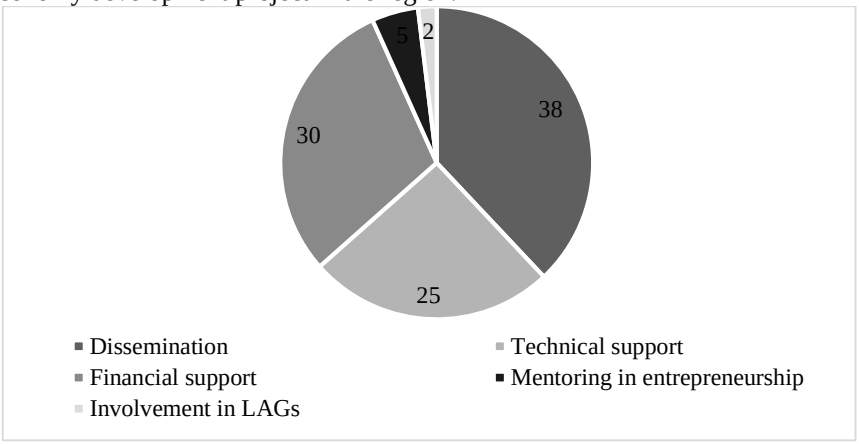

Figure 8 Analysis of Support Needs for Bioeconomy Development in Ghelinta Rural Municipality
Source: Own compilation

3.3. Qualitative Insights from Key Informants on Bioeconomy Development in Ghelinta

One of the primary challenges identified through the interviews was the complexity of integrating various stakeholders into the decision-making process. Project coordinators and local decision-makers highlighted the difficulty in aligning the interests and priorities of diverse groups, ranging from small business owners to academic researchers. This complexity often led to prolonged discussions and delays in decision-making, which, although beneficial for ensuring inclusivity, sometimes hindered the swift implementation of bioeconomy projects.

Additionally, business owners pointed out the challenge of maintaining consistent engagement from all participants. While initial enthusiasm was high, sustaining this involvement over the long term proved difficult. Factors contributing to this decline included limited time availability among busy entrepreneurs and a perceived lack of immediate benefits from participating in lengthy governance processes. These issues were further compounded by the varying levels of knowledge and understanding of bioeconomy concepts among stakeholders, necessitating ongoing education and communication efforts by local public institutions and promoters.

Despite these challenges, several successes were noted, as new council members were involved in local council from young generation. The participative governance approach fostered a sense of ownership and community among stakeholders. Local decision-makers emphasized that involving a broad spectrum of participants led to more comprehensive and robust decision-making, as it incorporated diverse perspectives and expertise. This inclusivity was particularly beneficial in addressing complex issues related to sustainability and bioeconomic development, ensuring that solutions were well-rounded and widely accepted.

Business owners of newly established startups reported that the collaborative environment facilitated by the project provided valuable networking opportunities. These interactions not only enhanced their business operations but also sparked innovative ideas and collaborations that might not have occurred otherwise. Furthermore, the support from academic institutions and regional cluster experts proved invaluable in providing technical knowledge and validating the feasibility of various bioeconomy initiatives.

A recurring theme in the interviews was the critical role of education and dissemination in the success of the bioeconomy project. Representatives from academic institutions underscored the importance of continuous education to bridge the knowledge gap among stakeholders. This

involved not only formal training sessions but also informal knowledge-sharing practices, such as workshops and community meetings. Effective dissemination of information was seen as essential for ensuring that all participants were well-informed and could contribute meaningfully to discussions and decision-making processes.

Project coordinators also highlighted the need for targeted communication strategies to maintain stakeholder engagement. Tailoring messages to address the specific concerns and interests of different groups helped sustain their involvement. For instance, providing tangible examples of how bioeconomy practices could benefit local businesses directly addressed the practical concerns of entrepreneurs, thereby increasing their commitment to the project.

Interviews revealed that financial and technical support were pivotal in overcoming some of the barriers faced by stakeholders. Financial support, whether in the form of grants or subsidies, was crucial for enabling startups to invest in necessary infrastructure and technologies. Business owners noted that without such support, many bioeconomy initiatives would have been financially unfeasible.

Similarly, technical support provided by regional cluster experts and academic institutions played a critical role. This support included offering expertise on advanced technologies and sustainable practices, which were essential for the successful implementation of bioeconomic projects. Entrepreneurs particularly valued hands-on technical assistance, which helped them navigate the complexities of adopting new technologies and integrating them into their business models.

3.4. QUANTITATIVE ASSESSMENT OF LOCAL ECONOMIC ENVIRONMENT

Ghelinta, a rural municipality in Covasna County, hosts 293 registered economic agents, including companies, individual entrepreneurs, and authorized persons engaged in economic activities. The local total turnover at economic agencies reached 22.7 M EUR in 2023, with a total number of 444 employees, with a net realized profit of 1 M EUR. An economic assessment based on available data highlights the distribution and economic impact of businesses, with a particular focus on bioeconomy-related enterprises (Table 1). The economic landscape of Ghelinta is diverse, with notable contributions from various sectors. Key sectors include food industry, manufacturing of timber products, forestry, and retails, and services. The data reveals the presence of businesses involved in activities such as furniture manufacturing, metal recycling, and forestry exploitation.

Table 1 Total 1 The main 10 economic domains in Ghelinta

No.	Economic domain	Turnover (M EUR)	No. Employees	Net Profit (Thousand EUR)
1	Forest exploitation	6.55	118	31
2	Retail sales of hardware, paints and glass	4.26	26	291
3	Retail with food and beveries’	3.25	52	32
4	Manufacture of timber	2.93	73	76
5	Manufacture of bread, fresh pastry goods and cakes	2.10	63	163
6	Wholesale on a fee or contract basis of wood and construction materials	0.89	26	23
7	Transport and logistics	0.46	7	45
8	Dismantling of all types of wreckage	0.34	14	30
9	Retail sale of medicines	0.30	8	34
10	Forest Management	0.15	15	20
Total		21.23	402	745

Source: topfirme.ro

The quantitative assessment of the local startup ecosistem in Ghelinta rural municipality provides detailed insights into the development and performance of various economic domains from 2020 to 2023 (Table 2). This analysis is critical for understanding the impact of bioeconomy

development projects in the rural region. The quantitative assessment of the local economy in Ghelinta highlights a diverse range of economic activities with significant potential for bioeconomy development. Key sectors such as construction, manufacturing of textiles out of wool, timber manufacturing, food industry and biomass production play a pivotal role in the region's economic landscape. The data indicates robust entrepreneurial activity, particularly in consultancy and IT services, which are essential for modernizing and supporting other economic domains. The strategic focus on integrating bioeconomy practices within these sectors can drive long-term economic growth, create employment opportunities, and promote environmental sustainability.

Table 2 The main startups between 2020-2023 established in Ghelinta

No.	Economic domain	No. Established startups between 2020-2023	No. Employees	Turnover in 2023 (Thousand EUR)
1	Consultancy in Business Development	2	2	56
2	Consultancy in IT and Communication Technology	5	2	21
3	Holiday and other temporary accommodation services.	5	2	16
4	Construction of residential and non-residential buildings.	5	3	89
5	Manufacture of timber	4	3	16
6	Biomass production	1	2	30
7	Manufacture of fruit and vegetable juice	1	2	23
8	Manufacture of made-up textile articles (except apparel)	1	2	13
9	Manufacture of other furniture	1	2	30
10	Manufacture of other products of wood, cork, plaiting materials	1	2	26
Total		26	22	320

Source: topfirme.ro

Ghelinta's economic landscape is characterized by a mix of traditional and emerging sectors, with a growing focus on the bioeconomy. Sustainable practices in forestry, recycling, and manufacturing are pivotal for the region's economic development. Addressing financial and operational challenges while leveraging opportunities for innovation can significantly enhance Ghelinta's bioeconomy, contributing to sustainable rural development.

4. Conclusions and Recommendations

4.1. CONCLUSIONS

The strategic directives for bioeconomy development in Romania are well-aligned with the European Union's broader objectives, emphasizing sustainability, innovation, and economic resilience. This alignment ensures that policies and initiatives in Romania can leverage EU support effectively, maximizing both funding and developmental impact. The Romanian Bioeconomy Strategy underscores the transition from a fossil-based economy to a bioeconomy, promoting sustainable practices in agriculture and forestry, and utilizing biological resources for energy, materials, and food production. These efforts are essential for enhancing productivity while ensuring environmental protection. However, the realization of these strategies starts on local level.

There is a notable emphasis on promoting bio-based industries that utilize renewable biological resources. This shift is critical for long-term sustainability and is supported by significant investments in research and innovation. Collaboration between academia, local industry, and the

central to local government is fostering the development of new bio-based products and processes, which is crucial for driving innovation and economic growth. Furthermore, the focus on rural development through bioeconomy initiatives is creating jobs and improving the quality of life in aging and emptying out rural areas, addressing regional disparities and ensuring inclusive economic growth.

The participative governance model, exemplified by the Godanubio project, has proven effective in engaging local stakeholders. This model ensures that a broad spectrum of participants, including young citizens, local government officials, and business representatives, are involved in decision-making processes. However, there is a significant need for increased education and dissemination of information regarding bioeconomy concepts. The survey results indicate a lack of knowledge among many stakeholders, which hampers effective engagement and participation.

Governance and stakeholder engagement face several challenges, including the complexity of integrating diverse interests and maintaining consistent involvement. Addressing these challenges requires continuous education and targeted communication strategies to keep stakeholders informed and engaged on local level. Financial and technical support is also crucial for enabling startups to invest in necessary infrastructure and technologies, which are essential for the successful implementation of bioeconomy projects.

4.2 Recommendations for Developing the Local Bioeconomy Sector

To further develop the local bioeconomy sector in Ghelinta and similar rural municipalities in Central and South-Eastern Europe, several strategic recommendations can be made. First, there should be a concerted effort to enhance educational and dissemination activities related to the bioeconomy. This can involve formal training sessions, workshops, and community meetings to bridge the knowledge gap among R&D people and local stakeholders. By increasing awareness and understanding, through applied innovation the stakeholders can contribute more effectively to bioeconomy initiatives.

Financial support is paramount for the success of bioeconomy projects. Providing grants, subsidies, and other forms of financial assistance can enable startups and existing businesses to invest in the necessary infrastructure and technologies. This financial backing is essential for making bioeconomy initiatives economically viable, particularly in rural areas where financial constraints can be significant barriers to progress.

Technical support is equally important. Regional cluster experts and academic institutions can offer valuable expertise on advanced technologies and sustainable practices. Hands-on technical assistance can help businesses navigate the complexities of adopting new technologies and integrating them into their operations. This support is critical for ensuring that bioeconomy projects are implemented successfully and sustainably.

To foster greater stakeholder engagement, targeted communication strategies should be employed. Tailoring messages to address the specific concerns and interests of different stakeholder groups can help maintain their involvement. For example, providing tangible examples of how bioeconomy practices can benefit local businesses directly addresses the practical concerns of entrepreneurs, thereby increasing their commitment to the project.

The creation of regional innovation hubs can also play a significant role in supporting bioeconomy development. These hubs can foster research and development in bio-based sectors, encouraging collaboration between local universities, research institutes, and businesses. By providing a platform for innovation and collaboration, these hubs can drive the development of new bio-based products and processes, further enhancing the region's bioeconomy.

Additionally, integrating circular economy principles into bioeconomy strategies can enhance resource efficiency and sustainability. This involves reducing waste, promoting recycling and reuse of biological or other materials, and implementing sustainable management practices for natural resources. By adopting these principles, the bioeconomy sector can contribute to environmental protection while driving economic growth.

Engaging local stakeholders, including community groups, farmers, and entrepreneurs, is crucial for the success of bioeconomy projects. Ensuring that these stakeholders are involved in the development and implementation of bioeconomy initiatives can enhance their relevance and sustainability. This participative approach fosters a sense of ownership and community among stakeholders, leading to more robust and widely accepted solutions.

In conclusion, the development of the local bioeconomy sector in Ghelinta and similar rural municipalities in Central and South-Eastern Europe requires a multifaceted approach that includes enhancing education and dissemination activities, providing financial and technical support, fostering stakeholder engagement, and integrating circular economy principles. By addressing these areas through targeted interventions, the bioeconomy development project can significantly enhance its efficacy and impact, driving sustainable economic growth and improving the quality of life in rural regions.

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