



LATVIA'S SMART SPECIALISATION STRATEGY (RIS3)
SPECIALISATION AREA

Knowledge-intensive bioeconomy

RESEARCH ECOSYSTEM REPORT
(2014–2018)

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THE NATIONAL
DEVELOPMENT
PLAN 2014-2020



EUROPEAN UNION
European Regional
Development Fund

Abbreviations

HEI – Higher Education Institutions

AREI – DPP Institute of Agricultural Resources and Economics

BIOR – Institute of Food Safety, Animal Health and Environment “BIOR”

BSC – Baltic Studies Centre foundation

IH – LLU Institute of Horticulture

DU – Daugavpils University

ME – Ministry of Economics

MES – Ministry of Education and Science

PPRI – LLU Plant Protection Research Institute “Agrihorts” (formerly LLU SIA “Latvian Plant Protection Research Centre)

LIAE (DU LIAE) – DU Latvian Institute of Aquatic Ecology

LiepU – University of Liepāja

LLU – Latvia University of Life Sciences and Technologies

UL – University of Latvia

LSIWC – Latvian State Institute of Wood Chemistry

R&D – Research and Development

R&I – Research and Innovation

RIS3 – Latvian Smart Specialisation Strategy

RSU – Rīga Stradiņš University

RTU – Riga Technical University

RTU IESE – Riga Technical University, Institute of Energy Systems and Environment

SILAVA – Latvian State Forest Research Institute “Silava”

VUC – Ventspils University College

ViA – Vidzeme University of Applied Sciences

STDI guidelines – Guidelines for Science, Technology Development and Innovations for 2014–2020

RI – Research Institutions

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Summary

The global demand for research and innovation in the field of bioeconomy is driven by global challenges, such as climate change, food and energy security. To tackle these challenges circular economy and sustainable principles must be taken into account to not entail the excessive use of organic resources when replacing fossil-based materials with bio-based ones.¹ The activities intended to promote the growth of a sustainable bioeconomy using research, innovations and the potential for knowledge transfer increasing industrial competitiveness and growth are particularly important for Latvia. Bioeconomy is a field with a significant impact on regional development. Knowledge-intensive bioeconomy involves not only the research and development of new products and services, but also boosting existing quality and production efficiency, as well as a more widespread use of non-technological innovations for creating high added-value products and services. *Latvian Research and Innovation Strategy for Smart Specialisation (hereinafter referred to as RIS3)* is a national-level research and innovation strategy for transforming the economy towards higher value added goods and services. The RIS3 objectives in Latvia are pursued within the framework of the science and innovation policy. The provision of EU funds contributed towards successful growth competence in research and innovation of bioeconomy in Latvia during the 2014–2018 reviewed in this report. More specifically, the country's research institutions are developing research projects in bioeconomy related to sustainable farming, horticulture, innovative food production and food

safety, livestock and animal health, sustainable forestry, biotechnologies and new products from wood and plant biomass and by-products of their processing, as well as topics in circular economy, rural renaissance, (social innovations, public goods, governance etc.). Specialisation niches that include the development of innovative products and technological solutions and sustainable forestry and wood supply are successful in raising private funding for R&I in the knowledge-intensive bioeconomy.

Between 2014 and 24 July 2019, Latvia gained 7.9 million euros funding for projects in EU research and innovation support programme Horizon 2020 area "Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy", which is 10.4% of all of the funding gained to the Latvian Horizon 2020 projects. The share of funding gained by Latvia in this area is high, accounting for 0.32% of the entire funding provided by the EC. More than half of the funding obtained was for research and innovation projects. Latvia has been a successful participant of the Bio-Based Industries Joint Undertaking (BBI JU), which is a public-private partnership between the European Union and the Bio-based Industries Consortium, gaining EUR 549,000 in funding for two projects.

Overall, in 2019, 35% of all researchers in Latvia were working in fields associated with bioeconomy. The majority of the research personnel related to bioeconomy are employed by major universities—LLU, UL, RTU—as well as by research institutes such as SILAVA, BIOR, LSIWC, AREI and others.

¹ OECD, 2018: Meeting policy challenges for a sustainable bioeconomy

There is a positive trend in Latvia for local research institution collaboration on research and innovation projects using various financial instruments, and producing joint publications. In Latvia, particularly productive collaboration among bioeconomy RI can be observed in the food industry, forestry and biotechnology. Cooperation was driven by support of food industry and forestry competence centres and by post-doctoral programmes. Meanwhile, Latvian research institutions, NGOs (especially farmer organisations) and municipal governments cooperated in the Horizon 2020 projects.

It is crucial to continue to build the innovation and research competence in

bioeconomy, especially in forestry and agriculture as well as in the research of the sea and inland waters to adapt to climate changes. The investments in the innovation and research competence in the bioeconomy are important to achieve a climate-neutral economy by 2050, and to ensure food and nutrition safety, to enable the sustainable production and use of biomass, to reduce food waste and to renew and improve the functions of ecosystems and biodiversity. Investments in research and innovation in the "Knowledge-intensive bioeconomy" will boost industrial competitiveness and growth, increasing productivity and promoting the more efficient use of resources.

Introduction

Knowledge-based bioeconomy involves boosting innovation and competitiveness in bioeconomic industries (agriculture, food and beverage production, forestry and fishing industry) on a regional and international scale. Innovation in bioeconomy involves not only the research and development of new products and services, but also improving the quality, increasing production efficiency and promoting more widespread use of non-technological innovations for creating high added-value products and services. The concept of bioeconomy also involves a gradual replacement of fossil resources with biological ones.³

In 2013, the Baltic Council of Ministers signed a Joint Statement, recognising the partnerships (public and private) and cooperation in the field of bioeconomy and sustainable growth among the research, government and business entities (especially small and medium enterprises in rural regions) of the Baltic States and the EU. The Ministry of Education and Science has been closely cooperating with the Ministry of Economics to coordinate and implement a policy associated with knowledge-intensive bioeconomy since 2014. In 2017, the Ministry of Agriculture published the 2030 Bioeconomy Strategy for Latvia, defining the strategic development goals for bioeconomy for 2030. In 2018, Latvia joined the

Central-Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy (the BIOEAST initiative). The ten member states of the Baltic Sea Region Bioeconomy Council (Denmark, Estonia, Iceland, Latvia, Lithuania, Norway,

Poland, Finland, Germany, Sweden) cooperate to promote the development of bioeconomy on the local, national and macroregional level. The activities intended to promote the growth of a sustainable bioeconomy using research, innovations and knowledge transfer potential are particularly important for Latvia. Achieving the climate goals and reducing the amount of greenhouse gas emissions in agriculture is a major challenge in Latvia, and takes much investment in research and innovation. Innovations must be stimulated to boost productivity growth in the field and make use of natural resources more efficient.

The report of the RIS3 "Knowledge-intensive bioeconomy" specialisation area research ecosystem has been prepared to demonstrate the achievements and competitiveness of innovations in bioeconomy on the regional and international scale in 2014–2018. Data sources used in the preparation of the report:

- National Research Information System (NZDIS);
- Scientific publications databases/*Web of Science* repository and InCites analytical network;
- Ministry of Education and Science statistics on higher education;
- Cohesion Policy Fund Management Information Systems for 2014–2020;
- Latvian Council of Science data on the Fundamental and Applied Research Programme and National Research Programmes;
- European Commission *CORDIS* database on Horizon 2020 projects.

The provision of EU funds contributed towards successful growth competence in research and innovation of bioeconomy

³ Analytical summary of the "knowledge-intensive bioeconomy" smart specialisation field ecosystem, 2015

in Latvia during the monitored period 2014–2018. The country's research institutions are particularly active on developing research projects in bioeconomy related to sustainable farming, horticulture, innovative food production and food safety, livestock and animal health, sustainable forestry, biotechnologies and new products from wood and plant biomass and by-products of their processing, as well as topics in circular economy and rural development. Latvia has gained 7.9 million euros in EC funding for the "Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy" area of the EU research and innovation framework programme Horizon 2020, with more than half of the funding obtained intended specifically for projects in research and innovation. Specialisation niches including the development of innovative products

and technological solutions, sustainable forestry and wood supply are successful in raising private funding for RI in the knowledge-intensive bioeconomy. It is crucial to continue to build the innovation and research competence in bioeconomy, especially in forestry and agriculture as well as in the research of the sea and inland waters to adapt to climate changes. The investments in the innovation and research competence in the bioeconomy are important to achieve a climate-neutral economy by 2050, and to ensure food and nutrition safety, to enable the sustainable production and use of biomass, to reduce food waste and to renew and improve the functions of ecosystems and biodiversity. Investments in research and innovation in the "Knowledge-intensive bioeconomy" will boost industrial competitiveness and growth, increasing productivity and promoting the more efficient use of resources.



1

Knowledge-intensive bioeconomy research and innovation potential

Latvia's *Research and Innovation Strategy for Smart Specialisation (RIS3)* is a national-level research and innovation strategy for economic transformation that seeks to identify ongoing competitive advantages, to select strategic priorities, and to design policy tools that maximise the country's knowledge-based socioeconomic development potential. The RIS3 objectives in Latvia are pursued within the framework of the science and innovation policy. A report of the RIS3 "Knowledge-intensive bioeconomy" specialisation field research ecosystem has been prepared to demonstrate the achievements and competitiveness of innovations in bioeconomy on the regional and international scale in 2014–2018. Initially, the bioeconomy ecosystem was described in the 2016 analytical summary of the "knowledge-intensive bioeconomics" smart specialisation field ecosystem.⁴ Meanwhile, in 2017, the Ministry of Agriculture published the 2030 Bioeconomy Strategy for Latvia, and the first RIS3 monitoring report was published in 2018⁵, defining the potential competitiveness niches for bioeconomy; the second RIS3 monitoring report came out in 2019, describing what has been achieved in bioeconomy research and innovation.

The provision of EU funds contributed towards successful growth competence in research and innovation of bioeconomy in Latvia during the 2014–2018 reviewed in this report. The research and innovation competence in the field of bioeconomy builds up among a significant number of research institutions and universities, spread all over Latvia's regions. Overall, as

of 2019, more than a third of all scientific personnel in Latvia were working in fields associated with bioeconomy. Between 2014 and 24 July 2019, Latvia gained 7.9 million euros in EC funding for the "Food supply, sustainable forestry and farming, research of seas and inland waters, bioeconomy" area of the EU research and innovation support programme Horizon 2020, which is 10.4% of all of the funding provided to the Latvian Horizon 2020 projects. The share of funding in this area for Latvia is high, accounting for 0.32% of the entire funding provided by the EC. More than half of the funding obtained was specifically for projects in research and innovation. Latvia has been a successful participant of the Bio-Based Industries Joint Undertaking (BBI JU), which is a public-private partnership between the European Union and the Bio-based Industries Consortium. In recent years, the wide scope of research institutions involved in the field of bioeconomy have built the capacity and excellence in various topics associated with bioeconomy. Especially successful research institutions have been in attracting funding for RI projects and publishing scientific articles in topic "Green and sustainable science and technology". Notable excellence in research has also been in the marine and agronomy as measured by high quality scientific publications. The quality of scientific articles is also above the EU average in topics related to ecology, fresh water and sea biology, agricultural engineering, veterinary and environmental sciences. At the same time, there is considerable research capacity

⁴ Analytical summary of the "knowledge-intensive bioeconomy" smart specialisation field ecosystem, 2015

⁵ Informative report: SMART SPECIALISATION STRATEGY MONITORING, 2017

in the fields of food science, forestry, horticulture and agriculture. Research capacity and excellence in bioeconomy are crucial for achieving a climate-neutral economy by 2050, ensuring food and

nutrition safety, enabling sustainable production and use of biomass, reducing food waste and renewing and improving the functions of ecosystems and biodiversity.



2

Research and innovation competences in the field of knowledge-intensive bioeconomy

2.1 Research areas

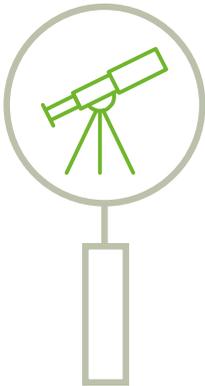
Overall, the EU fund instruments for the current period have fostered the development of research, technology and innovation in the thematic areas of knowledge-intensive bioeconomy. Multiple topics related to bioeconomy, such as horticulture and biotechnology and new products from plant and wood biomass are well developed throughout the entire range of financial instruments: from fundamental and applied sciences to the commercialisation of research (see Fig. 2.1). There is a similar coverage of topics in forestry, livestock research and food safety, developed with the support of food and forest industry competence centres.

The analysis of the research and innovation competences in bioeconomy in Latvia is based on the results of funding instruments for research and innovation managed by the Ministry of Education and Science and the Ministry of Economics and scientific publications in the *Web of Science*.

Most of the research and innovation projects funded have been focusing on topics related to horticulture (sustainability, productivity, pests and biodiversity), livestock farming (breeding, nutrition, diseases), forestry science (sustainability, pests, resilience to climate

change), biotechnology (bioethanol, biotechnologies and new products from wood and plant biomass and by-products of their processing, as well as the development of rural regions (social innovations, circular economy and rural governance).

Active knowledge transfer from research towards commercialisation takes place in the fields of food production and forestry with support of food and forest industry competence centres. Research institutions SILAVA and the Latvian State Institute of Wood Chemistry in forestry industry and LLU in food industry are main partners for companies that have received funding from industry competence centres. The RI actions related to horticulture that include sustainable plant breeding, productivity, pests and diversity have high potential for commercialisation. However topics related to marine and inland water research, fishery and aquaculture have been largely funded through financial instruments managed by the Ministry of Agriculture and The Ministry of Environmental Protection and Regional Development. The funding provided by EU funds has contributed the successful growth of bioeconomy competence in research and innovation, with potential for developing commercialisation projects in agriculture, forestry and biotechnology.



	Sustainable agriculture Livestock Crops Apiculture Food production and sustainable packaging	LLU AREI PPRI BIOR IH UL RTU
	Food security and safety Food safety Nutrition, lifestyle and socioeconomic conditions	LLU AREI BIOR
	Sustainable forestry Sustainable forestry, public goods Sustainable supply of wood	LLU LSIWC SILAVA
	Aquatic living resources and marine research Fisheries Aquaculture Ecosystem approach	LLU AREI BIOR LIAE RTU UL DU
	Bio-based industries Bio-based materials, chemicals and plastics, biotechnology Bioeconomy-relevant statistical and administrative data Regional dimension of bio-based industries	LLU AREI LSIWC UL RTU Baltic Studies Centre
	Blue growth Coastal economy Maritime Spatial Planning Clean coasts and seas	LIAE UL Baltic Studies Centre
	Rural renaissance Social innovation, policy tools for rural governance Agri-environmental public goods, Circular bio- based business models On-farm demonstration, Knowledge networks Digitisation of agriculture and rural areas, socio-economic impacts	LLU Baltic Studies Centre

Figure 2.2. R&I topics in bioeconomy by Latvian research institutions, 2014–2018

Research area	Research sub-area	Total number of projects funded over all instruments	Share of funding (%) in the overall funding for the sub-area					
			TRL 1-2	TRL 1-2	TRL 2-3	TRL 3-5-6	TRL 3-5	TRL 4-6
Farming	Livestock	5	24 %	17 %	42 %	16 %	0 %	0 %
	Horticulture	20	24 %	7 %	21 %	43 %	5 %	0 %
	Beekeeping	1	0 %	0 %	0 %	100 %	0 %	0 %
Food safety	Food production and packaging	29	0 %	3 %	11 %	0 %	0 %	87 %
	Food contamination, safe food	4	17 %	11 %	38 %	0 %	0 %	33 %
Forestry	Forestry	16	27 %	16 %	14 %	0 %	0 %	43 %
	Wood	2	0 %	0 %	0 %	25 %	0 %	75 %
Aquatic living resources and marine research	Fishery	3	0 %	0 %	0 %	0 %	44 %	56 %

Blue growth	Off-shore economies	0	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
	Clean coasts and seas	2	68 %	32 %	0 %	0 %	0 %	0 %	0 %	0 %
	Ocean/sea literacy	0	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
Bio-based industries	Biotechnologies, bioethanol	21	11 %	17 %	12 %	10 %	6 %	44 %	0 %	0 %
	Participative governance, partnerships in bioeconomy	9	0 %	0 %	0 %	100 %	0 %	0 %	0 %	0 %
	Statistics of the bio-based industry	6	32 %	25 %	0 %	44 %	0 %	0 %	0 %	0 %
	Regional dimension of bioeconomy	1	0 %	0 %	0 %	100 %	0 %	0 %	0 %	0 %
	Social innovation, rural governance tools	2	0 %	0 %	0 %	100 %	0 %	0 %	0 %	0 %
Rural Renaissance	Forest ecosystem services	1	0 %	100 %	0 %	0 %	0 %	0 %	0 %	0 %
	Circular bio-based business models for modern rural economies, agri-environmental public goods	3	0 %	0 %	0 %	100 %	0 %	0 %	0 %	0 %
	On-farm demonstrations: deepening farmer-to-farmer learning mechanisms	2	0 %	0 %	0 %	100 %	0 %	0 %	0 %	0 %
	Digitisation of agriculture and rural areas, socio-economic impacts	2	0 %	0 %	0 %	100 %	0 %	0 %	0 %	0 %

● Financial instruments of the Ministry of Education and Science
 ● Financial instruments of the Ministry of Economics and Innovation Programme
 ● European Union Research and Innovation Programme
 NB – National budget funding
 EU – European Union funding

Figure 2.1. R&I acquired projects by topics in bioeconomy and financial instruments 2014–2018

2.2 Potential specialisation niches

Transformation directions of national economy include growth priorities within specialisation areas established by RIS3.⁶ Growth priorities or specialisation niches of the Latvian industry emphasise the establishment of a business environment that promotes the development of innovative activities and human resources. The forestry and wood processing has a crucial role in in the field of the bioeconomy. Moreover four out of seven specialisation niches in the field of bioeconomy involve sustainable and climate change-resilient forestry, chemical processing of wooden biomass, and developing innovative wood products in the bioeconomy (see Fig. 2.3). Furthermore, with the support of EU funding competence centres for Food and forestry industry have been created

which play a particularly important role in attracting business investments in research and innovation. The total funding for RI in Competence centres for Food and forestry industry reaches 6.56 million euros and constitutes a considerable share of the overall funding of research and innovations in the field of bioeconomy (see Fig. 2.4). Specialisation niches that include the development of innovative products and technological solutions, sustainable forestry and wood supply are successful in raising private funding for RI in the knowledge-intensive bioeconomy. Latvia has high potential to continue to gain the research and innovation competence in forestry and agriculture that are compatible with climate change.

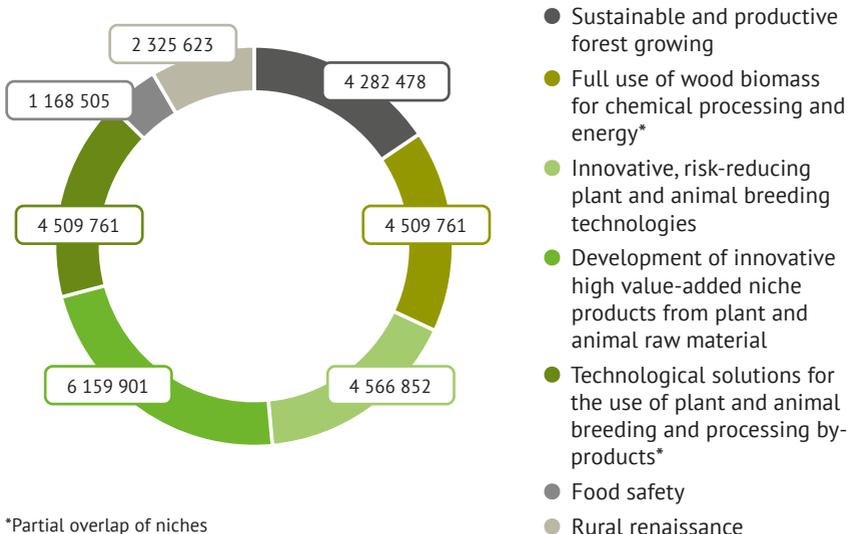


Figure 2.3. Investments into bioeconomy R&I projects by thematic niches 2014–2018 (EUR)

⁶ Informative report: SMART SPECIALISATION STRATEGY MONITORING, 2017

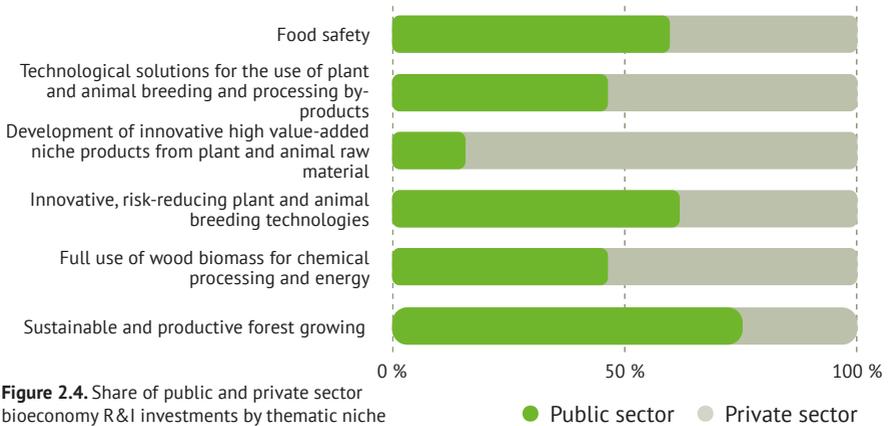


Figure 2.4. Share of public and private sector bioeconomy R&I investments by thematic niche

2.3. R&I regional dimension

Bioeconomy is a field with a significant impact on regional development in Latvia. The leading research institutions

in bioeconomy are spread all over the country. (see Fig. 2.5).

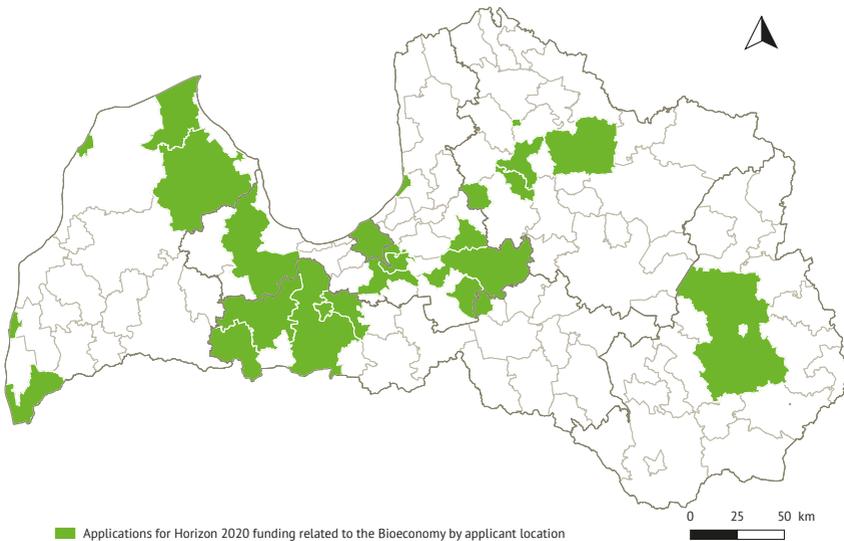


Figure 2.5 Applications for Horizon 2020 funding for "Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy" between 2014 and 2019 by applicant location

3

Human resources in R&I

3.1 Scientific personnel

The human resources available in research and innovation are a key prerequisite for developing the field. Overall, 35% of all scientific personnel in Latvia are working in fields associated with bioeconomy. The OECD Fields of Science associated with bioeconomy were defined in the first RIS3 monitoring report⁷, however scientific personnel working in physics, civil engineering and mathematics were excluded, because of the large number of researchers and limited ability to determine their association with bioeconomy. Most of

the scientific personnel involved in the fields related to bioeconomy are employed by major universities: LLU, UL, RTU (see Fig. 3.1). Scientific personnel aged 30–35 form the largest age group among the all personnel engaged in bioeconomy thus creating potential for future development of the specialization area. Nevertheless, there are research institutions with small number of scientific personnel that shows ability to gain funding for their research and demonstrate their performance through scientific publications.

Research institution	Scientific personnel (%)	Research institution	Scientific personnel (%)
UL*	28.0%	DU*	3.0%
RTU*	21.4%	Institute of Horticulture	2.6%
LLU*	16.1%	DU LIAE	2.5%
SILAVA	7.7%	Institute for Environmental Solutions	2.3%
BIOR	6.2%	PPRI	0.7%
LSIWC	5.3%	BALTIC STUDIES CENTRE	0.3%
AREI	3.9%	TOTAL	100.0%

*Approximate data

Figure 3.1. The share of scientific personnel of total working in the fields associated with bioeconomy by research institution (NZIDIS, 2019)

⁷ Informative report: SMART SPECIALISATION STRATEGY MONITORING, 2017

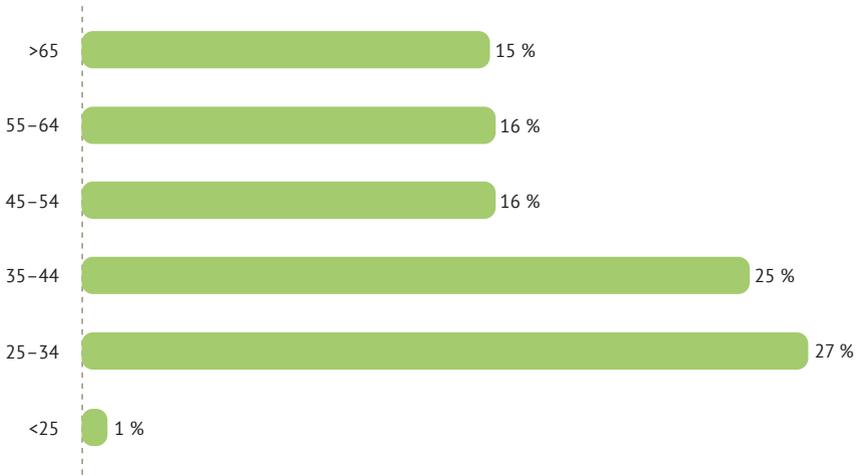


Figure 3.2. Age structure of the scientific personnel working in the fields associated with bioeconomy (NZIDIS, 2019)

3.2 Students

The number of bachelor's and master's students and graduates in fields closely related to bioeconomy has been stable over the last three years (see Fig. 3.3).

LLU, UL, RTU and DU offer the widest variety of bachelor's and master's study programmes in the field of bioeconomy.

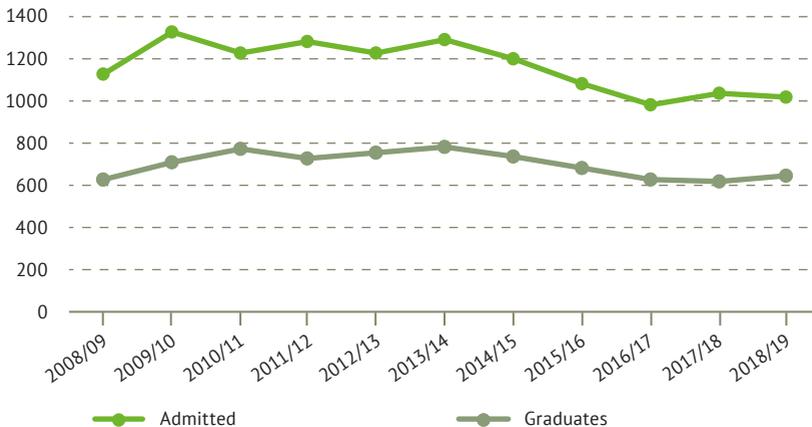


Figure 3.3. Number of students in study programmes closely associated with bioeconomy in the last 10 years

4

Scientific publications

Over the last 10 years the number of scientific publications in bioeconomy from Latvia in the *Web of Science* database has grown, peaking in 2016, perhaps, because of support of European Social Fund for doctoral studies (see Fig. 4.1). The mapping of scientific publications in bioeconomy was carried out for the period 2014–2018 using the Incites tool/*Web of Science* database. Between 2014 and 2018, there were 1689 publications in 19 topics related to bioeconomy (see Fig. 4.5). The share of scientific publications in bioeconomy is higher in Latvia than in the other Baltic States, exceeding the EU and global average (see Fig. 4.3). The institutions that have the most research staff are also the ones producing most scientific publications (see Fig. 3.1 and 4.4). In recent years, it was possible to build up capacity and excellence in various

topics associated with bioeconomy, e.g. "Green and sustainable science and technology" because of to the wide range of research institutions involved (RTU, RTU IESE, BSC, UL and LSIWC). Excellence in research has also been noted in the fisheries and agronomy, despite the limited number of publications in this field. The quality of scientific publications is also above the EU28 average in ecology, marine and freshwater biology, agricultural engineering, veterinary and environmental sciences. Meanwhile, food science and technology, forestry, horticulture and agriculture studies are in a good position for quality growth to reach the EU28 average for scientific publications, because of sufficient capacity. Overall, the research publication indicators in bioeconomy reflects the success of attracted R&I funding in corresponding topics.

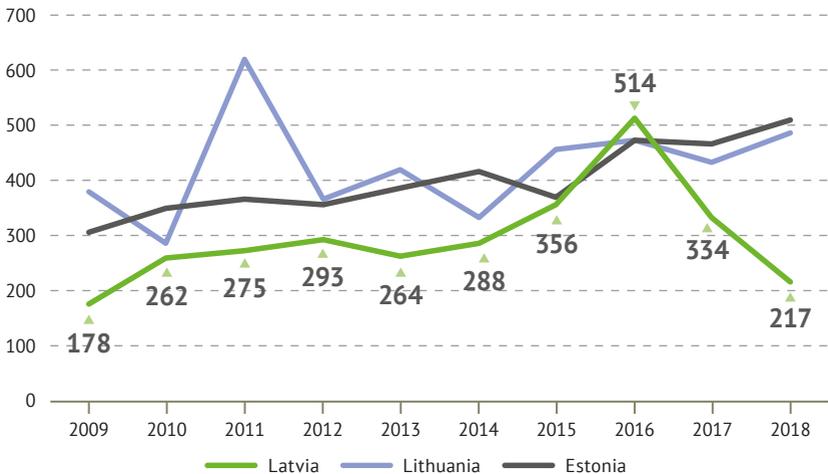


Figure 4.1. Count of publications in the bioeconomy (*Web of Science*, 2009–2018)

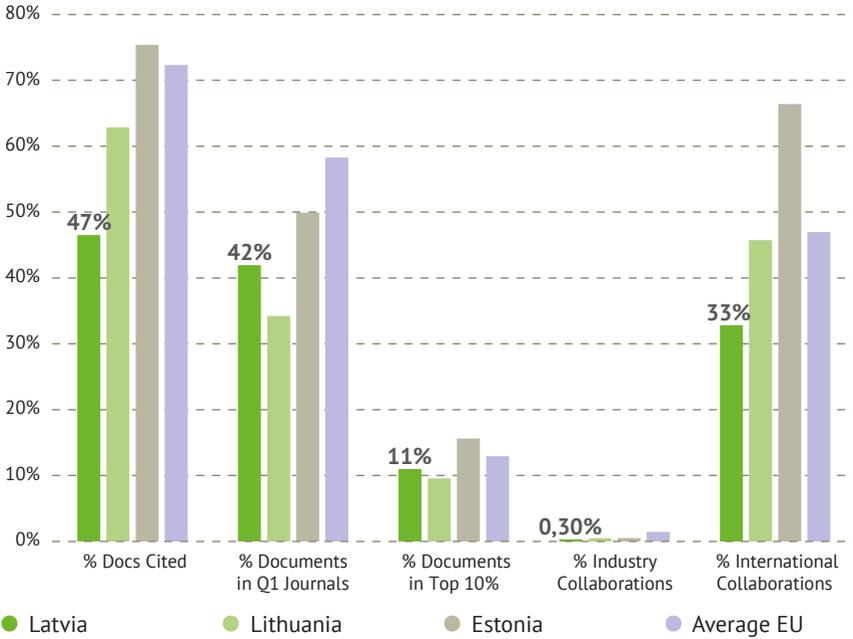


Figure 4.2. Productivity and collaboration metrics of publications in the bioeconomy of Baltic and EU Countries (*Web of Science, 2014.–2018.*)

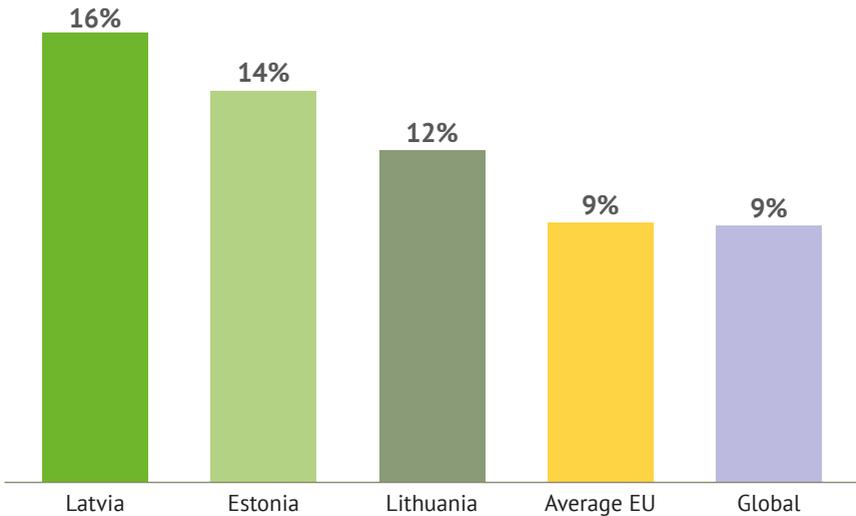


Figure 4.3. Share of publications in bioeconomy compared to the overall number of scientific publications in the Baltic States, the EU and the world (*Web of Science, 2014–2018*)

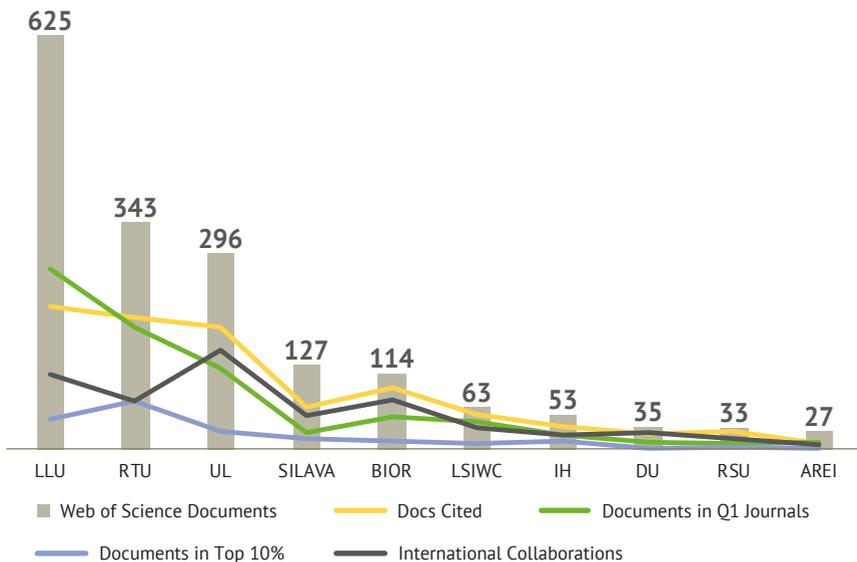


Figure 4.4. Productivity and collaboration metrics of publications in the bioeconomy by research institution (*Web of Science*, 2014–2018)

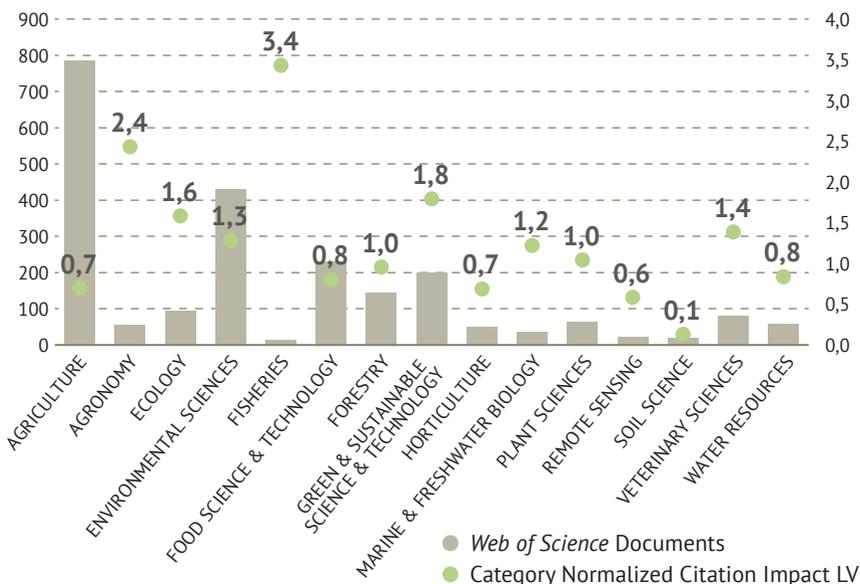


Figure 4.5. Number of scientific publications and the Normalized Citation Impact comparing different topics in bioeconomy (*Web of Science*, 2014–2018)

5

Collaboration

5.1 Collaboration on the national level

A review of the joint publications by Latvian research institutions in the *Web of Science* database for 2014–2018 shows that research networks have been established around LLU, RTU, UL and RSU (see Fig. 5.1). UL and BIOR have the most joint publications in bioeconomy (43), followed by UL and LLU (23), and LLU and SILAVA (19), which suggests a positive trend for collaboration among universities and research institutes on a national level. Meanwhile, the TOP 3 Category Normalized Citation Impact for joint scientific publications were result of collaboration of RSU with SILAVA and the Institute of Horticulture, as well as by RTU and UL. In field of bioeconomy in 2014–2018, within the various financial instruments for research and innovation projects, research institutions collaborated with each other taking part in the Fundamental and Applied Research Programme, Practical Research and Post-Doctoral Programme. However, in the bioeconomy projects of Horizon 2020 research institutions collaborated with NGOs and municipal governments. Overall, there is a positive trend in Latvian research institutions collaborating on a national level in research and innovation projects using various financial instruments, and producing scientific publications as result. In Latvia, bioeconomy-related cooperation between RI and businesses took place through food and forestry industry competence centres, where businesses were provided financial support for

developing products and technologies and tackling various challenges (see Fig. 5.2 and 5.3). RI also collaborate with businesses in other areas related to bioeconomy, using various financial instruments. The wide collaboration with business has been observed in the field of biotechnology related to use of bio-resources: the Latvian State Institute of Wood Chemistry and AS "Latvijas finieris" have been major players here, researching the development of biotechnologies and new products from wood and plant biomass and by-products of their processing (lignin, betulin). At the same time, cooperation with forestry businesses involves topics such as sustainable forest management and effective and sustainable supply of wood, where a major role is played by SILAVA, which collaborates with a number of companies working in forestry and wood processing (see Fig. 5.3). In the food industry, such cooperation concerns studies in new and innovative food products, food storage technologies and food safety, where the LLU Faculty of Food Technology, BIOR and UL and UL Institute of Microbiology and Biotechnology have a major role. The LLU Faculty of Food Technology has much experience on collaboration with businesses. In the field of horticulture and agronomy the main players are LLU, LLU SIA "Latvijas Augu aizsardzības un pētniecības centrs", Institute of Horticulture, Institute of Agricultural Resources and Economics, UL and Institute for Environmental Solutions. Various topics receive particular research

attention in this field, including the diseases and productivity of cereal plants, technologies for growing and processing fruits and vegetables, biological farming, sustainability, productivity, pests and promotion of diversity. Research in the field of animal farming concerns genetic resources, diseases, and animal feed, with the major players being LLU and BIOR. The research of potential applications

of the Latgale blue clay as part of the post-doctoral programme was carried out by the Rezekne Academy of Technologies, Daugavpils University, Institute for Environmental Solutions. In field of bioeconomy for collaboration between RI and businesses in Latvia have been promoted using various financial support from various financial instruments.

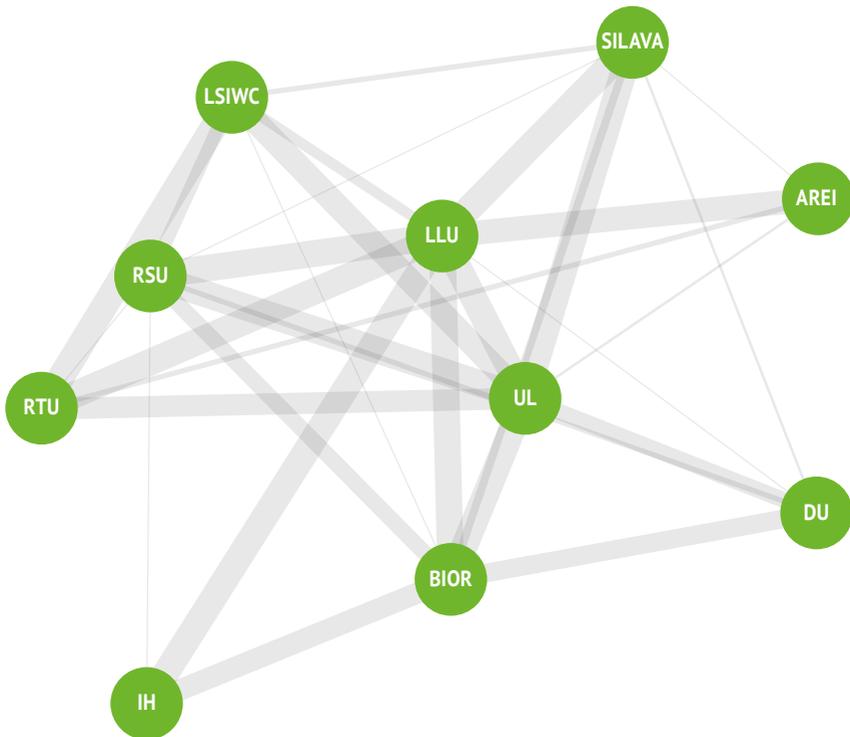


Figure 5.1. Collaboration between Latvian universities and scientific institutes by joint publications in bioeconomy (*Web of Science*, 2014–2018)

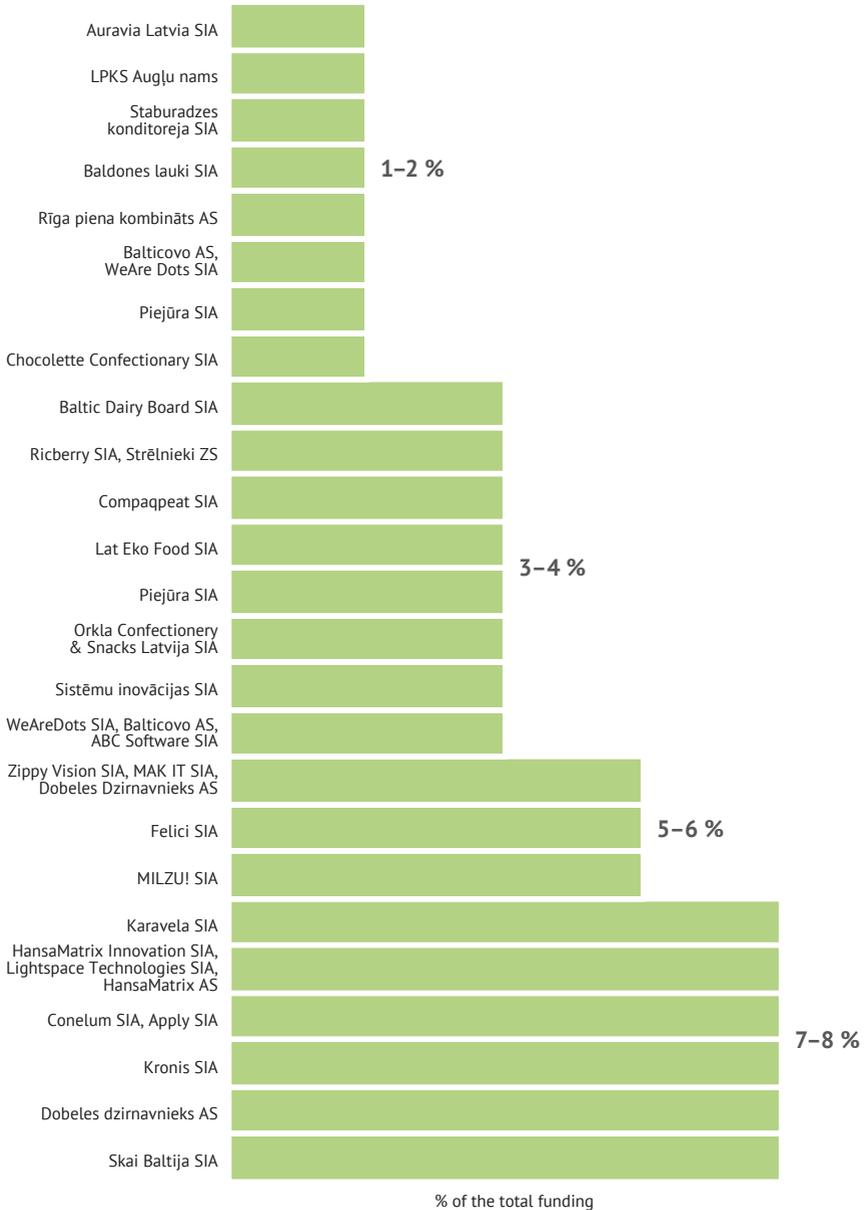


Figure 5.2. Funding obtained at the Latvian food industry competence centre, as a % of the total funding

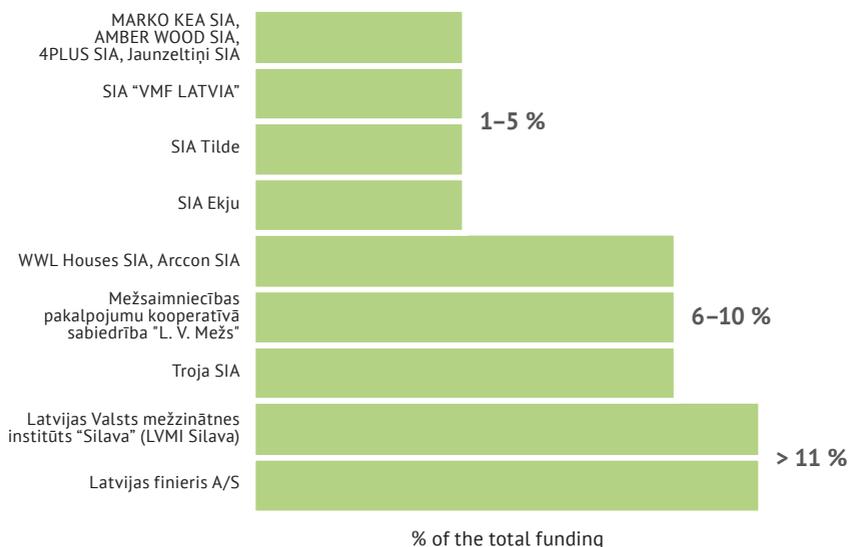


Figure 5.3. Funding obtained at the Latvian forest industry competence centre, as a % of the total funding

5.2. International collaboration

According to the *Web of Science* database, in 2014–2018 three Latvian universities (UL, LLU and RTU) and the BIOR research institute had the most publications in the field of bioeconomy prepared in collaboration with foreign research institutions (see Fig. 4.4). Meanwhile, Daugavpils University, BIOR, Latvian State Institute of Wood Chemistry and UL have the highest share of publications prepared in collaboration with foreign research institutions taking more than half of the total number of publications by these entities. Such collaboration arose most frequently with partners from European countries, especially in

the Baltic Sea region and Central Europe (see Fig. 5.4). The largest number of bioeconomy publications (>100) resulted from cooperation with neighbouring countries: Lithuania and Estonia, as well as Sweden, Poland, Finland and Germany, with a positive trend in that the highest number of scientific publications in Q1 journals were produced in conjunction with these countries. It is also notable that cooperation in bioeconomy includes countries such as Russia, the US, Canada, Australia and many others, which is an indicator of bioeconomy being relevant on a scale that goes beyond just the Baltic Sea region.

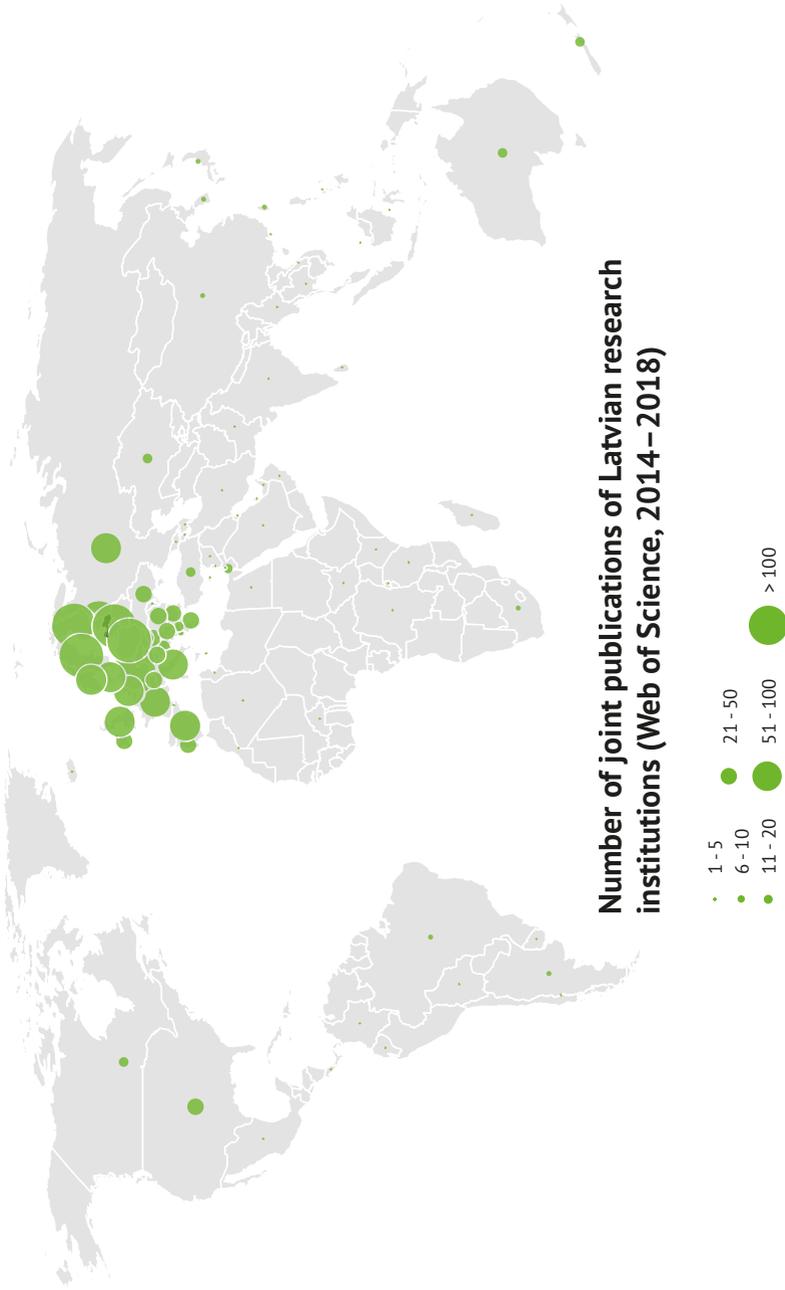


Figure 5.4. International collaboration by number of joint publications of Latvian research entities (*Web of Science*, 2014–2018)

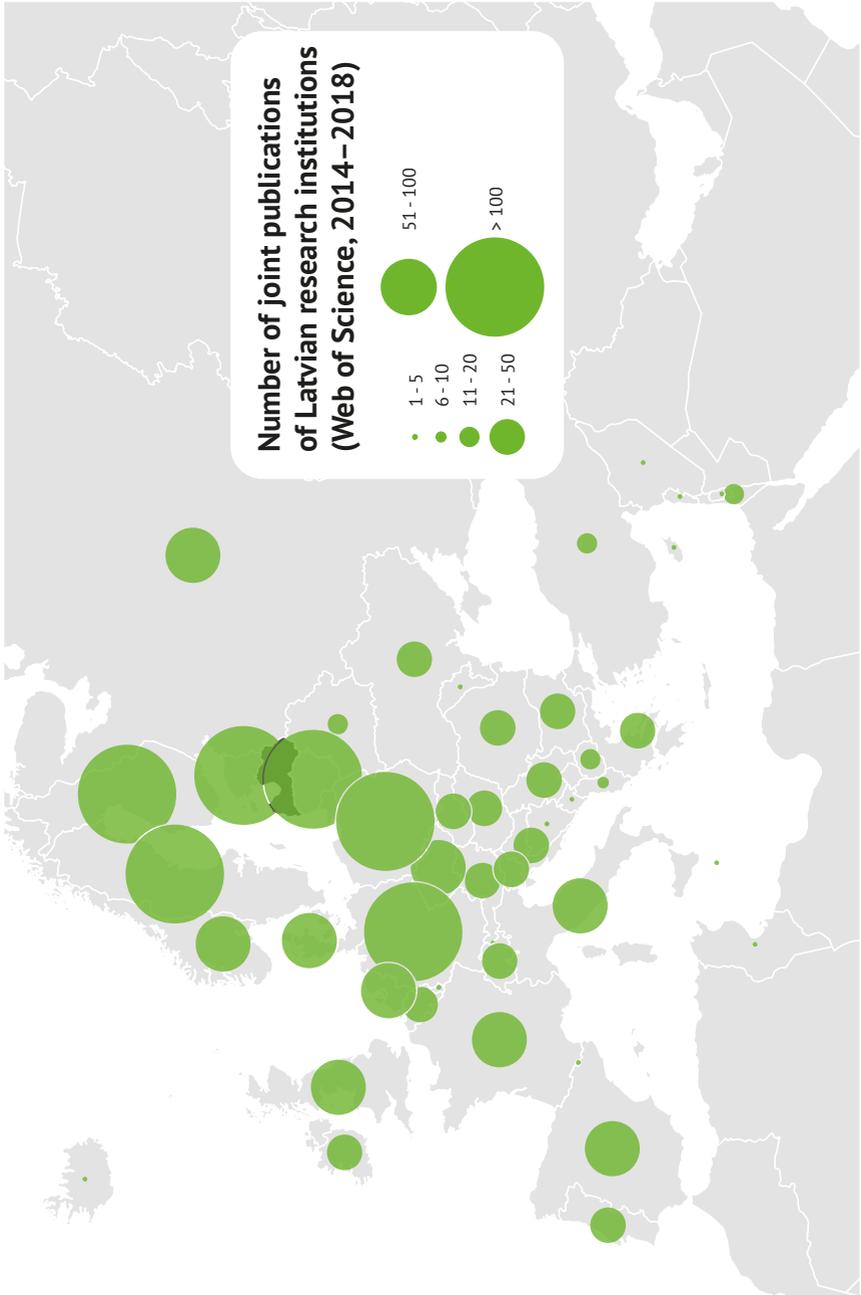


Figure 5.4. International collaboration by number of joint publications of Latvian research entities (Web of Science, 2014–2018)

5.2.1. Actions within the Horizon 2020 framework programme

Between 2014 and 24 July 2019, Latvia gained 7.9 million euros in EU research and innovation support programme Horizon 2020 in area "Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy", which is 10.4% of all of the funding provided to the Latvian Horizon 2020 projects. The share of financing in this field is high, accounting for 0.32% of the entire funding provided by the EC. More than half of the funding obtained was specifically for projects in research and innovation. Latvia has been a successful participant of the Bio-Based Industries Joint Undertaking (BBI JU), which is a public-private partnership between the European Union and the Bio-based Industries Consortium, gaining EUR 549,000 in

funding for two projects for sustainable innovation for new local value from waste and biomass. The Latvian State Institute of Wood Chemistry is an associate member of the Bio-based Industries Consortium.

A total of 191 project applications were submitted by Latvian research institutions as part of the Horizon 2020 programme in the "Food supply, sustainable forestry and farming, research of seas and inland waters, bioeconomy" topic between 2014 and 1 March 2019, of which 40 were funded (see Fig. 5.5). There have been collaboration between Latvian research institutions, NGOs and municipal governments (with particular activity demonstrated by agriculture associations) as part of the Horizon 2020 bioeconomy projects.

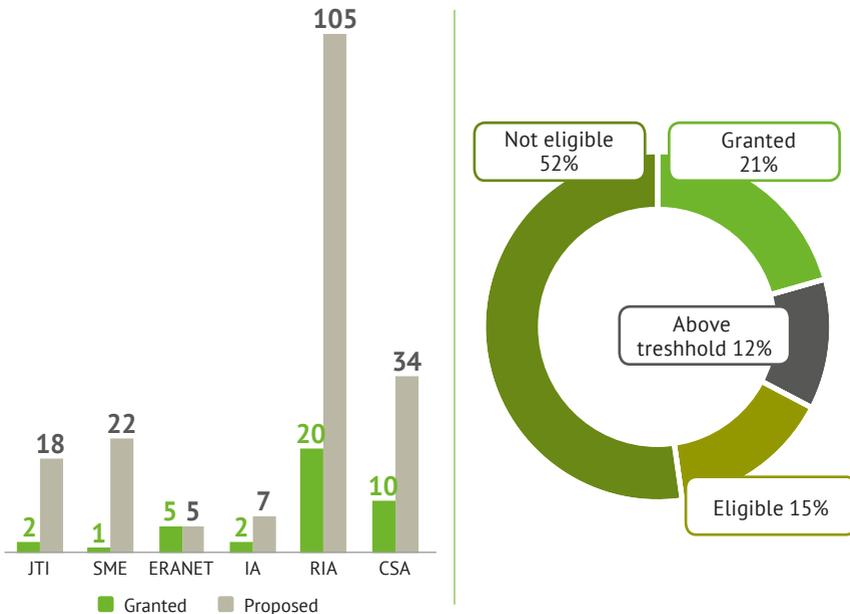


Figure 5.5. Types of project applications and success of the Horizon 2020 programme area "Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy" between 2014 and 1 March 2019.

Figure 5.6. Applications submitted by Latvian research institutions for the Horizon 2020 programme area "Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy" between 2014 and 1 March 2019

Institution	Proposed	Above threshold (%)	Granted
LLU	25	36%	2
BALTIC STUDIES CENTRE	21	62%	6
SILAVA	15	47%	4
RTU	13	8%	0
AREI	10	90%	3
UL	9	22%	0
IH	6	67%	0
Latvian State Institute of Wood Chemistry	6	17%	1
BIOR	3	33%	0
ViA	3	33%	1
PPRI	2	100%	1
Latvian Academy of Sciences	2	100%	1
SIA "Pūres dārzkopības pētījumu centrs"	2	50%	0
Stende State Cereal Selective Breeding Institute (VSGSI)	2	50%	0
VUC	2	50%	0
LIAE	1	100%	0

6

Research institutions



Latvia University
of Life Sciences
and Technologies

Latvian University of Life Sciences and Technologies (LLU) is a leading Latvian research institution in the field of bioeconomy. Priority areas of research:

- Bioscientific research is largely associated with agriculture, forestry and veterinary medicine.
- In the field of engineering, the research largely concerns food production, bioenergy, smart machinery and technologies (especially in agriculture and forestry), IT management of biological processes, bioresource-based construction, timber harvesting and processing, geotechnics, environmental aspects of bioeconomy, including greenhouse gases (GHGs) and waste water produced by agriculture.
- In social sciences, the research activities are mainly associated with the socioeconomic aspects of bioeconomy, with landscape architecture (in the context of eco-services), land management.

LLU Faculty of Veterinary Medicine: the research is supported by the well-equipped Clinical, Laboratory and Pathology Centre for Horses, Pets and Livestock. The faculty conducts research in the fundamental fields of veterinary medicine: physiology and morphology, comparative medicine and diagnostics, treatment, and (within the scope of one field of medicine) infectious and invasive diseases, food safety and antimicrobial resistance.

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LLU Faculty of Food Technology

researches the development of new and improved foods and production technologies. The faculty conducts research in fields such as the production of food raw materials, development of new foods and the suitability of by-products for recycling. The faculty studies biologically active substances in raw materials and foods. There is research concerning food safety and risk management, in order to ensure that foods are not harmful to health. The institution also looks into the potential of functionally increasing the nutritious value of foods and plant-based products, into solutions for reducing the amount of plant-based waste, into new technologies and types of packaging, and into the optimisation of storage of foods.

Contact details:

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LLU Faculty of Information Technologies

conducts studies in the computer management and modelling of biological systems, and in the use of IT in the field of precision beekeeping.

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LLU Forest Faculty researches forest ecosystems and biological diversity, as well as the impact of forestry activities and machinery on forest ecosystems. The faculty researches the potential of increasing the productivity of planted forests. The faculty researches the infrastructure of hunting and game animals. The faculty assesses the by-products of forestry and timber processing. The faculty researches timber materials and technologies associated with the use of wood in construction, innovative technologies and possible multifunctional uses of timber products.

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LLU Faculty of Engineering - sustainable Vehicle Technologies, Smart Technologies and Robots in Biosystems, Recycling of Biomass and Rational Use of its Waste Materials, Renewable Energy Production and Use).

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LLU Faculty of Agriculture – research in agriculture is conducted in four directions: (1) important microorganisms and invertebrates in agriculture, their interaction with plants and animals in conditions of globalisation and climate change; (2) soil and land as basic resources in agriculture; (3) improvement of plant productivity and quality of yield by using environmentally friendly technologies; (4) improvement of animal productivity and functional efficiency.

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Zinta Gaile
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LLU Faculty of Economics and Social Development: the group in charge of bioeconomy research at the faculty specialises in approaching bioeconomy from the economic, social and environmental standpoints (especially those pertaining to climate, air and water). The group works with socioeconomic and environmental models of bioeconomic industries, with bioeconomic value chains, bioeconomic supervision and monitoring, and handles the matters of the use of land and other biological resources. The group closely cooperates with industries in implementing innovations and developing proposals for policy-makers in order to promote the development of sustainable bioeconomy.

Contact details:

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LLU Faculty of Environment and Civil Engineering conducts research pertaining to sustainable construction, developing new and innovative construction materials and their properties, combatting climate change, managing land and real estate, researching and developing urban and rural landscapes, as well as geotechnical and geospatial research.

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Agrosursu un
ekonomikas
institūts

LLU Institute of Agricultural Resources and Economics (AREI) conducts research in agriculture, agrarian economics and other fields of bioeconomy, including crop breeding and genetics, development of sustainable crop

growing technologies, potential uses of crop plants in various fields, effects of innovation on production efficiency and social benefits, competitiveness of farming and bioindustries as well as the role of bioeconomy in the sustainable development of rural areas.

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LLU Institute of Horticulture (IH) engages in the breeding of fruit and berry crops; research and development of horticultural plant growing, storage and processing technologies; fundamental biological research in horticulture.

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LLU Plant Protection Research Institute “Agrihorts” (PPRI) conducts biological research into the protection of plants against pathogens, pests and weeds.

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University of Latvia (UL) conducts research in a broad range of topics associated with the industries based on biological resources, biotechnology, the environmental and sustainability aspects of bioeconomy, climate change, sustainable use of natural resources, blue economy, and regional development.

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UL Institute of Biology carries out diverse applied research in the field of the microbial conversion of renewable resources and industrial by-products, and in food and farming biotechnology, finding innovative, sustainable, environmentally and human-friendly solutions for achieving the goals of the circular economy. One of the most promising areas of research, in which the institute has widely and internationally recognised competence, are microbially synthesised bio-degradable polymers with diverse possible applications in the food, packaging and medical industries.

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UL Institute of Microbiology and Biotechnology researches biotechnological processes, with a focus on the uses of microorganisms; the institute also conducts research into food and environmental biotechnology.

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lumbi@lu.lv



Riga Technical University (RTU) develops the fields of research related to the processing of biomass and production energy from it, as well as to water resources. RTU conducts studies on event-based computer vision in farming robots and drones.

<https://www.rtu.lv/en/science/research-platforms>

Contact details:

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Department of Artificial Intelligence and Systems Engineering
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RTU Institute of Energy Systems and Environment (IESE): the main research topics are energy efficiency, production of renewable energy resources including aspects of the impact on the environment, fuel combustion technologies, climate technology solutions, eco-design and life cycle analysis, energy planning and energy supply socio-economic aspects, and sustainable use of resources according to bioeconomic principles.

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Latvian State Forest Research Institute "Silava" studies various topics pertaining to sustainable forestry, forest ecology and the supply of timber materials, to

optimal forest growing strategies in the context of the role of forests in the state's economy, climate change mitigation and biodiversity conservation, and to the production of high-quality wood. "Silava" ensures the Latvian national forest inventory and calculations of the greenhouse gas policy in the national sector of land use and land use changes.

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Latvian State Institute of Wood Chemistry (LSIWC) conducts extensive research in the subjects related to obtaining competitive materials and products from wood and lignocellulosic biomass, to developing technologies for processing their by-products, and to creating new products and analysing their life cycles.

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Institute of Food Safety, Animal Health and Environment "BIOR" is a research centre of national importance which develops innovative research methods and creates new practically applicable knowledge in the following areas: public and environmental health, food, fishery and veterinary medicine. In the area of its competence, Institute "BIOR" with its excellent research, technical and developed human resource base is leader in the region.

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Baltic Studies Centre (BSC) researches the social, economic and regional aspects of bioeconomy, including the topics of coastline economy, regional dimensions of bioeconomy, sustainable rural and regional development and agrifood systems.

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Daugavpils University (DU) research aims to ensure sustainable agriculture, fisheries and aquaculture. DU carries out genetic, epigenetic and biochemical studies to assess the resistance of certain breeds of cereal plants to the stress caused by various factors. Research in fisheries is concentrated on the recovery and sustainable use of wild fish stocks. In conjunction with leading EU research bodies, the university has developed new or improved aquaculture products and research is focused on new aquaculture species with commercialisation potential.

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DU Latvian Institute of Aquatic Ecology (LIAE) conducts research for the development of a sustainable blue bioeconomy. Its studies include the ecology, distribution of various resources of the Baltic Sea (bivalvia, algae) and their interactions with the marine

environment. LIAE has experience in the field of cultivation technologies for the Baltic blue mussels, having set up an experimental mussel farm in the Baltic Sea. LIAE also works on issues pertaining to the ecology of invasive species in the Baltic Sea and their impact on local ecosystems, as well as those concerning the distribution and impact of plastic microparticles. LIAE studies the potential of using the ecosystem approach in maritime spatial planning, as well as the scope and quality of marine ecosystem services. LIAE has developed a verified and accredited methodology for ecotoxicological testing that can be used to assess the impact of various toxic and harmful substances in aquatic environments, including aquaculture, and there is a considerable amount of experience using such testing.

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