



Food and Agriculture  
Organization of the  
United Nations

# REGIONAL ASSESSMENT OF FOREST EDUCATION IN LATIN AMERICA AND THE CARIBBEAN

Creation of a Global Forest Education Platform and Launch of a Joint Initiative  
under the Aegis of the Collaborative Partnership on Forests



# REGIONAL ASSESSMENT OF FOREST EDUCATION IN LATIN AMERICA AND THE CARIBBEAN

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# ACRONYMS AND ABBREVIATIONS

BMEL	German Federal Ministry of Food and Agriculture
CPF	Collaborative Partnership on Forests
FAO	Food and Agricultural Organization of the United Nations
ICT	Communication and information technology
IFSA	International Forestry Students' Association
ITTO	International Tropical Timber Organization
IUFRO	International Union of Forest Research Organizations
LAC	Latin America and the Caribbean
NGO	Non-governmental organization

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# 1. BACKGROUND

## 1.1. The need to strengthen forest education and adapt it to a changing context

Forest education is the main path for creating the shared knowledge, skills and values that underpin sustainable forest management. Similarly, it also underlies the contributions of forests and trees to the achievement of environmental, social and economic development goals, from the local to the global level.

However, in recent years, in various international forums, concerns of many countries have been raised that forest education is insufficient, deteriorating or outdated. This has led to a lack of awareness and understanding of the forests in these places, as well as forest graduates who are insufficiently prepared to meet the changing demands of the workplace.

Various reports indicate that countries around the world have experienced variations in student enrolment in forest education programmes and have faced challenges in including forest-related topics in the curricula (van Lierop, 2003; Temu and Kiwa, 2008; Rekola *et al.*, 2017; Jegatheswaran *et al.*, 2018).

FAO's Global Forest Resources Assessment (FRA) 2020 includes information on trends in enrolment for forest studies at post-secondary education levels between 2000<sup>1</sup> and 2015, which was collected in 119 countries and territories. In countries that provided information at all educational levels<sup>2</sup> and complete time series<sup>3</sup> (accounting for about half of the world's forest area), there has been a general increase in the number of forest graduates and marked progress towards gender parity. Although FRA 2020 warns that these trends should be treated with caution given that the data are incomplete, the findings appear optimistic.

Moreover, forest education has been largely absent from the global forest policy agenda for almost 20 years, which was reflected in a reduction of efforts by the Food and Agriculture Organization of the United Nations (FAO) regarding this issue. However, the focus on forest education has recently picked up, due to the activities of various research organizations and non-governmental organizations (NGOs), and in particular, the inclusion of forest education on the agenda of the 14th session of the United Nations Forum on Forests, held in May 2019. This signals a growing awareness that forest education can and must be part of the solution to many pressing needs. Some of these needs are: reducing the rate of deforestation and forest degradation; protecting ecosystems; improving livelihoods and safeguarding human health and well-being; conserving biological diversity; and mitigating and adapting to climate change. Hence, there is greater awareness that forest education must adapt to the many challenges facing the forest sector. These challenges include:

- changes in societal expectations regarding the goods and services that forests provide to communities, as well as in how they are perceived;
- changes in employment trends, and hence the need for further training and education in the forest sector to maintain a strong cadre of qualified forest professionals and environmental professionals;
- a lack of interest in the forest sector, which needs to be revamped and rebranded to attract the most talented and engaged students in the study and management of the world's forests and interdependent ecosystems;

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<sup>1</sup> See FAO's Global Forest Resources Assessment (FRA) 2020.

<sup>2</sup> The aggregated figures were underestimated in regional and global areas; most countries could only provide data for some educational levels.

<sup>3</sup> The trend was accurate for those that provided a complete time-series of gender-disaggregated data..

- an aging workforce in many countries;
- a curriculum that is often outdated and too narrowly focused, and that needs to be expanded to integrate the main emerging topics.

In this context, there is an urgent need to revitalize interest in forest education, and strengthen and expand current programmes. This entails taking advantage of the new opportunities offered by modern digital communication and information technologies (ICTs), as well as the new types of jobs in the growing green economy.

Without a revival of forest education, it will be difficult to achieve sustainable forest management, ensure widespread recognition of the full value of forest goods and services, and overcome the growing disconnect between people, nature and forests. Similarly, without sound and adequate forest education, forests and trees are unlikely to contribute to the achievement of global development goals and targets, including the Sustainable Development Goals (SDGs),<sup>4</sup> the objectives of the United Nations Framework Convention on Climate Change, the post-2020 Global Framework for Biodiversity of the United Nations Convention on Biological Diversity, and the United Nations Strategic Plan for Forests, among others.

Target 7 of SGD 4 specifically highlights the need to improve education on sustainable development:

*By 2030, ensure all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development.*

## 1.2. A global forest education initiative

The Global Forest Education Project, formally titled “Creation of a Global Forest Education Platform and Launch of a Joint Initiative under the Aegis of the Collaborative Partnership on Forests” was carried out between November 2019 and September 2021.<sup>5</sup> This project was generously funded by the German Federal Ministry of Food and Agriculture (BMEL) and implemented by three main partners – FAO, the International Tropical Timber Organization (ITTO) and the International Union of Forestry Research Organizations (IUFRO). These entities collaborated with other members of the Collaborative Partnership on Forests (CPF) and regional main partners, who carried out project activities at the regional level.

The main regional partners were:

- Africa: African Network for Education in Agriculture, Agroforestry and Natural Resources (ANAFE).
- Asia and the Pacific: The Center for People and Forests (RECOFTC) and ITTO
- Europe and Central Asia: University of Helsinki, Forum4Edu and IUFRO
- LAC: IUFRO and Reforestamos México
- Near East and North Africa: the Arab Organization for Agricultural Development (OADA)
- North America: University of British Columbia (UBC), Michigan Technological University, and the Learning Tree Project.

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<sup>4</sup> Mainly, SDGs 15 (Life on Land), but also SDG 1 (No Poverty), 2 (Zero Hunger), 3 (Good Health and Well-being), 6 (Clean Water and Sanitation), 7 (Affordable and Clean Energy), 11 (Sustainable Cities and Communities) and 13 (Climate Action).

<sup>5</sup> For further information on the project, consult the project's website: [www.fao.org/forestry/forest-education/en](http://www.fao.org/forestry/forest-education/en).

Within the scope of the project, forest education was defined as education related to forests, other wooded land and trees outside forests, including natural forests, forest plantations, agroforestry and urban forests. This project focused on formal education. Although formal, informal and continuing forest education and training, as well as indigenous and traditional knowledge related to forests were outside the scope of the project, partners felt that these sources of education and knowledge were essential for general learning related to forests. Accordingly, the survey included several questions related to non-academic and non-formal education and traditional knowledge on forests; the partners were hoping that this education and knowledge would be included in a joint initiative of the Collaborative Partnership on Forest Education as well as other initiatives developed to strengthen forest education, training and knowledge.

The project consisted of several interrelated activities aimed at taking stock of the current state of forest education (see Appendix I, Figure 1). A global survey on forest education was carried out between 15 July and 31 October 2020. The survey results were supplemented with information from other sources and informed six regional assessment reports, as well as a global summary report on forest education. In each regional report, the situation of forest education in the region was assessed, and a set of recommendations was formulated to strengthen it. The reports served as reference material for the regional consultations on forest education, which took place in February 2021. In addition, the regional reports and the findings of the regional consultations were used to prepare an assessment on the state of forest education worldwide. Finally, in June 2021, the International Conference on Forest Education was held virtually in which the conclusions were reviewed from the global assessment and recommendations for the adoption of measures aimed at strengthening forest education worldwide.

Moreover, within the framework of the project, two pilot activities were carried out to develop online resources aimed at improving forest education. Under the direction of IUFRO, the Forestra® prototype was developed, an enhanced online platform for consolidating and making forest educational resources globally accessible. Similarly, ITTO developed an online course, Legal and Sustainable Supply Chains (LSSC) for Tropical Wood and Forest Products (LSSC), which consists of a pilot effort to explore new approaches and technologies for training and education.

The project culminated in the preparation of a global framework of action on forest education. This framework will form the basis of a multi-year initiative of the Collaborative Partnership on Forests (CPF) with multi-partners. The joint initiative proposed by this Partnership will address contemporary and new problems facing forest education. Hence, its scope could include official forest education, formal, informal and continuous forest education, as well as indigenous and traditional knowledge related to forests.

## 2. INTRODUCTION

### 2.1 Objective and description of the regional assessment

The objective of the regional assessment was to appraise the current situation of official forest education at all educational levels, as well as to identify gaps and areas that need to be strengthened. On this basis, the aim was to provide information on the main initiatives and agents working to assess or improve forest education. Finally, the assessment is expected to present recommendations for measures that could be adopted to strengthen forest education in the region.

The levels of education analysed were:

- primary education (in most countries, from 5 or 6 years old to 12 or 13 years old);
- secondary education (in most countries, from 12 or 13 years old to 17 or 18 years old);
- technical and vocational education (TVET);
- tertiary education in universities and colleges.

Moreover, the regional assessment was based on the following sources of information: the global survey on forest education carried out between July and October 2020; scientific and grey literature; and the Regional consultations for strengthening global forest education, which was held virtually on 23 and 24 February 2021.

One hundred and thirty experts and stakeholders participated in the regional consultation whose objectives were to validate the conclusions of the regional assessment report and finetune the recommendations to strengthen forest education in the region. The reports of the six regional consultations can be consulted from March 2021 on the project website ([www.fao.org/forestry/forest-education/en](http://www.fao.org/forestry/forest-education/en)).

Similarly, the assessment covered the content and competencies of education, teaching approaches, educational resources and policies, workplace preparedness and employability, digital preparedness, and the development and general trends of forest education. These themes reflect the frame of reference that represents the conceptual framework of the assessment.

### 2.2. The frame of reference

For the global forest assessment on forest education, a frame of reference was adopted as the conceptual framework, which helped define the questions in the global survey on forest education. The frame of reference consists of four main components of forest education and their relationships (see Appendix I, Figure 2).

The *needs and demand* describe the *goals* of education. Needs are defined as general, socially desirable goals, for example, the SDGs. Demand refers to (economic) needs, narrowly defined, with respect to how much and what types of skills and competencies are required in labour markets.

The *course offer and the resources* are necessary inputs to organize and implement the education programmes. There are direct and indirect links between the needs, the demand, the supply and the resources.

*Teaching and learning* are the essential and central components of education. They are activities that interact with each other, like two sides of the same coin.

*Learning outcomes* (or achievements) are students' competencies upon graduation, which include their knowledge and skills, as well as their attitudes and values. Competencies can be subject-specific and linked to forest knowledge and skills (such as those related to the ecological, technological and economic aspects of forests and forestry) or generic (related to skills such as literacy and numeracy, communication, teamwork and leadership).

### 2.3. Overview on Latin America and the Caribbean forests

About 23 percent of the world's forest cover is found in the Latin America and the Caribbean (LAC) region (Cordero, 2011), of which 97 percent is concentrated in South America. This 97 percent is mainly concentrated in Brazil (where 12 percent of the world's forests are located) and in the other countries that make up the Amazon River Basin, as well as Chile (FAO and UNEP, 2020). In general, the region is characterized by its great diversity of flora and fauna species, habitats and ecosystems that provide livelihoods for millions of people, which reflects a great diversity of languages, customs and ways of perceiving the forest (Villalobos *et al.*, 2012).

Recent studies show that the contribution of the forest to economic development is mainly provided by the wood industry, which has been continuously growing since 2000 due to the increase in wood pulp exports. During 2016, around 22.2 million cubic metres of wood were exported, representing 0.45 percent of the gross domestic product (GDP) of the region in that year (Quiroga, 2017). For most of the countries, the contribution of the wood industry to GDP is less than 1 percent, yet there was a 10 percent increase in job creation between 2000 and 2011. However, within the region there are some differences: for Central America and the Caribbean, for example, there was a reduction in employment in the sector in the same period (FAO, 2014). The contribution of the forest industry to employment in the region, therefore, is around 0.5 percent, well below the 1.7 percent of the global contribution of the industry, and this does not include wood processing for furniture.

FAO data estimate that most of the region's rural population (82 percent) are living in poverty, and eight million people depend directly on the ecosystem services provided by forests, as a source of energy (firewood) or food, or through the sale of non-wood products (Angelsen and Wunder, 2003; FAO, 2018; FAO and UNEP, 2020; Jiménez González *et al.*, 2017). Recently, due to the success that Costa Rica has had in developing the ecotourism sector, other countries in the region have sought to emulate their model to minimize poverty in the rural sector through green tourism (Gunter, Graziano Ceddia and Troster, 2017).

Despite all efforts, the management and conservation of forests in the LAC region remain a challenge; each year in the region, an area of a little over 40 000 km<sup>2</sup> is deforested (FAO and UNEP, 2020). The extension of the agricultural and livestock boundary, mining, illegal logging, forest fires and armed conflicts are factors that permanently threaten the natural resources and the populations that depend on them (Gabay *et al.*, 2020).

In the last two decades, public policies and laws related to the forest sector have developed to meet the particular needs of each nation, and in general, to cope with climate change. They mainly promote sustainable forest management, an increase of protected areas, the restoration and reforestation of degraded areas, the strengthening of institutions, community participation and the inclusion of traditional knowledge in forestry plans (FAO, 2010; Keipi, 2000; Zanetti *et al.*, 2017). To achieve the objectives proposed in forest policies and link them with the socio-economic needs of the region and the world, it is necessary for forestry technicians and professionals to develop specific capacities. Therefore, it is advisable for forest programmes to consider incorporating some topics in their curricula, and to update and enhance the content of others (Arce-Rojas, 2014).

Formal forest education programmes in LAC were created just over 60 years ago in response to a growing demand for wood, pulp and paper. According to the studies carried out by Shirley and Llaudadó (1969), the range of professional forest programmes in LAC (17 in total) were sufficient to serve the labour market until 1985; however, the authors recommended establishing at least one school in each of the following areas: the Brazilian Amazon, Central America, the Caribbean, and Ecuador. The study also observed the need to increase the number of experts and technical forest schools in the region; at the time of the study, there were 12 technical schools out the 28 needed to meet the demand for technicians projected for 1985. The authors also mention that there was a single graduate school, and two more were being created at the time of the study.

In 2018, the Joint IUFRO-International Forestry Students' Association (IFSA) Task Force on Forest Education updated the GFIS platform with an inventory of professional forest programmes in the world. For the LAC region, 100 forest programmes were listed, of which 33 correspond to postgraduate programmes (master's and doctoral).

The countries with the largest number of both undergraduate and graduate programmes are Mexico, Brazil, Chile, Peru and Colombia, in that order. It should be noted that these figures are not exhaustive, since there is no information for some of the countries in the region.

It is also important to mention the variety of programmes at the undergraduate level, among which are forest engineering, industry and the environment, biodiversity and forest management, natural resources engineering and conservation, natural resources management, agroforestry engineering and forest restoration engineering. At the graduate level, programmes focus on natural resources management and conservation, tropical forests, the environment and development, and forest industries and wood technology. It emerged from consulting the platform that not all universities that offer undergraduate programmes also offer graduate studies, and not all universities that offer graduate programmes have undergraduate programmes. However, there was no specific list of technical forest schools.

The three regional assessments were carried out on forest programmes at the technical, undergraduate and postgraduate levels, which were carried out with the collaboration of some universities, all under the auspices of FAO. In 1969, Shirley and Llauradó, following the recommendations on forest education from the 14th Session of the FAO Conference, Technical Committee on Forests and Forest Products, assessed the number of forestry schools in the region and their projected demand for 1985. This study also estimated the number of forest staff required per country to meet the needs of forest management and conservation, wood production, watershed management, recreation, teaching, research and extension. The result of the study indicated that the region required 6 500 professionals and 30 600 experts, and needed to create the four forest programmes mentioned above. This study did not assess the quality of the programmes; however, it recommends that each country do so according to its needs. The following study reported in the literature was carried out in 2007 in collaboration with the Universidad de Concepción in Chile, the Universidad de los Andes in the Bolivarian Republic of Venezuela and FAO. This study assessed the quality of the programmes through a survey on the productive and academic sectors of 15 countries. In addition, an electronic forum was held in that same year, in which 17 countries participated, represented by 67 individuals who made a total of 90 presentations. In the forum, the discussion topics were the study plans and curricula, as well as employment and proposals for the future. The survey and the forum led to the organization of a Regional Workshop on Forest Education in Latin America, held in Quito, Ecuador in September 2008. At the Workshop, the work programme of the *Red Latinoamericana de Enseñanza Forestal* (RELAFOR, Latin American Network for Forest Education) was discussed and the *Carta de Quito* was declared, which recognizes the value of forest education as a driver of development in the region. The *Carta de Quito* also indicates the inclusion of the concept of teaching for life and sustainability, and encourages countries to include the use of ICTs, and to seek strategies to update study plans so as to facilitate the mobility of students within the region. The Quito Charter also mentions the need to update teaching methods, and calls for academia to participate more actively in developing public policies related to the sector.

Later in 2014, the *Taller Regional Latinoamericano de Educación Forestal* (Latin American Regional Forestry Education Workshop) was held in Peru, sponsored by the Universidad Agraria la Molina and FAO. In this Workshop, in addition to presenting the results of the survey carried out in 15 higher education institutions with forest programmes, the need was identified to define a forest professional profile that would correspond to the demand for knowledge required in the public and private business and community sectors and NGOs.

Therefore, the proposed profile of the forest engineer is defined as follows:

*The forest engineer is a professional with scientific, technical, humanistic and ethical training who has the ability to manage the sustainable use of forest ecosystems for the benefit of society through the organization and/or management of public and private entities, as well as his/her own entrepreneurship, efficiently influencing the forest production value chain. Similarly, he or she participates in the development and implementation of policies aimed at the management of the forest, wildlife, protected natural areas and forest plantations* (Malleux, 2014: 36).

This profile assumes that the forest engineer must have a set of competencies in forestry management and in the humanities, as well as in public and business administration. In order to ensure these competencies, in addition to current topics related to the management of natural and planted forests, it is necessary to include those related to the micro- and macroeconomics, international and national legislation, climate change, business management, project development, financial management, project and community programmes, fundraising, sociology, socio-economics, rural development and research methods (Arce-Rojas, 2014; Malleux, 2014).

In view of the above, the forest engineer would be able to understand the forest holistically as a provider of ecosystem services in order to seek the well-being of rural and urban communities. He or she would also be able to link his/her activities with strategic programmes and national plans that are closely related to international agendas and commitments on climate change, biodiversity conservation, forest governance, landscape restoration and the SDGs.

Although to date there is no study on the labour market offer in the forest sector for the region, the most recent report from the World Economic Forum (WEF) indicates that the traditional business model (business as usual) has no future. The report discusses 15 necessary transitions in three socio-economic systems, which currently threaten biodiversity and global GDP: (i) food, land use and the oceans; (ii) infrastructure; and (iii) extractive activities and the energy sector. The transitions mentioned include solutions in harmony with nature that, if carried out, would allow to build more resilient societies and could also generate up to 395 million jobs by 2030.

Five of the 15 transitions are directly related to forest professionals: ecosystem restoration, sustainable forest management, protection of strategic ecosystems, sustainable consumption, and sustainability of value chains (WEF, 2020). Indeed, there are employment opportunities for forestry professionals in the region because the total land classified as degraded and deforested in the region is around 650 million ha (Vergara *et al.*, 2016) and public policies have included restoration on their agendas.

Additionally, there is strong potential to capitalize on the ecosystem services of forests in a sustainable manner (Balvanera *et al.*, 2012; Giménez, 2017; Guariguata and Evans, 2010) in order to significantly contribute to the achievement of the SDGs and the well-being of the inhabitants of the region (Hernández-Blanco *et al.*, 2020). In light of this, the forest profile proposed in 2014 is in line with the nature-based solutions proposed by the WEF group of experts, who also see community participation, the management of satellite technologies and databases, and forest certification as important tools to implement these solutions.

There are no more recent studies related to forest programmes in the region; however, some countries are reviewing the curricula offer in order to meet the current labour demand that considers the forest from a socio-ecological point of view, with a more multidisciplinary approach (Giménez, 2017; Jiménez, 2004; Villarraga-Florez, Rodríguez-Pineros and Martínez-Cortés, 2016).

The protection and sustainable management of forests should not be a task exclusively for forest engineers and technicians. Various studies have shown that an attitude of care and respect for nature is developed in the early stages of education (Broom, 2017). However, the legislation explicitly mentions forest education for the primary and secondary levels in only four countries in the region. It should be noted that, in most countries of the region, environmental education legislation has developed in recent years, which is why some concepts related to the forest have been adopted as part of environmental education at the formal basic education and non-formal education levels. It is essential to strengthen the transmission of knowledge to children and youth about forests and their ecosystem services in order to build a society that seeks solutions in harmony with nature.

### 3. METHODOLOGY

This report presents the analysis of three surveys designed to explore the state of forest education worldwide. The surveys were registered on the Weboprol platform, according to the security, ethics and data processing protocols of the European Union. The three surveys targeted different forest sector actors, as follows:

- Forest professionals working in government organisations, business organizations (the private sector), labour unions, forest owners' associations and environmental and other non-governmental organizations (Questionnaire 1).
- Teachers and administrators in primary schools, secondary schools, TVET institutions, and in universities and colleges (Questionnaire 2).
- enrolled or recently graduated students of forestry and forest-related programmes in TVET schools and in universities and colleges (Questionnaire 3).

For the sake of brevity, these groups are referred to hereafter in the report as 'professionals', 'teachers' and 'students'.

The questions asked in the survey covered a range of topics including education content and competencies; teaching approaches, educational resources and policy, workplace readiness and employability (of TVET and university and college students and recent graduates), digital readiness (for secondary, TVET and university and college students), and general development and trends in TVET and university and college education. Most of the questions use a Likert scale in which several response options were provided to choose from. Some questions were open-ended, permitting the respondent to write in a response. The survey questions were multiple-choice and, in some cases, open-ended. The questions in the Q1 and Q2 surveys are similar and are mostly related to the four levels of education: primary, secondary, TVET and university. It is important to clarify that the same respondent may have answered the survey for more than one level of education. Similarly, given that the questions were not mandatory, some respondents omitted some of them, i.e. the total of the individual analysis of questions do not necessarily coincide with the total number of responses. Table 3.1 (Appendix I) shows the distribution of the responses for each of the levels in each of the questionnaires.

Sampling of the target groups consisted of statistical sampling and snowball sampling. For the statistical sample, a subset of countries in the region was selected, and individuals, organizations and institutions in the three target groups in these countries were identified and sent survey invitations. Snowball sampling was achieved through sending an open invitation to take the survey through social media channels, such as Twitter; promoting the survey through the use of the Global Forest Education hashtag (#globalforesteducation) and through web stories prepared by the partners (e.g. FAO's web story upon the release of the survey on 15 July 2020 <http://www.fao.org/forestry/news/97465/en/>), sending survey announcements to project partners' membership or contact lists, and encouraging survey respondents to forward the survey invitation to their contacts, networks and colleagues. The regional data analysis was based on the total responses received, combining both statistical and snowball survey responses.

In the LAC region, both statistical sample and snowball were used for distribution. For the statistical sample, three databases of emails obtained through the Google search engine were created in an exhaustive review of the participants in eight countries: Argentina, Brazil, Colombia, Chile, Costa Rica, Ecuador, Mexico and Peru. Over 80 percent of the region's forest cover in the region is found in these countries (FAO, 2015).

Regarding the Q1 survey, the database contains specific information: country, name of the organization, type (NGO, government, association, etc.), contact email, website, main office address and observations. A total of 616 emails were obtained.

The database for the Q2 survey includes the following information: country, state or province, municipality, name of the institution, level (primary or secondary), type (private or public), location (rural or urban), contact email and phone number. A total of 1 289 emails were used for this survey. For the TVET and university programmes, all the programmes with a website in the countries mentioned were considered, from which the emails of the directors-deans and/or programme coordinators were drawn, together with those of the professors of the undergraduate and graduate programmes. Therefore, there was a total of 901 emails for the TVET and university levels.

For the Q3 survey, the database was obtained from the list of 1 333 participants of Reforestamos' *Joven Emprendedor Forestal* (Young Forestry Entrepreneur Programme) for the 2017–2019 period.

The second type of sampling, snowball, was carried out through social networks (Facebook, WhatsApp groups, LinkedIn and personal emails) for Q1 and Q2; for Q3, IFSA was consulted for the distribution of the survey through its members. Table 3.2 (Appendix I) shows the number of emails from the statistical sample with the number of responses from the two samples. The survey was structured into five sections, as follows:

1. Content of the programmes and competencies
2. Education policies and resources
3. Teaching-learning activities.
4. Learning outcomes.
5. Demographics.

## 4. RESULTS

The quantitative data were analysed with the Weboprol® analysis commands using Excel, while Atlas.ti 8® software was used for the analysis of qualitative data from the open questions. From the analysis of the data and the comments made by the respondents, a series of recommendations emerged, which will be implemented to strengthen forest education at the four levels of education.

This section presents, for each of the levels of education, the perceptions of the survey respondents regarding the content of the programmes and competencies, the resources, the teaching materials and policies available, as well as the teaching and learning activities and their results.

In total, 896 responses were collected, of which 274 were from the Q1 group, 333 from the Q2 group and 289 from the Q3 group. It is important to mention that the respondents from the Q1 and Q2 groups could answer for each of the education levels; therefore, if all the responses from the levels are added together, the total number of responses will be 1 168.

The demographic data indicate that 65.7 percent of the respondents in Q1 indicated that they were male and the remaining 34.3 percent, female. In addition, 63.8 percent of the respondents indicated that they belonged to an ethnic majority; 11.1 percent, a minority; 19.6 percent indicated that the question did not apply; and the remaining did not answer. Most of the respondents (46.6 percent) indicated that they belonged to the government sector, and the remaining were distributed among environmental NGOs, the business sector and, to a lesser extent, forest owners.

Regarding the Q2 survey, 66.1 percent of the respondents indicated that they were male, 32.7 percent female, and the remaining 1.2 percent did not answer. In addition, 70 percent indicated that they belonged to the ethnic majority group; 6.6 percent, a minority; and 18.8 percent indicated that the question did not apply to their case; the remaining chose not to answer. Further, 1.8 percent of the respondents indicated that they were primary school teachers, 4.9 percent, secondary school teachers; 2.1 percent education administrators; 4.1 percent, TVET school teachers; 65.7 percent, university teachers; 7.2 percent, directors or coordinators of university programmes; and 14.2 percent indicated 'other'. Regarding academic degrees, 27.9 percent had a university degree, 29 percent had a master's degree, 33.1 percent had a doctoral degree and the remaining indicated that they had completed a continuing education programme. Most of the teachers indicated that they had over 20 years of teaching experience (39.1 percent); the remaining indicated: 3 to 5 years (9.5 percent), 6 to 10 years (18.3 percent), 11 to 15 years (16.5 percent) and 16 to 20 years (12.5 percent).

Regarding the Q3 group, 60.2 percent of the respondents indicated that they were female and the remaining, male. Moreover, 51.6 percent of the respondents indicated that they were from the majority ethnic group; 7.6 percent from a minority ethnic group; 31.2 percent indicated that this answer did not apply; and 9.6 percent preferred not to say.

For the analysis of the primary and secondary education data, the responses from the Q1 and Q2 surveys were combined at each of the levels. For the analysis of TVET and university education (undergraduate and graduate), the data from Q1, Q2 and Q3 were combined.

The quantitative results of the data are presented in figures in Appendix II for the primary, secondary and TVET levels, and in Appendix III for the undergraduate and graduate levels, and the responses of all university levels (presented in section 4.4.3).

### 4.1. Primary education

Knowing certain aspects related to the forest at an early age is essential for achieving the Sustainable Development Goals and targets set for 2030. There were a total of 15 responses obtained for this level. Of the total number of respondents, 113 belonged to the Q1 survey (professionals) and 38 to the Q2 survey (teachers).

### **4.1.1. Content of the programmes and competencies**

There was a clear agreement among respondents of Q1 and Q2 on the reduced presence in the primary curricula of topics related to forests, as individual topics or as part of other topics. Indeed, the respondents of the two groups agreed that the topics that included forestry content should be included as individual topics in the curricula, or at least should be incorporated into other subjects (A1 and A3).

There is a striking lack of topics in the curricula related to the value of the forest for the well-being of society or its cultural and social importance, as well as forest products, while environmental observation was given slightly more importance in the curricula (A2.1 to A2.3). From the open-ended survey, respondents recommended including topics related to forest ecosystem services, forest management and use, conservation, biodiversity, forests and the community, and climate change.

### **4.1.2. Teaching-learning activities**

The use of the forest as a teaching environment of classroom is not considered a common practice in the LAC region (A6); yet, environmental observation is the most relevant topic in the curricula. This suggests that teachers prefer to teach about their immediate surroundings, such as parks, school gardens, or their locality, but not necessarily in the forest. This result corroborates the lack of practical opportunities and the low level of learning of the current extracurricular activities (A11). Respondents indicated that extracurricular activities contributed significantly to learning about forests despite the fact that, as mentioned, they were not practised regularly (A12). Some of the activities that students engaged in outside of school were visits to botanical gardens, camping clubs, forest walks, and visits to nurseries.

Since direct experience with the forest is limited, the teaching methods used regularly by teachers are lectures, individual reading and writing assignments, and project-based learning (A9). However, the respondents indicated that they had little preparation in the use of digital technology in teaching (A5). These factors limit children's learning about forests and their interest in nature and natural resources (A8).

When asking teachers and education administrators what are the three activities they would like to implement in their school to improve knowledge of forests, they indicated outdoor learning, guest speakers, and project-based learning (A10).

Survey respondents indicated that extracurricular activities had not been the means to learn about forests, but considered them a useful tool for effective learning.

### **4.1.3. Education policies and resources**

For education to be effective, educational resources and policies play an important role, both in the classroom and at the administrative level. The survey focused in particular on the existence of policies or strategies that lead to improving forest education. Although the largest share of those surveyed indicated that there were no clear policies or strategies to this end, they did not exceed 50 percent of those surveyed. The survey reflects the presence of policies or strategies leading to improved forest-related curriculum in primary schools at the government, board or school level (A4).

Regarding the volume and level of the teachers' preparation, most of the respondents felt that the number of teachers was partially sufficient and that they were prepared to teach concepts related to the forest, in particular aspects of forest flora and fauna, forest management, the contribution of the forest to global issues such as biodiversity, renewable energy, food security, water, as well as other aspects of sustainability. Laboratory resources such as textbooks, online learning material and other tools needed for effective teaching and practical opportunities were lacking (A7).

## **4.2. Secondary education**

Secondary education plays an important role in preparing young people for entering the labour market, technical school or university, and helps them expand their individual options and improve their work and personal skills. Therefore, knowledge about forests is essential at this level of education if wishing to increase the number of forest technicians and professionals or to raise awareness among the population about forest management.

In order to analyse secondary education, the answers from the Q1 and Q2 surveys were used. There were a total of 161 questions, 52 of which from teachers and education administrators.

### **4.2.1 Content of the programmes and competencies**

Survey respondents revealed the scant attention paid to forest topics in secondary school curricula, both in individual topics and in additional content. For this reason, the two groups of respondents agreed that forest-related topics should be included in the curricula (A13 and A14).

The relationship between forests and biodiversity, water and climate change are topics sufficiently covered in secondary school curricula, as is deforestation and respect for nature. However, topics such as forest ecology, wood and non-wood products, wood as an energy source, ancestral knowledge and its relationship with the forest, and recreational and cultural values are not sufficiently covered. There is a difference between the perception of the teachers and that of the group of Q1 respondents regarding topics of the forest, climate change and deforestation. The teachers felt that these topics were sufficiently covered, while the other respondents felt that they were inadequately covered (A21.1, A21.2 and A21.3).

In the open questions, the respondents indicated that it was possible to integrate topics such as productive chains and the calculation of wood volumes in topics such as mathematics, and also suggested ecotourism and forestry. The common denominator of the perceptions is that knowledge of the forest is cross-cutting, and therefore the concept of sustainable management can be covered in areas such as history, natural sciences and the environment.

### **4.2.2 Educational resources and policies**

There are limited resources available for effective teaching, such as teaching resources, learning materials, such as textbooks, laboratories, and hands-on opportunities such as field visits (A15). In general, teachers felt that they had the capacities to teach aspects related to the forests, including sufficient skills in digital technology in teaching (A17). The survey also showed that in some instances there are forest-related policies and strategies for education present, both at the government and at school level., although not always the case(A16).

### **4.2.3 Teaching-learning activities**

At this level, the forest is used as a classroom to a limited extent, and activities outside the school are carried out such as visits to botanical gardens, field trips, visits to orchards, ecological walks to peri-urban forests, gatherings in parks and cleaning beaches or ecological parks and camps. However, although these activities are limited, the survey respondents considered them crucial for increasing knowledge and appreciation of the forest (A18 and A19).

### **4.2.4 Learning outcomes**

Secondary education fails to stimulate students' interest in continuing their learning about forests or related topics (A20). Given the low coverage of these topics and poor understanding of sustainable forest management, students do not show a very high motivation for entering technical or university forest programmes (A22). This is partly because they do not see the forest as a source of employment, and because salaries are very low compared to other professions. However, there are some secondary schools specialized in agriculture that enable students to continue the study in this field at the technical or university level.

## **4.3 Technical and Vocational Education and Training**

The professionalization of forest education begins at the TVET level, whose programmes are characterized by a duration of two or three years after basic secondary education; however, some countries in the region have a system that prepares forest technicians during the last three years of secondary education. Forest technicians are trained to apply forest production techniques and methods, manage nurseries, prepare management and utilization plans, identify the health status of plants, manage fires, and learn about the primary wood processing. Forest technicians are expected to perform supervisory functions, so they must develop their skills managing staff in the field and have knowledge of safety and hygiene (applicable in each country). In general, the forest technician is responsible for the operations necessary for wood production, use and processing.

Of the 1 168 responses of the LAC region, 137 were collected on the TVET education level. For data analysis, the responses of the three surveys (Q1, Q2 and Q3) were compared.

### **4.3.1 Contents of the programmes and competencies**

For most of the respondents in the three surveys, topics related to forest resources, such as forest soils, biodiversity, forest ecology and forest products, were sufficiently covered in the curricula of TVET programmes. However, with respect to forest genetics themes, there was a discrepancy between the opinions of students, teachers and professionals: 60 percent of students felt that the topic was sufficiently covered, while 52 percent of teachers and 70 percent of professionals felt that it was inadequately covered (A28).

In general, for the three groups of respondents, topics related to forest planning and management (forests and climate change, remote sensing, inventories, forest mapping, planning and forestry) were sufficiently covered in the curricula. However, there were some discrepancies in the percentages of the perception of each group with each topic: 70 percent of the students and 50 percent of the teachers felt that the topic of forests and climate change was sufficiently covered, but close to 10 percent of the teachers felt that the topic was covered excessively, while a little over 50 percent of professionals felt that the topic was inadequately covered (A29.1).

There are highly diverse opinions among the three groups of respondents regarding the topics of landscape restoration, grasslands management, sustainable land use systems, agroforestry and watershed management. Most students felt that these topics were sufficiently covered, while most of the professional sector felt that the topics were inadequately covered. Just over 50 percent of the teachers felt that the topics of landscape restoration and grasslands management were inadequately covered, and just over 50 percent of the teachers felt that the other topics were sufficiently covered (A29.2).

In addition, most students felt that the topics of wildlife management, forest health (pests and diseases), forest fire management, forest conservation and urban forestry were sufficiently covered in the curricula. However, most professionals felt these topics were inadequately covered, particularly urban forests. In the group of teachers, there were differences with respect to these topics: 50 percent felt that the management of wildlife and fire were sufficiently covered topics, while 65 percent felt that the topic of urban forests was not covered in the curricula (A29.3).

Regarding forest services and the cultural and social aspects of forests, most of the students felt that the topics of forests for recreation, their cultural values, their relationship with human health, and gender and ethnicity aspects were sufficiently covered in curricula. In contrast, most of the teachers and professionals highlighted that these topics were not covered in the curricula. The respondents of the three questionnaires agreed that wood as a renewable energy source, and indigenous and traditional knowledge were adequately covered in the curricula (A30.1 and A30.2).

Topics related to forest companies (entrepreneurship, forest industries, marketing, wood technology and small forest companies) seem to be included slightly more in the curricula, according to the perception of most of the students. However, teachers and professionals felt that these topics were inadequately covered (A31).

Most of the students (60 percent) and teachers (55 percent) felt that forest economics was sufficiently covered. Similarly, most students (55 percent) believed that forest policy and legislation was sufficiently covered, whereas most groups of teachers and professionals (55 percent and 65 percent, respectively) indicated the opposite. It should be noted that 20 percent of the students felt that the topic of forest economics was covered to a large extent (A32).

More than 60 percent of the respondents in the three groups felt that basic science and mathematics were sufficiently considered in the curricula. Regarding oral and written communication skills, most of the professionals (66 percent) felt that they were not sufficiently covered, but most of the teachers (53 percent) and students (70 percent), that they were sufficiently covered; 20 percent of students felt that they were covered to a large extent. Regarding forest extension and agroforestry skills, 73 percent of the students felt that they were sufficiently covered in the curricula, while 64 percent and 56 percent of the professionals and teachers, respectively, felt that they were not.

Regarding the skills to manage forest nurseries, the general perception was that they were sufficiently covered in the curriculum (A33.1). Most students and teachers highlighted that wood harvesting operations with harvesting machines and manual tools, timber extraction and transport, and other mechanized work (e.g. site preparation) were skills that were sufficiently covered in the curricula of TVET programmes. In contrast, most professionals felt that these skills were inadequately covered, except for site preparation. Regarding professional ethics, 68 percent and 65 percent of professionals and teachers, respectively, felt that it was not sufficiently covered in the curricula, while 40 percent of the students felt that it was sufficiently covered and 30 percent, that it was covered to a large extent (“very much”) (A33.2).

In the open questions, Q1 respondents stated that the three topics and skills that should be included in TVET education were forest industries, soft skills, and the use of digital technology. Teachers and education administrators believed that more topics related to sustainable forest management, community activities, and forest policy and legislation should be included. In addition, students felt that content should be included on the management of forest programmes and equipment, in addition to incorporating forestry policy and resilient cities.

The students believed that the most important knowledge they obtained was related to applied forest science, entrepreneurship and soft skills. However, this information should be interpreted with caution, because it is not known with certainty the semester or year in which the students were enrolled at the time of answering the survey. Additionally, it is important to recall that part of the database was obtained from the *Joven Emprendedor Forestal* (Young Forest Entrepreneur Programme) of Reforestamos México, so it is likely that many of the students had participated in the entrepreneurship courses offered by Reforestamos, which are not necessarily part of the curriculum.

In the survey, teachers were asked about the modifications made to the programmes in the last five years: six indicated that several updates were made to the programmes: two referred to the change in educational modality (from technical to specialization); two referred to the structural changes of the programmes; one spoke about a programme that was created; and one spoke about re-accreditation. When asked who participated in the modifications of the programmes, most of the respondents (13) said that these changes occurred in the academic sector, while only three mentioned state and labour entities.

### **4.3.2 Educational resources and policies**

The available resources and policies related to education, both at the governmental level and within the institutions, are very important in the teaching and learning process. However, 76 percent of the Q1 respondents felt that the quantity and quality of teaching materials were limited or non-existent at a technical level, while 49 percent of the teachers felt that they were moderate. Fifty-three percent of the teachers indicated that they had sufficient learning materials, a perception not shared by the Q1 respondents. Most respondents in the two groups agreed that laboratory access, class size and other educational spaces was scarce or non-existent (“not at all”). And most of the teachers (50 percent) and professionals (61 percent) indicated that practical opportunities were limited or inexistent (A23).

Regarding governmental or school policies of programmes, most of the teachers indicated that there were policies or strategies to improve the quality of education; however, a low percentage of the respondents in Q1 indicated that they were familiar with them (A24).

When asking the three groups of respondents about the extra-curricular activities in which the students participated, the largest share (64 percent) of the professionals indicated that they were inexistent or limited, while 50 percent of teachers indicated that they were a moderate number or many. Also, 55 percent of the students indicated that there were a moderate number. Most of the respondents in the three groups felt that these activities helped to a moderate or great extent (Q1, 60 percent; Q2, 72 percent; and Q3, 91 percent).

Regarding the availability of part-time jobs and/or internship opportunities, the largest share of respondents in Q1, Q2 and Q3 (71 percent, 49 percent and 82 percent, respectively) indicated that they were limited or inexistent; 5 percent of the teachers indicated that they did not know how to answer this question. When asked if part-time jobs and internships enriched student learning, most respondents in the three groups agreed that they would “very much” (i.e. to a great extent) (46 percent, 58 percent, and 64 percent, respectively). Another significant percentage chose the option 'moderately' in each of the three groups (A26).

In the open questions, among the most frequent extracurricular activities, the respondents mentioned protection and restoration of forests, in addition to lectures and technical field visits. It should be noted that most teachers viewed internships as extracurricular activities.

### **4.3.3 Preparation for the labour market**

When the respondents were asked if they believed that the education that students received prepared them for entering the labour market, the responses were different in the three groups: the largest share of the respondents (41 percent) of Q1 believed that it prepared them to a limited extent, 33 percent (the largest share) of the teachers believed that it prepared them to a moderate extent, and most of the students (60 percent) marked the option ‘very much’ (A34).

When asking about the gaps between TVET education and the needs of the labour market, the respondents highlighted the lack of practical experience prior to graduation, the lack of coordination between bodies, the scarce knowledge in economics, the lack of soft skills, and poor use of digital technology. It is interesting to note that scarce knowledge in economics is mentioned since this area received the highest assessment in the content chapter.

Gender and ethnicity are a factor that may have an influence on finding employment. The survey allowed to observe how the respondents perceived these issues and their influence on the forestry labour market. When asking if gender is a factor that influences the chances of the graduate to find employment, the answers were relatively homogeneous in each group for each option (‘not at all’, ‘to a limited extent’, ‘to a moderate extent’ and ‘to a great extent’). The 31 percent and 41 percent of the respondents (the largest share) from Q1 and Q2, respectively, indicated that it was a factor that affected chances of finding employment to a moderate extent, while 36 percent of the students (Q3) indicated that it was a factor that affected chances to a great extent. The responses regarding the influence of gender on the type of professional work were as follows: 36 percent, to a great extent; 35 percent, to a moderate extent; and 36 percent, to a limited extent (for Q1, Q2 and Q3, respectively).

The same two questions were asked regarding ethnicity. Most of the Q1 and Q2 respondents responded that it was not a decisive factor, while most of the students (Q3) responded that it was, but to a limited extent (A35). With respect to the factors that affect job opportunities, respondents mentioned lack of experience, lack of job opportunities in the sector, personal qualities of candidates, and gender.

Continuing education is important as part of the learning process and for opportunities to improve employment. When assessing the respondents’ perception on the economic ease of accessing continuing education, 57 percent of the Q1 group indicated that it was accessible to a limited extent, 35 percent of the teachers (Q2) indicated 'to a moderate extent, and 27 percent of the students (Q3) said ‘no’. However, another 27 percent of this same group

indicated that they were unable to answer the question because they were still enrolled in a formal programme. In the open question, students stated that due to the need to travel and low income, they could not access continuing education (A25).

#### **4.3.4 Use of digital technology**

The use of digital technology has been an important factor in education, but is highly debatable in forest education. The survey inquired about the digital technology used in teaching and asked the respondents if they considered their use a valuable complement to forest education at the TVET level: 36 percent of the Q1 respondents indicated that there was a limited use of digital technology and 64 percent considered it an extremely important complement to learning. Among the group of teachers and education administrators, 43 percent indicated that they were used to a moderate extent, and 65 percent considered them extremely important for learning. In contrast, 36 percent of the students indicated that they were used very much and 45 percent, that they were very important for learning (A27).

In the open questions, the respondents argued that the use of digital technology should be strengthened in addition to serving as support for exercises and for students to clarify doubts when outside the classroom. However, they also indicated that in some very remote places, there was not even Internet and that therefore the use of digital learning tools was inexistent.

#### **4.3.5 Developments and trends at the TVET level**

Concerning the number of students who enrolled in TVET-level programmes, most teachers and education administrators indicated that the number of students enrolled had remained stable over the last decade. However, most Q1 respondents felt that the number of registered students had decreased (A36). When asking the respondents about policy initiatives or decisions that affected the quality of forest education, it emerged that educational reforms made in the sector tended to improve quality. In this regard, the compulsory licensing of technical and public institutes was mentioned as a government measure that improved the quality of technical education. The *Programa de Certificación de Competencias Laborales y Formación Continua* (Labour Skills Certificate Programme Skills) and Continuing Training and the establishment of the *Instituto Nacional de Formación Técnica* (National Institute of Technical Training) were also mentioned as two government initiatives in Argentina, which have helped to standardize and improve technical education in the country.

However, it was also mentioned that national policies did not include the forest sector, and that low investment and low rates of reforestation diminished the quality of forest education. In addition, low teaching salaries, the lack of infrastructure in schools, the closure of some research institutes, and insecurity in rural areas were mentioned as factors that affected the quality of education. The COVID-19 pandemic clearly highlighted how the education community was unprepared for virtual classes, and it also led to the complete cancellation of field work.

### **4.4 The university level**

For the data analysis of this report, the information presented by the respondents of the three surveys was considered. The term ‘undergraduate’ refers to all higher studies that offer a bachelor's or engineering degree, with an approximate duration of 4 to 5 years, and in some cases, 6 years. The undergraduate degree is a prerequisite for entry into a postgraduate degree (master's and doctoral). Although in the LAC region, there are postgraduate modalities that are different from the conventional ones, such as specialization and diploma, this study will focus on master's (two years or more) and doctorate degrees (three years or more).

The results presented here in this section are from all three groups of participants. Of the 217 respondents from the group of professionals who answered the questionnaire on assessing the university level, 43 percent assessed the undergraduate programmes; 19 percent, the master's programmes; 8 percent, the doctoral programmes; 23 percent, all the programmes together; and around 7 percent assessed the associate level.

Of the 266 respondents in the group of teachers and education administrators (Q2), 69 percent assessed the undergraduate programmes, 15 percent, the master's programmes, 11 percent, the doctoral programmes, and 5 percent, the associate programmes.

Regarding the students (Q3), 75 percent of the 253 respondents answered the questions on assessing the undergraduate programmes; 6 percent, the master's programmes; another 6 percent, doctoral programmes; 2 percent, associate programmes, and 6 percent, TVET programmes (discussed in the previous section). It is interesting to note that 5 percent of the students said that they assessed other types of programmes: forest engineering, forest engineering student, thesis programme, bachelor's degree in environmental information, technical degree in environmental information and biology, and diploma in environmental restoration and rehabilitation.

Given the low number of responses for associate programmes and the limited availability of information on them, their assessment was not included in this report.

#### **4.4.1 Undergraduate programmes**

A total of 508 responses were received regarding this level of education. Most undergraduate programmes in forest and related sciences offered by public or private universities have different names, such as forest engineering, bachelor's degree in forest engineering, forest restoration engineering, forest sciences, forest science engineering, forest and environmental engineering, engineering in renewable natural resources, bachelor's degree in agroecology, bachelor's degree in the agricultural sciences specialized in forestry, bachelor's degree in forestry, forest engineering with a focus on ecosystem conservation and restoration, industrial forestry engineering, forest engineering with a focus on forestry and forest management, and in some cases, environmental engineering. The term '*bachillerato*' (bachelor's degree) comes from its Portuguese translation.

From the open questions, the numbers and names of undergraduate programmes assessed by the students were identified; 165 responses were given by forest engineering students, of whom 34 were in bachelor's degrees in forest engineering, five in forest restoration, four in natural resources engineering and three in forest-environment engineering programmes. At least one student from each of the following programmes also participated: Bachelor's Degree in Agroecology; Bachelor's Degree in Agricultural Science with a specialization in forestry; Bachelor's Degree in forestry, environmental information, and environmental engineering; industrial forestry engineer; Bachelor's Degree in Geography; Bachelor's Degree in Environmental Information; and Bachelor's Degree in Forest Engineering with a focus on forestry and forest management.

##### **4.4.1.1 Content of the programmes and competencies**

The content of the programmes was analysed in separate thematic groups, as follows: Forest resources and forest ecology:

- forest biodiversityforest soils
- forest ecology
- wood and non-wood forest products
- forest genetics

Management and planning:

- forests and climate change
- forest mapping, inventory, remote sensing and GIS
- forest planning
- forestry
- forest landscape restoration
- grasslands management
- sustainable use practices

- agroforestry
- watershed management
- wildlife management
- forest health/sanitation (pests and diseases)
- forest fire management
- forest conservation
- urban forests

Forest services and social and cultural aspects:

- wood as renewable energy
- forests for recreation
- indigenous knowledge and traditions related to the forest
- cultural values of forests and trees
- forests and human health
- forests, trees and gender aspects
- forests, trees and ethnic aspects

Forest enterprises:

- entrepreneurship
- industry, trade and forest management
- wood technology
- small forestry companies (wood and non-wood products)

Forest policy and economics:

- forest policy and legislation
- forest ownership and governance
- forest economics/resource economics/environmental economics.

Most of the respondents felt that the topics of *biodiversity and forest ecology* were sufficiently covered. Regarding the topics of forest soils, genetics and wood and non-wood products, there is a discrepancy between the opinion of the professionals of the survey, and those of the teachers and students. For 32 percent of the respondents in Q1, the topic of soils was inadequately covered, while for those of the other two groups, it was sufficiently covered. The same is perceived with regard to wood and non-wood products, and forest genetics; the respondents of Q1 felt that the topics were not sufficiently covered (48 percent and 72 percent, respectively), while most of the other two groups of respondents felt that they were (A55).

Regarding the topics of forest planning and management, the responses are more homogenous among the three groups of respondents, with only small percentage differences between the groups. Most felt that the topics of climate change and forest restoration were inadequately covered, while the topics of inventories, remote sensing, forestry and forest planning were deemed sufficiently covered by most of the respondents of the three groups (A58).

The respondents of the three groups felt that the topics of rangelands (grasslands) management, wildlife management, fire management, agroforestry and urban forests were not sufficiently covered, while the largest share of respondents felt that the topics of sustainable use systems, forest conservation and watershed management were sufficiently covered. With regard to the topic of forest health, almost 50 percent of the group of professionals felt that it was inadequately covered, while most of the respondents of the other two groups felt that it was sufficiently covered (A61 and A63).

Most of the respondents in the three groups felt that topics related to forest services, and cultural and social aspects were inadequately covered in the curricula. The topics mentioned were: wood as renewable energy; forests for recreation; indigenous knowledge and traditions; cultural values of forests and trees; forests and human health; forests, trees and gender aspects; and forests, trees and ethnic aspects (A65 and A68).

With respect to topics related to forestry companies, there were different opinions. For most respondents in Q1 and Q2 (72 percent and 55 percent, respectively) the topic of entrepreneurship was not sufficiently covered, while for 55 percent of the students (Q3), it was sufficiently covered. For the 70 percent of the respondents in Q2 and Q3, the topic of industry, trade and forest management was sufficiently covered, while for the 47 percent of the Q1 group, it was not. Participants agreed that the topic of wood technology was sufficiently covered. It is interesting to observe that 75 percent of the teachers held this opinion, yet for the same group, the topic of forestry companies was not sufficiently covered (A70).

Most of the respondents felt that the forest policy issue was sufficiently covered, but many disagreed regarding the curricula coverage of the governance and economics topics: 61 percent of Q1 believed that the issue of forest governance was inadequately covered, and close to 45 percent of the same group felt the same regarding the issue of economics (A73).

In addition to the content of the programmes, extra-curricular activities are important for acquiring knowledge, and participants can engage in them within student associations, outreach programmes and thematic groups or clubs. Twenty percent of the students indicated that they had participated fully in these types of activities, 40 percent to a moderate extent, 22 percent to a limited extent; and the remaining did not participate. However, Q1 and Q2 respondents felt that the students (Q3) were engaged in extracurricular activities to a moderate or limited extent (A41).

All of the respondents listed some topics that, according to their criteria, should be included in the forest curricula. Most of the respondents of Q1 mentioned soft skills, such as communication, literacy, critical thinking and teamwork. This group also noted the importance of including topics in which students could learn about the forest and the community, such as sociology and forest anthropology. Finally, they mentioned the importance of including managerial aspects such as forest business management, entrepreneurship, project management, human resources and quality management, and information technology management.

Teachers and education administrators felt that it was necessary to include topics where soft skills were developed, which include professional ethics, forest economics, ecosystem resources and services, socio-environmental topics, forest policy and legislation, and information management technology. In addition, students felt that it was necessary to include topics on forest production, sustainability, social aspects, digital technology, research, entrepreneurship, and some soft skills such as ethics and effective communication with professionals.

#### ***4.4.1.2 Educational resources and policies***

The largest share (50 percent or more) of the respondents in the three groups agreed that the resources to pursue a forest programme were available to a moderate extent or fully available. These resources are: quality and quantity of teaching resources, such as books, online materials, laboratories and practical opportunities (A37).

With respect to the existence of policies or strategies that help to improve the quality of forest education, the respondents of the Q1 and Q2 groups indicated that there were governmental policies at the level of the institution (university) or within the programmes. However, the same number of respondents indicated that there were no clear policies or strategies in this regard (A40).

#### ***4.4.1.3 Preparation for the labour market***

The quality of education is not only related to the theoretical content of the programmes; accessibility to professional experience prior to graduation complements a successful programme. Regarding the availability of part-time employment or internships, the academic respondents (Q2, 78 percent and Q3, 95 percent) indicated that they did not exist (or were not included in the curriculum); however, the largest share (80 percent) of professionals (Q1) indicated

that they were available to a limited extent. Moreover, 90 percent of students (Q3) indicated that these activities did not increase learning, but 65 percent of Q1 and 50 percent of Q2 participants indicated that they did to a moderate extent or very much (A76).

Most of the respondents in the three groups (Q1, 50 percent, Q2, 78 percent and Q3, 75 percent) agreed that the programme prepared students to a moderate extent or a great extent ('very much') for entering the labour market (A78).

Among the extracurricular activities that students carried out, the respondents of Q1 mentioned: attending conferences; drafting a thesis in an organization; supporting fire brigades and student groups who participate in environmental conferences; and volunteering in carrying out forest inventories or as park rangers in national natural parks. Teachers and education administrators listed carrying out seedbed research activities, developing projects with communities, supporting reforestation campaigns, pursuing environmental education in communities, attending conferences and participating in social services.

In contrast, students mentioned participating in student clubs, carrying out conservation and restoration activities, and participating in research and in conferences.

The largest share of the respondents of the three groups (57 percent, 45 percent and 58 percent, respectively) indicated that gender was a factor that influenced the search for jobs related to the forest to a moderate extent or fully, and that it also influenced the type of jobs for which graduates were considered. Less than 25 percent of the groups indicated that gender had no influence on the job search nor did it influence the type of jobs. It should be observed that more than 10 percent of the groups indicated that it influenced the job search very much and that it had an influence on the type of jobs (A81).

Regarding the influence of belonging to an ethnic group on the job search, the respondents had varied opinions: most of the students and teachers (63 percent and 51 percent, respectively) highlighted that this factor had no influence, while 45 percent of the professionals in Q1 indicated 'moderate' or 'very much' (A84).

Continuing education as an important component of professional experience appears to be limited; more than 50 percent of the respondents in the three groups indicated that it was 'not at all' available or that it was available to a limited extent (A87).

With respect to the gaps between forest education and the labour market, the Q1 respondents raised some relevant comments: they felt that the programmes were outdated with respect to the current demands of the sector, and that there was a huge gap in soft skills, which causes a lack of practical experience and work with communities. They also felt that there was a lack of knowledge of the administrative aspect of forests, which includes entrepreneurship, forest economics, project management and human resources management.

Teachers and education administrators mentioned the lack of soft skills, entrepreneurship and innovation, internships, field visits, and the lack of education policies that would guarantee the updating of curricula and investment to improve institutions. The students mentioned that the greatest gap was the lack of practical experience prior to graduation and also mentioned the lack of topics that would increase the development of soft skills and aspects of forest management.

The current situation of the forest sector was mentioned as one of the factors affecting employment opportunities. Public policies did not consider the forest sector in their priorities, nor the lack of personal skills (soft skills), nor the lack of professional experience, which are directly related to lack of experience; in addition, some respondents indicated state topics such as public order.

#### ***4.4.1.4 Use of digital technology***

Most of the respondents in the three groups (Q1, 55 percent; Q2, 58 percent; and Q3, 63 percent, respectively) agreed that digital technology for learning was used to a moderate or large extent. However, it is important to note that almost 40 percent of each of the three groups felt that the use of digital technology was limited. More than 60 percent in each of the three groups felt that digital learning tools could be a highly valuable for supplementing forest education (A44).

Regarding the analysis of qualitative data, the respondents indicated that the theoretical content could be obtained through digital platforms to give more space to practical content. In addition, digital technology facilitates access to updated information in real time; therefore, it is a good complement to forest education. Participants believed that the geographic information system (GIS) used digital technology as a highly useful tool in the forest sector. The use of digital technology is also mentioned as a fundamental tool due to the COVID-19 pandemic. However, the respondents expressed concern about the fieldwork, which implies that the students did not have opportunities to participate.

There were differences between the digital technology used by teachers and students, and those used by professionals. The tools most used by the three groups were communication and publication, followed by tools for editing and sharing documents, for meetings and conferences, and geospatial technologies; the latter were the tools most used by respondents in the professional sector, who also used digital technology for field and mill operations in contrast to the teachers and students, who did not usually use them (A47).

In general, respondents were not very familiar with current online platforms for digital content: 80 percent of the students were familiar with the FAO Learning Academy tool, while only 49 percent of teachers and education administrators said that they knew about this tool, while just over 60 percent of the professionals surveyed indicated that they were familiar with this tool. More students than teachers knew about the Global Forest Information System (GFIS) platform. The other tools, Forest Learning, Project Learning Tree, FAO SFM Toolbox, and the GLF Landscape Academy, were almost unknown to all three participating groups (A52).

Among the three digital technologies that teachers and students wanted to include in their curricula were digital tools for field and sawmill operations, followed by augmented reality and online research tools. Students, in particular, would like to use more online learning platforms and were confident that they could learn about communication and publication tools (A50).

#### **4.4.1.5 Developments and trends at the undergraduate level**

The professionals stated that enrolment in the last ten years was increasing, whereas 80 percent teachers and education administrators stated that it remained stable (A90).

About 70 percent of Q2 respondents believed that students were up-to-date on topics of importance to the forest sector, such as the SDGs; 58 percent of Q1 respondents did not share the same opinion (A93).

With regard to the key events and initiatives that have either harmed or improved forest education, some of the positive aspects mentioned by the respondents were: certification and accreditation of university programmes as a strategy adopted by some countries to improve the quality of education in general, in addition to the forest education programmes that are covered under these standards. Similarly, the updating of the curricular programmes to align them with public policies was mentioned, together with the upgrading the skills of the teaching staff to improve the programmes. In some countries, the creation of environmental and/or forest public policies was also mentioned, mainly those that involve climate change. Also mentioned were the creation of a conservation system and natural areas, the creation of a wood technology centre, and in some cases, agreements with other institutions. Finally, the *Joven Emprendedor Forestal* (Young Forest Entrepreneur) programme was mentioned as an innovative initiative that drew students' interest.

Unfortunately, negative comments were more prevalent in these responses; the respondents openly expressed their dissatisfaction with: the high levels of corruption that affected the quality of education; the reduction in the budget; the elimination of research centres; the strong focus on the environmental issue without considering the forest; the scarcity of programmes in rural areas; and insecurity in some remote places. Counterproductive agricultural and mining policies were also mentioned, which conflict with forest conservation, the lack of support for student mobility, budget cuts in scholarships for postgraduate education, the reduced employment opportunities, the fiscal crisis, and clearly, the COVID-19 pandemic.

In addition, the comments of the respondents should be highlighted with respect to the disconnect between the labour sector, academia and policy designers. Due to this disconnect, students have information gaps regarding current forest-related topics. In this regard, the respondents highlighted the importance of having more interdisciplinary curricula. They were also concerned about the lack of employment opportunities, directly related to the lack of public policies that strengthen the forest sector.

Students felt that the COVID-19 pandemic significantly affected their learning due to the lack of field practice; however, the emergency forced them and the educational institutions to learn and use digital technology that they had not used before. In some cases, students mentioned concerns over limited Internet access in rural areas.

When asking the students to describe in three words their forestry programme, the responses were quite positive: 'good', 'multidisciplinary', 'challenging', 'interesting', 'pride', 'sustainability', 'future', 'conservationist' and 'important'; some of the negative words used were: 'outdated', 'not practical' and 'not very competitive'. Finally, the students felt that it was necessary to include more internships and more funding for institutions.

#### **4.4.2 Post-graduate (master's and doctoral) programmes**

The information presented in this section corresponds to the 157 answers that were obtained for the master's and doctoral programmes combined. It is important to mention again that the total results are not congruent since each participant had the opportunity to assess the four levels of education (primary, secondary, TVET and university), and the latter was divided into associate, undergraduate, master's and doctoral programmes).

The names of the assessed postgraduate programmes correspond are as follows: academic master's degree in natural resources management; master's degree in forests and environmental conservation; master's degree in forest management; use and conservation; master of science, specialized in forests and the environment, master's degree in forest resources, graduate programme in forest sciences; graduate programme in agronomy – energy in agriculture, graduate programme in forest engineering, graduate programme in environmental and forest sciences, doctoral programme in forest sciences, master's degree in forests, master's degree in watershed management, master's degree in wood science and technology, doctoral programme in agricultural and forest sciences, doctoral programme in agro-livestock and forest sciences, master's degree in tropical forest management; master's degree in geomatics applied to natural resources; master's in forest industries, master's and doctorate in tropical ecology; and others that were only classified as master's and doctoral programmes.

##### **4.4.2.1 Content of the programmes and competencies**

The contents of the postgraduate programmes (master's and doctoral) were assessed according to the same thematic groups of the undergraduate programmes: *forest resources and forest ecology, management and planning, forest services and social and cultural aspects, forest enterprises, and forest economics and policy.*

Regarding the thematic group of forest resources and forest ecology, the respondents in the survey agreed that the topic of forest genetics was not sufficiently covered. For the group of teachers and students, the other topics (forest biodiversity, soils, ecology, and wood and non-wood products) were sufficiently covered. The group of professionals for the most part felt that these topics were inadequately covered, mainly the topics on forest soils, and wood and non-wood products (A56).

Regarding the thematic group of management and planning, most of the respondents of the three groups felt that the topics of forestry, forest mapping, forest planning, sustainable use systems, watershed management, forest conservation and forest health were sufficiently covered in the programmes. In contrast, the same group highlighted that the topics of forests and climate change, landscape restoration, grassland management, agroforestry, wildlife management, fire management, and urban forests were insufficiently covered in the graduate programmes.

There are discrepancies between the opinions of the group of professionals and those of the groups of the teachers and students: the professional participants observed high percentages in the category of "inadequately", showing a high degree of dissatisfaction regarding the knowledge of graduates of the labour sector (A59, A62 and A64).

According to most of the respondents in the three surveys, the seven topics related to the thematic group *forest services and their social and cultural aspects* were inadequately covered in the graduate programmes. It is important to note that this largest share exceeds 70 percent in some cases in the three groups (A66 and A69).

Regarding the thematic group, *forest enterprises*, the three groups of respondents agreed that the topics of entrepreneurship and small forest companies were not sufficiently covered in the postgraduate curricula, while the topics of wood technology and forest industries were (A71).

For the thematic group, *forest policy and economics*, the respondents had similar perspectives: most Q1 and Q3 respondents (62 percent and 64 percentage, respectively) felt that the topic of policy and legislation was sufficiently covered, but that the topics of land tenure, governance and the economy were inadequately covered (A74).

Extracurricular activities are a very important part of learning. When asking the respondents to what extent the students took an active part in them, opinions from the three groups differed: 50 percent of the Q1 respondents indicated that the participation of postgraduate students in these activities was limited. Most of the Q2 respondents indicated that students were engaged to a moderate extent, whereas most of the students (Q3) indicated that they had engaged very much in extracurricular activities (A42).

#### **4.4.2.2 Educational resources and policies**

Most of the respondents in the three groups, with some percentage differences between them, agreed that resources for forest education in the postgraduate programmes were moderately or fully available. These resources are: quality and quantity of teaching materials (textbooks, online materials), the educational environment (access to a laboratory and class size), and practical opportunities (experiential learning, practical training, field visits) (A38).

Regarding the existence of policies that improve the quality of forest education, the respondents in the Q1 and Q2 surveys agreed that there were governmental and programmatic policies. The professionals examined government policies in greater detail than did the teachers (A40.1).

#### **4.4.2.3 Preparation for the labour market**

Forty-five percent of the Q1 and Q2 respondents believed that the availability of part-time jobs or internships available for postgraduate students was moderate, and in the two groups, almost 40 percent felt that there were many jobs available. Moreover, 62 percent of Q1 respondents indicated that there was no or limited job availability. In this regard, most of the three groups (65 percent, 70 percent, 65 percent, respectively) agreed that part-time jobs and internships increased student learning 'very much' (A77).

Eighty-two percent of teachers and 70 percent of students felt that forest programmes prepared students for entry into the labour market to a moderate extent or fully; 27 percent of the 82 percent of this group of teachers felt that it prepared them fully. The largest share of professionals felt that postgraduate programmes prepared students to a limited extent (A79).

Moreover, 53 percent of professionals (Q1), 53 percent of students (Q3), and 43 percent of teachers (Q2) felt that gender was a factor that affected the possibility of finding employment. Similarly, most of the respondents in the three groups felt that gender had a great or moderate influence on the type of jobs for which recent graduates were considered (A82).

Moreover, the respondents agreed that belonging to an ethnic group had no influence on obtaining employment or the type of employment for which the graduate was considered (A85).

Most of the respondents in the Q1 and Q3 groups (50 percent and 70 percent, respectively) agreed that the availability of continuing education was limited. Also, 55 percent of teachers and education administrators (Q2) felt that continuing education was moderately available (A88).

#### ***4.4.2.4 Use of digital technology***

Regarding the use of digital technology in forest programmes, opinions varied in the three groups. Most of the respondents in the Q1 and Q2 groups indicated that they were used to a moderate extent, while most of the students (Q3) indicated that their use was limited. The vast majority of respondents in all three groups agreed that digital content tools were extremely valuable ('very much') in forest education (A45).

In general, the three most used digital tools were for communication and publication, followed by net-based research and geospatial technology. The use of geospatial tools was well known to the group of professionals (A48).

The digital forestry platforms that the three groups of respondents recognized the most were: the FAO Learning Academy and the Global Forest Information System (GFIS). However, the *Council for Learning Outside the Classroom*, *Forest Learning*, *Project Learning Tree*, *FAO Sustainable Forest Management (SFM) Toolbox* and *Global Landscapes Forum (GLF) Landscape Academy* were little known. The latter is more recognized by the group of students than by the other two groups (A53). Participants felt that it was necessary to integrate augmented reality, digital technology for field and mill operations, geospatial tools and technologies, and net-based research tools (A51).

#### ***4.4.2.5 Development and trends at the post-graduate level***

Forty-three percent of the respondents in Q2 indicated that enrolment trends during the last ten years had remained stable, and 40 percent that it had decreased. The largest share (36 percent) of respondents in the Q1 survey indicated that enrolment had increased (A91).

Most of the respondents in Q1 and Q2 felt that students had moderate understanding about the SDGs and the importance of forests in global trends (A94).

### **4.4.3 All levels of tertiary education**

Q1 survey respondents (professionals) were given the opportunity to comment on all levels of education. This section presents a total of 66 results obtained.

#### ***4.4.3.1 Content of the programmes and competencies***

The professionals believed that the topics of forest genetic resources, forest fire management, wildlife management, agroforestry, range landscape management and forest restoration were inadequately covered (A57 and A60). This perception extends to the thematic group of forest services and social and cultural aspects (A67). Regarding the group of forest companies, most of the respondents felt that the topics of entrepreneurship, forest industries and small forest companies were not sufficiently covered, but they felt that the topic of wood technology was sufficiently covered (A72). This group also felt that forest governance and economics topics were inadequately covered, but that legislation was covered to a moderate extent (A75).

Regarding extracurricular activities, this group indicated that students participated to a limited extent (A43).

#### ***4.4.3.2 Educational resources and policies***

Most of the respondents indicated that the resources for education were available to a limited extent. These resources are: quantity and quality of learning materials (textbooks, online learning materials, tools or applications), laboratories, educational environment (e.g. class size) and practical opportunities (A39).

Regarding current policies to improve the quality of education, only the group of professionals answered the question. The largest share (37 percent) of respondents indicated that there were no policies that improved the quality of education, against 34 percent indicated that there were policies within the programmes (A40.2).

#### ***4.4.3.3 Preparation for the labour market***

Most of the respondents felt that forest education prepared students for entering the work force to a limited extent; however, 30 percent felt that they prepared them to a moderately (A80).

Regarding the perception of the influence of the graduate's gender on obtaining a job in the sector, most of the respondents in this group indicated that the influence was moderate or very high ('very much'), and they made a similar observation regarding gender and the type of work they were offered (A83).

Almost 60 percent of the respondents believed that belonging to an ethnic group had no influence on finding a forest-related job or on the type of work that graduates could be considered for (A86).

Most of the Q1 respondents who assessed all levels indicated that continuing education was not fully accessible (A89).

#### ***4.4.3.4 Use of digital technology***

Regarding the availability of digital technology for learning, the Q1 group indicated that they were available to a moderate extent, and most indicated that they were very important tools for teaching forestry topics (A46).

Regarding the most used tools, they mentioned geospatial technologies and digital technology for operations in the field and in the mill, followed by online research tools (A49). When asked if they were familiar with some existing digital technology, the FAO Learning Academy tool was the best known, followed by the Global Forest Information System (GFIS); the least known tool was Council for Learning Outside the Classroom (A54).

#### ***4.4.3.5 Developments and trends***

The respondents of the Q1 group indicated that enrolment of students over the last ten years was, for the most part, increasing (A92).

Finally, the respondents indicated that the graduates had limited knowledge on current topics related to the relevance of forests and their sustainable management, as well as the SDGs (A95).

## 5. DISCUSSION

An analysis of the data obtained from the surveys is presented below. Given that the results of the surveys for the primary and secondary levels are very similar, they will be analysed together; this same situation emerged with the results of the surveys on the undergraduate, graduate and all other levels.

### 5.1 Primary and secondary levels

Due to the lack of legislation on forest education, forest content is included only marginally in the primary and secondary education curricula. The little that is included on forests at these levels is due to the fact that the forest is considered a component of environmental education, i.e. environmental education and its corresponding legislation have included forest education, but to a limited extent. Since the students have no direct contact with the forest, their learning about it is purely theoretical and only through research. The importance of forests for society is not considered a separate topic or within another topic. Although there are efforts to teach students to recognize the value of the environment, their learning is not strengthened with practical content or visits to the forest, which play a fundamental role in developing caring behaviour and respect for the forest (Kanowski *et al.*, 2020). The concepts of sustainable forest management and the contribution of forests to society are not included in primary education. In the region, there are no permanent initiatives that strengthen teaching in the forests similar to that found in other latitudes, such as: the "Project Learning Tree" in the United States of America; "Forest Education Foundation" in Australia; and Outdoor and Woodland Learning (OWL Scotland) in the United Kingdom, among others (Gabay and Rekola, 2009). Similarly, there is little research on primary education and forests; current studies are within the framework of environmental education and limited to teaching about conservation and recognizing the value of nature (e.g. Pellegrine, 2009; Estévez, 2000; Veloz-Miño *et al.*, 2018).

Secondary education is focused on preparing students in core areas such as mathematics, natural sciences, chemistry and physics. Although forest education could be integrated within these topics, it has not yet been achieved, basically because teachers do not have training in forests and because there are no continuing education programmes and didactic material that can help them teach these subjects. The information that is transmitted about forests is related more to the conservation of the resource than to its use and its sustainable exploitation.

The lack of direct experiences with the forest and its inhabitants, the low wages and the scarce labour offer in the sector were factors that affected the high school students' interest in continuing their education in related programmes. Survey respondents highlighted the region's widespread unemployment and poverty as factors preventing high school students from wanting to enter higher education. Those who had the possibility preferred to study conventional programmes with a high job demand.

In secondary education, the lack of public policies on forest education limits teaching on related topics. In addition, in Latin America, the exact sciences are a strong component in secondary education, and there is a current demand to include topics in which socio-emotional skills are developed, which reduces the possibility of integrating new classes into the curricula (Fiszbein *et al.*, 2018).

The teachers indicated that they needed more training in the use of technologies and teaching materials on forest-related topics. The lack of coordination between schools and other sectors, the government, universities and NGOs was also highlighted. This coordination is important for establishing agreements that would allow students to have access to research centres, botanical gardens and national parks, and also have direct experience with forest users.

## 5.2 Technical and vocational education and training

According to the general data produced by the survey, it was clearly observed that: the group of professionals (Q1) felt that the content of the programmes was not sufficiently covered in the curricula; the teachers (Q2) felt that it was covered to a moderate extent; and the students (Q3) felt that it was sufficiently covered. This information is of interest, because it is possible that the professionals (Q1) observed gaps in the knowledge acquired by recent graduates of forest programmes; this observation was previously made in the assessment of forest education produced in 2007 by Encina (2007).

In this regard, the teachers and administrative staff consistently stated that the programme content was covered to a moderate extent; however, it is of concern that the students felt that it were sufficiently covered. The students' responses should be interpreted with caution since it is not possible to identify the semester or year in which the students were enrolled at the time of answering the survey, which generates bias in the responses; less than 1 per cent indicated, "I can't say".

It should be noted that the professionals felt that soft skills and professional ethics should be included in the curricula. Teachers, however, believed that administrative topics and all topics that engage students with society should be strengthened.

There is general consensus about basic science education: all three groups felt that these topics were covered satisfactorily. There is a moderate use of digital technologies and a lack of knowledge on legislation. This trend was observed in other forest education studies. Encinas (2007) observed the need to include administrative and social topics and to strengthen soft skills. However, although efforts were made to review the programmes, the recommendations previously made have not been considered. Each country has its needs, and both the results of Encinas and those of this study are regional. However, it can be inferred that the results of previous studies were not sufficiently socialized for them to reach the technical schools that could use them as a basis for the design of their curricular plans.

The region's forest sector is making inroads into the use of digital technologies, although this is not reflected in the labour sector. Teachers and students felt that the technologies were complementary tools to learning and fieldwork; however, the latter has not been explored in practice and is seen only as a recommendation. Although the use of technology was viewed in a positive light, there are rural schools that still do not have Internet, so the application of technology there has been a real challenge.

With regard to educational resources and policies, it was widely indicated that resources were not sufficient, that the infrastructure was weak, and that opportunities for practical experience were limited. Although some policies have improved the quality of education, it seems that they have not considered aspects related to professional internships and extracurricular activities, part-time jobs and work experience, activities that the respondents considered essential in the teaching-learning process. It is striking that most of the professionals indicated that these activities were scarce or non-existent, and that it was precisely this group that should provide opportunities in this regard. The lack of these activities clearly affects students' preparation for entering the labour market. This situation shows a disconnect between the labour and academic sectors.

Regarding the influence of gender and ethnicity on entering the labour sector, it seems to have some influence, mainly from students' point of view. For students, the most relevant factors were the lack of soft skills, experience and job opportunities. Thus, the forest sector is not offering the necessary jobs for technicians and does not provide internship opportunities. Continuing education turns out to be a challenge for graduates; the time and cost of travel and courses are factors that limit access to continuing education.

Participants also noted the disconnect between national plans and the forest sector. Due to the lack of incentive for reforestation and restoration, the job offer for graduates is low as is the motivation for teachers, and some institutes have closed.

### 5.3 Undergraduate, graduate and post-graduate levels

In general, for the three groups, there was some disagreement among the respondents of the Q1 group on how the graduates were prepared in the undergraduate programmes, because they perceived that the topics assigned in the survey were not sufficiently covered, which is of concern since this group consists of government agencies, industry, NGOs, forestry associations and businesspersons who hire graduates to put their knowledge into practice.

The respondents believed that traditional topics related to the *planning and management* of forests and trees (e.g. biodiversity, forest ecology, forestry, forest planning, sustainable use systems, watershed management, soils, forest products, conservation and forest health), were considered sufficiently covered. This trend was observed in previous studies (Encino, 2004), and these topics, being the core of undergraduate forest programmes, continue to be covered.

It should be noted that with regard to the topics related to the use of the geographic information system (GIS) tools, Encino (2004) raised the need for their inclusion in the curricula, which, judging by the results of the survey, was satisfactorily achieved according to both academics and professionals. Clearly, although this topic has been around for some years, it still remains at the forefront and is considered highly useful in all forest-related aspects.

However, it was felt that other topics such as agroforestry, wildlife management, fire management, grasslands management and forest genetics were not sufficiently covered despite previous studies highlighting their importance.

Similarly, the low coverage of emerging topics such as urban forests, forests and climate change, and forest landscape restoration is of concern, since they were addressed in international policies and initiatives, and in many national ones. This situation explains why students have scarce knowledge of the SDGs and how this limits the participation of graduates in the forestry labour sector.

The same occurs with the thematic group of forest services and social and cultural aspects, even though all international and national policies urgently call for the inclusion of the social component in management plans, forest programmes and all activities related to forest management and conservation. This situation was observed in the last two conferences on forest education (Encino, 2004; Malleux, 2014), but it has been neglected in the region. It is important to mention that although efforts were made to include social aspects of the forest in the curricula (Villarraga-Florez, Rodríguez-Pineros and Martínez-Cortés, 2016; Arce-Rojas, 2014), they seem insufficient with respect to the high demand and the importance of the social component in forest practice.

Regarding the topics related to the forest industry, only wood technology was covered in a satisfactory manner; the topics of small forestry companies and entrepreneurship were not. This result coincides with previous studies that show the little importance given to these topics and the need to include them in the curricula (Rekola *et al.*, 2017). The topic of forest economics versus forest policy seems to have better coverage, or at least enough so that students would be familiar with the forest policy of their countries.

It is noteworthy that, for seven years, Reforestamos México, a non-academic organization, has been promoting an initiative to encourage knowledge of forest entrepreneurship in the region and train forest students and teachers. In its recent publication, *Guía de emprendimiento forestal* (Guide to forestry entrepreneurship), about 7 000 students and 200 teachers were trained (Reforestamos-IUFRO, 2020). Recently, Tropical Agricultural Research and Higher Education Center (CATIE) and Reforestamos México launched the Innovature programme with the aim of opening opportunities for both students and professionals to present nature-based solutions (<https://activa.catie.ac.cr/web/innovature>). Hence, it can be concluded that inter-institutional and international cooperation (in the region) fills some gaps in the academic curricula.

These same trends are observed in the master's and doctoral programmes, and in the assessment of all programmes, which indicates that the graduate programmes are not addressing emerging topics or topics that have been clearly neglected, such as: fire management, forest genetics, restoration, forests and climate change, socio-economic aspects of the forest, aspects of forest enterprises, governance and forest economics.

It should be noted that the topics of forest certification, clean development mechanisms, ecotourism and payments for environmental services were not mentioned by the respondents for consideration in the undergraduate and postgraduate curricula; however, in his survey, Encino (2007) observes that it is important to include them.

The survey reveals the lack of soft skills among forest professionals and students, an observation also made in the last two assessments on forest education in the region and in the Global Outlook on Forest Education (GOFE) report (Rekola *et al.*, 2017). Forest programmes are four or five years, and it is a challenge for universities to cover all this material over this period. In addition, the lack of practical opportunities and part-time jobs limits the students' capability of developing these skills. It should be mentioned that the group of professionals (Q1), who are considered the employer sector, was highly categorical in assessing the soft skills and the lack of practical experience of the students. This shows the lack of coordination between this sector and higher education institutions, since the Q1 group consists of those who can provide internship opportunities, part-time jobs, and in some cases organize visits to model forests, national parks and saw mills.

Although both undergraduate and graduate students participate in extracurricular activities, such as attending conferences, reforestation campaigns, research support, environmental education and inventories, among others, they are not available to all students and surely do not aim to develop soft activities. Therefore, it is necessary to identify possible alternatives that would develop them.

Regarding the resources available for education, teachers and students felt that they were sufficient to meet the current demand. In contrast, the professionals felt otherwise; their response is correlated with the observation of the poor coverage of forest topics in their curricula. Regarding the quality and quantity of the teachers, the professionals indicated that they were satisfied with the teaching staff and with their capacities to educate students to become forest professionals at both undergraduate and graduate levels.

In contrast, there is a clear lack of knowledge of teachers on the policies and initiatives that helped to improve the quality of education; 50 percent indicated that they were informed about them, but the other 50 percent were not.

Q1 respondents were not satisfied with the preparation of undergraduate and graduate students for entering the labour market, while teachers and students felt that preparation allowed them to enter the labour market without a major issue. For undergraduate students, there are no part-time jobs or internships, yet there are for graduate students; all respondents agreed that professional internships and part-time jobs were important because they complemented the quality of education.

There was a moderate use of digital technology, perhaps not comparable with other regions of industrialized countries. Nevertheless, the tools that are dispensable for research and online classes are available, although the lack of Internet in rural schools is a concern. The current platforms that have forest content are little known; it is likely that the language constitutes a barrier to access, since all the platforms presented in the survey were in English. There is also a gap in the use of digital technology for field and sawmill operations, since the region's forest sector has been characterized by rudimentary and informal wood extraction and low processing. The wood market is generally roundwood and sawnwood, but it does not reach higher processing levels.

Gender and ethnicity do not substantively influence employment opportunities or type of employment for undergraduates but they do appear to influence employment for graduates and postgraduates.

It emerged from the assessment on forest education carried out in 2007 that there was a gap in the curricula in terms of the inclusion of topics of concern to the labour sector, such as climate change, certification and agroforestry. It also identified the scant coverage of topics related to forest administration, economics, politics, forest industries, project management and formulation, and non-wood products, as well as the social aspects of forests. In addition, the assessment mentions the disconnect between the labour and the academic sectors, the scarce integration of public policies into study programmes, and the high unemployment rate in the sector.

It is of concern that after 13 years, the same problems persist in the programmes of the region. The main objective of the assessment carried out in 2007 was to create a technical and academic cooperation network to permanently assess

the programmes; however, little information is recorded on the scope of this network. Although there is collaboration between the countries and within country programmes, it is necessary to analyse the causes for the discontinuance of the network (RELAFOR) and the relevance of creating a regional network. It is important to design a solid and permanent strategy for collaboration among the countries of the region that encourages and facilitates research, exchange, and above all, the assessment of forest education.

## **5.4 Non-formal, informal and continuing education**

Although the survey does not make a direct reference to non-formal and informal education, the respondents developed some of their open responses based on the importance of, and lack of attention given to, these types of education. Regarding continuing education, the survey asked about its accessibility, and both the quantitative and qualitative responses made it possible to discuss this.

First, non-formal education is defined as any organized, structured, systematic and training activity that takes place outside the framework of the official school system. One of its characteristics is a relatively short duration, which seeks to generate rapid changes in behaviour. Some examples of this type of education are massive open online courses (MOOC), webinars (i.e. training courses organized by universities as part of their outreach functions), seminars, conferences and other courses offered by governmental and non-governmental organizations, among others. Furthermore, informal education is everything that is acquired throughout an individual's life, without necessarily being structured or planned by the individual. Some examples may include listening to a radio or television programme, a casual conversation with a colleague or friend, reading notes from social media, or direct observation of events.

In 2006, UNESCO mentioned that non-formal education increasingly played an important role in achieving the goals of education for all and the Millennium Development Goals (MDGs), whose goal 7 made direct a reference to forests (Ensuring environmental sustainability). In this regard, non-formal education has been an important tool for raising awareness of the role of forests in human well-being.

It should be noted that 41 percent of the respondents of Q1 (professionals) indicated that their affiliated institutions were involved in training students, 25 percent helped in training teachers, and a smaller percentage ( 2 percent) trained communities. Similarly, it is important to highlight that 47 percent of the respondents of Q1 indicated that their institutions had participated in the development of forest-related educational material.

As mentioned above, inter-institutional and international cooperation in the region is filling some curricular gaps in academia. However, when judging by the results of the survey (presented in this section), it can be observed that they also had an affect outside academia. Bearing in mind that forest education must reach the general population, it is important to observe in greater detail the scope of non-formal education and the contribution that both non-academic organizations and higher education institutions have in this regard in order to identify strategies that would strengthen this contribution.

The data collected indicate the difficulty of accessing continuing education, either due to the distance between the centres that offer education programmes and the rural area, or due to the high costs that this involves. Students in technical programmes indicated that they were unable to continue university education due to the long distances between universities, which are mostly in urban areas, and their places of residence. Undergraduate students indicated that master's and doctoral programmes had high costs. At this point, it is important to recall that some Latin American countries have graduate programmes of 1 or 1.5 years, called specializations, or shorter programmes called diploma courses. Since these programmes were not considered in the study, the responses should be treated with caution; perhaps this calls for a more in-depth analysis of these programmes in the region.

## 6. RECOMMENDATIONS

The recommendations presented here follow the suggestions made by the survey respondents and the data analysis. The survey respondents at the primary and secondary levels felt that the activities carried out outside the classroom should be enhanced, and that experts should be invited to classes so that students would know more about the forest. Learning by projects and problem solving was considered by both levels a useful strategy that could provide more knowledge about forests. And in secondary school, case studies bring young people closer to solving actual problems. Some ideas for primary education on forests emerged from the qualitative analysis. In this regard, the respondents advised that students go into the forest to interact with its inhabitants, as well as with the forest engineers who use the forest. They also felt that it was necessary to increase the use of forests or urban green areas as a place of learning. In addition, the respondents mentioned that it was necessary to increase teacher training and highlighted the importance of the engagement of the private and government sectors with schools. They also indicated that international assistance was important to develop projects that link universities with forest programmes and secondary schools.

It is important that cooperation tools are developed for teachers for their continuing education and experience sharing. An example of this type of tool is an online magazine, such as Green Teacher, that allows information to be shared between primary and secondary school teachers.<sup>6</sup> This magazine has a version in Spanish. Teachers publish their methods of teaching about nature and environmental issues, many of which are included in education on exact sciences.

Just as in primary education, there is little research in secondary education and on forests. The studies emphasize environmental content and the contemplation of nature, but not necessarily sustainable forest management or the effect that the forest has on the quality of life of the planet's inhabitants. Clearly, and as the respondents mentioned, strategies should be sought (teaching material, mainly) that integrate forest management content with the exact sciences in such a way that students could understand that the forest is a system that provides multiple services, indispensable for the life of human beings. Participants recommended that, at the secondary level, mathematics be taught in sawmills so that by calculating volumes of wood and other measurements, students would understand the use of mathematics in real life. They also recommended integrating forest learning with other sciences, emphasizing topics of climate change, protecting forests, forests and society, and ecosystem services.

It is important to recognize that secondary education is not the only factor that influences students' decision to pursue a professional programme; poverty, the lack of universities or technical schools in rural areas, and unemployment also affect the continuing education of more than 40 percent of high school graduates.

For TVET and university levels, the recommendations are listed below:

- Increase the involvement of the labour sector for updating study programme in order to meet current needs.
- Establish cooperation agreements with the labour sector to encourage internships and part-time jobs.
- Include more fieldwork in the curricula.
- Strengthen and foster knowledge of basic science and forest sciences.
- Include topics of forest legislation and sociology in the curricula so that students may complement their preparation in the three pillars of sustainable forest management (ecological, economic and social).
- Encourage the development of basic skills and forest ethics.
- Ensure greater coordination and collaboration between institutions, the forest labour sector, which includes indigenous and Afro-descendant communities, and academia.
- Encourage the development of soft skills through teacher training and the development of online material.

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<sup>6</sup> Green Teacher, <https://greenteacher.com>

- Develop mechanisms that make it possible to convert forest education into a more experiential practice so that students may understand the dynamics of the forest as a natural component and its inhabitants as a social component.
- Ensure greater participation of professionals in the development and restructuring of study programmes and plans.
- Update study programmes to include emerging topics and social and economic aspects.
- Ensure greater participation of teachers and education administrators in the development of public policies and initiatives related to the sector and related ones.
- Strengthen inter-institutional and international cooperation in the region to provide opportunities for professional internship, exchanges, student mobility and the upgrading of teachers' skills.
- Use digital technology for basic science classes.
- Increase fieldwork.
- Open opportunities for students to participate in extracurricular activities.
- Promote interdisciplinarity in the curricula.
- Set up mechanisms to make continuing education more accessible to rural areas and low-income students.
- Find mechanisms that ensure that forest education has a commercial, environmental, social, sustainability and conservationist vision of traditional and cultural knowledge.
- Create training platforms.
- Strengthen research.
- Prepare an analysis of the relevance of create a Forest Education Network for the tertiary level.
- Seek international cooperation mechanisms among the countries of the region.
- Set up platforms for dialogue between stakeholders in the region.
- Invest in technology and infrastructure.
- Develop leadership competence so that future graduates will be involved in policy decisions.
- Encourage entrepreneurship since job opportunities are poor.
- Provide free access to publications on forest sciences.

## 7. THE VIRTUAL CONSULTATION

On 23 and 24 February 2021, Reforestamos México organized the virtual consultation on forest education for the LAC region. Around 130 attendees out of 520 invitees participated, representing government and non-governmental sectors related to forest education from 35 countries. More detailed information can be found in the report of the consultation on the FAO website.

The objectives of the consultation were to:

- Present the global survey on forest education results for LAC.
- Obtain suggestions from forest education experts in how to meet the challenges identified in the survey.
- Identify the actors involved in meeting these challenges.

The consultation was carried out on the Zoom platform, and the Padlet and Jamboard tools were used to facilitate participation. Simultaneous translation was offered for the English-speaking participants and all the working material was presented in English. Six experts were invited to present their experiences in forest education, and working groups were set up for two sessions of the consultation. The main findings and reflections of the sessions of the regional consultation are presented below.

In the first session, which took place on 23 February 2021, participants were asked to compare the challenges presented in the report with those faced in their respective countries. The participants agreed that field practice was very limited in part due to the low budget allocated for it, and that there was a disconnect between the forest actors and the sectors, which translates into scarce employment opportunities. Tertiary-level forest programmes had gaps regarding topics on economics, project management, entrepreneurship and plantations. It is worth noting that the participants of the consultation agreed that the topic of professional ethics should be better addressed in the programmes. In addition, the consultation revealed that there was difficulty in accessing postgraduate programmes. Regarding the primary and secondary levels, the participants agreed that there was a great lack of knowledge of the cultural values of the forest. Participants from the English-speaking Caribbean region commented that few students were enrolled in the programmes compared to other more popular programmes.

When asking what topics should be included in future surveys, the participants replied that there should be a more in-depth study on legislation and regulations on education, education on indigenous peoples and communities, the labour market, landscape management and land use planning. The participants also mentioned that it would be important for this study to be carried out at the national level and for the regional consultation to be followed up.

During the second session of the consultation on 24 February 2021, workshops were held with the participants to identify the most relevant challenges for forest education in the region and their solutions. The English-speaking Caribbean region noted with great concern the low enrolment in forest programmes and the few initiatives available to increase it. In addition, given that the forest sector was not a driver of the economy, investment for training forest staff was low, hence unemployment and low wages. Thus, there were no incentives for students to consider enrolling in forest programmes. Therefore, it was proposed to: encourage the exchange of students between countries of the region; design an online programme; prepare a project proposal (involving all the programmes of the English-speaking Caribbean region) to acquire more resources (scholarships) for students, addressing topics such as entrepreneurship and the development of wood products, forest rehabilitation and restoration, bioenergy and ecotourism. It was also proposed to include forest education in environmental management courses. Participants felt that mandatory forest restoration projects for mining companies would be a solution to lowering unemployment rates.

The participants of the consultation felt that the main problems at the primary and secondary school levels were that the pedagogical approach to forests was more appropriate to adults, that there were no curricula focused on forest

topics and no clear distinction between environmental and forest education. The participants agreed with the results of the survey that education was not provided on site and that there were a lack of tools and technological inputs for teachers. Therefore, the participants proposed that links be established between forest schools and educational centres, as well as with those responsible for public areas. They also proposed that activities to disseminate forest culture be carried out so that the general population would have basic knowledge on the topic. The participants mentioned that it would be advisable to form interdisciplinary teams with at least three profiles: thematic experts (forest professionals/biologists), pedagogical experts and ICT experts as well as volunteers, including native and rural communities so that forest education in the basic levels would be accessible to all. Alternative solutions presented were to connect environmental and forest education with a change in worldview (i.e. the way we understand ecosystems) with a holistic vision, sharing experiences of the forest sector (e.g. the forest industry, faculties, schools, non-wood goods) with the primary level so that it can be taken as a higher education option and incorporate forest professionals in the work of the municipalities and communities. It was recommended to include courses related to climate change, socio-ecological systems and the importance of native species, and to develop students' interest in the wood production chains.

The participants, when they identified the most important technical challenges, they highlighted the change in terms of demand for forest professionals and how it differs from the current offer, as well as the bad reputation of forest exploitation. The solutions presented to resolve these challenges were to: promote the establishment of cooperation ties between forest specialists forest sector actors (forest land owners, technicians and civil society); to establish closer ties with forest companies to identify and prioritize their human capital needs and required capacities; and to ensure continuous training at the national level. It was recommended that technical education place greater emphasis on community-based forest management, delving into entrepreneurship issues to give added value to the forest, forest finance, project evaluation, conservation and restoration, agroforestry, and some soft skills such as professional ethics.

Regarding university education, the participants were distributed in nine roundtables. The main challenges identified were: the lack of student mobility between universities in the region; the weak ties between the actors in the forest sector; the insufficient impact of the forest sector on public policies and in reducing poverty; the bad reputation of the profession and competition with other related areas; the outdated content of the programmes; and the meagre budget for the programmes. The participants presented around 165 proposals to meet these challenges, which were condensed into an Excel table, and the technique of content and colorimetric analysis was performed to identify patterns and thus reduce the number of proposals. This exercise yielded a total of nine topics in which 35 solutions were grouped: the topics were as follows: partnership, extension on the forest profession, training, investment, soft skills, specific skills, the inclusion of ancestral knowledge, legislation and policies, and the creation of new programmes. On 24 February 2021, the participants had the opportunity to prioritize the 35 solutions and identify the actors involved. Of the 35 proposals, 21 remained on the priority list; they are presented here below.

#### Partnerships:

- Increase research and academic exchange of students and teachers with forest companies and communities to broaden the landscape of forest resources management and increase resource efficiency. The stakeholders involved would be research centres, the academic sector, private companies, educational centres and education authorities.
- Establish ties with government organizations, companies and communities for the design of education programmes that incorporate activities to train students and that support the work targets of partner institutions. The stakeholders involved are the productive sector, government, communities and educational authorities.
- Create forest extension programmes in which students are involved so that they may act directly with the communities and obtain funding from the environmental authorities. The stakeholders involved are: NGOs, educational centres, communities, environmental authorities and the private sector.

- Establish a network of forestry teachers and educators. The actors involved are the coordinators of the forestry schools at all levels.

Dissemination:

- Disseminate skills, opportunities and advantages of the forest programme in social networks through public awareness campaigns and field evidence. The stakeholders identified were: academia and educational centres.
- Inform society at all levels of education of the true value of the ecosystem services provided by forests, as well as the possibilities they provide for sustainable development. To implement this solution, the participation of the ministries/secretaries of education, the environment, culture and agriculture as well as academic bodies is needed.
- Involve the active participation of the entire academic community in institutional planning and curriculum design. The stakeholders identified were teachers, research institutes, students, ministries, programme directors and external experts.
- Communicate academic content in a more attractive way without its losing its scientific depth. This requires the participation of academia and extension experts, journalists, designers, communicators and professional advisers.

Capacity building:

- Design an educational curriculum, applied starting right from the primary, basic, high school and university levels, which develops skills in resources management and forest plantations. To this end, government actors were identified at the ministry of education and academia.
- Adapt the curriculum of the forest engineering programme to the actual situation of the 21st century (biodiversity, restoration, climate change, etc.). Employer entities and graduates identified forest programmes as the key ones in adjusting the curricula and provided feedback.

Investment:

- Seek alternative sources of funding through agreements or projects that increase the academic departments (universities) revenue for the purposes of research, forest extension projects and software. The stakeholders identified were international cooperation organizations, educational institutions and the private sector.

Soft skills:

- Define the needs and types of skills and / or competencies that are required in the labour markets. This requires the participation of the private sector, the chambers of commerce and industry, the government (ministries), universities, producer associations and professional associations.

Specific competencies:

- Define the needs and types of skills and/or competencies required in the labour markets. This would require the participation of private sector, chambers of trade and industries, the government (ministries), the universities, producer associations and professional associations.

Specific competencies:

- Include didactic exercises and their assessment in subject seminars, and develop them with the support of producers, industrialists, investors and government officials.
- Integrate forest topics with socio-environmental aspects, climate change, adaptation and mitigation, non-wood resources, forest restoration, and management of ecosystem services from the environment. The stakeholders identified in implementing this solution were the government sector, universities, producers and graduates.
- Develop professional experience in the field linked to actual projects. This solution requires the participation of academia and government institutions.
- Incorporate management of computerized monitoring tools and forest resources into the curricular plan. Each programme will be responsible for making these adjustments together with the graduates and the hiring sector.

Others:

- Strengthen admissions and graduate profiles in line with the demands of the sector. The stakeholders identified were the universities and the private and public sectors.

It should be mentioned that regarding the topic of policy and legislation, none of the proposals included the priority list.

Once the activity of prioritizing solutions was completed, the participants were asked to discuss the trends that should be incorporated into forest education programmes. The results are presented below:

For the primary and secondary levels, mention was made of climate change, carbon sequestration, social and cultural aspects of the forest, economics, sustainable forest management, promotion of native species and conservation, socio-ecological systems, forest industry, forest goods and services, traditional indigenous knowledge and production chains.

With regard to TVET, the following topics were mentioned: forest extension, productive chains and markets, entrepreneurship, financial analysis, conservation and restoration, and climate change. For the university level, the following topics were mentioned: the gender aspect, policy management, culture and the environment, climate change, programming, entrepreneurship, innovation, agroforestry, community-based forestry, sociology, forest biotechnology, non-wood forest products, economic valuation of the ecosystem services, reading and writing skills, restoration and urban forestry.

In conclusion, the participants of the consultation corroborated the alignment of the survey results with the situation of forest education in their countries. The situation is similar both for the group of participants from the English-speaking Caribbean and in the rest of Latin America, and has been recorded in previous studies (2002, for the Caribbean; 2007 and 2014, for the rest of the region). The main alignment challenges in the region are the lack of forest content in basic education (primary and secondary), due to the lack of public policies and budget that must be allocated at these levels for field practice in the forest and the acquisition or creation of teaching materials. The lack of professional ethics was another distinguishing factors, as well as the limited content on economics and project

management for the tertiary level. The disconnect between stakeholders and higher education institutions was also mentioned as a problem that the countries share.

Despite the challenges of forest education in the region, the participants showed a strong interest in extending this type of study at the national level and were enthusiastic in proposing solutions. It is important to bear in mind that the solutions reported in this document were considered by the participants as having high impact and high feasibility. Therefore, it would be advisable to examine in more detail the possibility of implementing some of them and following up on them. Clearly, this action requires good management and coordination among the actors, as well as the funding capability. The participants of the consultation were satisfied with the work carried out and with the fact that their results were shared with the corresponding authorities. Furthermore, they expressed their availability for participating in related projects in the future.

## 8. GENERAL CONCLUSIONS

Forest education in LAC is undergoing an important historical moment. On the one hand, there is a constant demand from applicants to technical, undergraduate and graduate programmes, and on the other hand, international forestry policies demand an increasing number of forest professionals. However, the importance of forests in human well-being is not a topic covered in the programmes, and the forest is still perceived as a source of wood and its derived products. This perception affects the image of the forestry professional and has caused other related programmes to compete with forest programmes. Therefore, it is necessary that knowledge about the use and conservation of the forest be expanded at all levels of education.

At the primary and secondary levels, due to a lack of legislation on environmental/forest education, forest-related concepts have been included in the curricula on a continuous basis. In this regard, there is evidence of the need to train teachers (mainly secondary) to include related topics in their traditional, basic science courses. Lack of contact with the forest reduces students' interest in pursuing forestry careers. Although teachers make a great effort to include forest-related concepts, they are not sufficient, and the participation of governmental and non-governmental institutions, industry, forest owners and universities is required to strengthen teacher training. Similarly, this will provide opportunities for field visits so that the inclusion of content on forests can be increased and students' learning on these topics can be significantly improved.

Regarding technical and university-level education, the results of this study concur with those presented in previous studies; here, the lack of economic and social content in the curricula of these programmes is evident. Clearly, the demand for training in these topics is due to international dynamics that are committed to sustainable development, whose three main components (social, economic and ecological) are well-founded and interconnected.

Sustainable forest management cannot be conceived without considering the social and economic aspects. For this reason, the group of professionals expressed dissatisfaction with the level of knowledge that graduates have on these topics and, clearly, in applying them to solve actual problems. Similarly, there is little development of the basic or soft skills of professionals. However, it should be pointed out that students and graduates of forest programmes have a good knowledge of the concepts of forest ecology, wood technology and forest use. In addition, these topics have been very well complemented with the good knowledge of GIS tools. Here, it is important to mention here that the study by Encinas (2007) highlighted the importance of including these tools in forest education. The results of this survey provide a good account of the attention paid by forest education institutions to include these technologies. Now it is important to include socio-economic aspects and to develop soft skills without neglecting the concepts of forest management and the continuous use of GIS tools. It is worth mentioning that according to the profile of the forest engineer developed during the *Taller Regional Latinoamericano de Educación Forestal* (Latin American Regional Forest Education Workshop) in 2014, he or she is a professional with the necessary ecological, social and economic skills to address the problems that afflict the sector, which, if resolved, would improve the contribution of the sector to the GDP of the region and the countries. Thus, it is necessary to adopt this profile and strengthen the institutions so that they acquire the resources and tools that guarantee to develop competencies specific to the issues of each country, as well as to international strategies on forests.

In conclusion, at the undergraduate level, there is still a model of studies with an emphasis on wood production, although some programmes have been updated to meet other types of demands, such as environmental impact studies and land use planning (Encino, 2007). However, at present, there is a large number of governmental and non-governmental organizations that employ forest graduates to meet the international and national demands in terms of sustainable forest management, climate change, the SDGs and restoration, among other. In addition to requiring professionals with technical knowledge of basic sciences, these demands require professionals with social, economic and management knowledge, and soft skills as important components of sustainable development. Indeed, it is evident that these topics are also not offered in graduate school.

Moreover, some relevant aspects that emerged from the surveys at all levels of education were the lack of direct contact with the forest and the inclusion of emerging issues. Although the use of modern technologies and online courses was recommended to minimize these problems, each country should analyse its situation regarding the availability of telecommunications infrastructure. It is no secret that Internet service in rural areas is weak, and COVID-19 has demonstrated the challenges that access to technology represents for students in rural areas. Hence, including technologies as a complement to field visits and learning on emerging issues requires a more in-depth analysis, which will be adapted according to the conditions of each country. However, the impact of COVID-19 on students is more related to the cancellation of fieldwork than actually to the use of digital technology. In this regard, the students mentioned that, although the tools were available, they were not used, and during the COVID-19 pandemic, they have become more useful and important in their learning.

It is essential to involve the respondents in the development of public policies. Therefore, it is necessary to find cooperation strategies that foster the involvement of academia, industry, forest owners, professional associations, indigenous and Afro-descendant communities and NGOs, among other stakeholders in the sector, in the analysis and the development of policies on forest sector, and clearly, on education.

The regional consultation made it possible to identify the challenges faced by the English-speaking Caribbean subregion. The respondents mentioned the concern over the lack of forest programmes in most countries of the subregion, a situation that has already been reported in previous studies (Eckelmann and Clarke, 2002). In addition, the respondents from the subregion indicated that they agreed with the survey findings. Due to the low number of forest programmes in some countries, some students have to travel to other countries to acquire their education; however, it is an economically unsustainable situation and therefore they prefer not to study forest science. Thus, one of the solutions presented was to set up scholarships to encourage students and retain them in forest programmes; it was also proposed to design online programmes so that education would reach higher numbers of students. Accordingly, it is important to look into the possibility of establishing partnerships with other universities. For example, the online programme of the University of British Columbia could be expanded to this subregion since most countries in the subregion are English-speaking. It was also proposed that forest education be part of other related programmes; i.e. to offer it as a “minor”.

Regarding the solutions presented by the participants of the consultation, the importance that should be given to the promotion of forest education to show its benefits and reduce its negative reputation due to its emphasis on wood use was highlighted. The participants also proposed to strengthen the ties between stakeholders in order to create collaborative networks. Training for teachers and for graduates were relevant topics in the discussion, together with the development of soft skills. Clearly, all proposals require investment; therefore, the participants proposed to seek international funding sources and internally manage the funding of research and training projects. It should be noted that participants agreed that forest programmes were outdated and that it was urgent to redesign them to include current topics, such as data mining, socio-ecological aspects, restoration, project management and urban forests, and to encourage academia to seek solutions to actual problems.

In conclusion, the participants agreed that the results of the survey were very close to the situation on the ground of forest education in the region, and therefore that solutions were similar for the countries. Hence, it is imperative to strengthen the links between the universities of the region and the NGOs that have non-formal education programmes. This would facilitate the management of resources and also the mobilization of students and teachers to acquire new knowledge based on the particular experiences of each country.

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# Appendix\_I: Introduction and Methodology

Figure 1. Milestones of the Global Forest Education Project



Figure 2. Frame of Reference for the Assessment of Forest Education

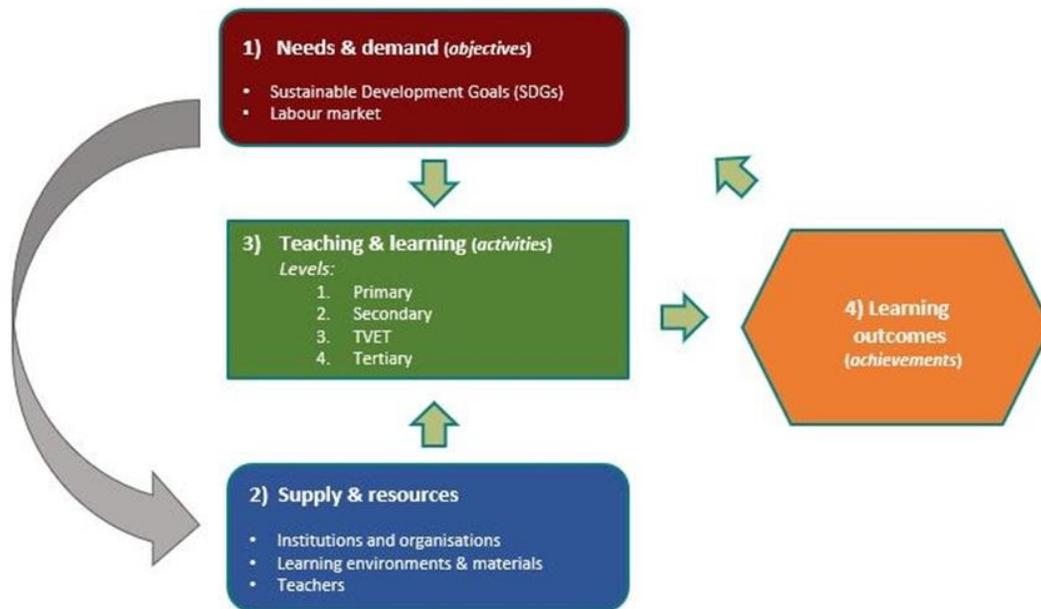


Table 3.1. Responses Distribution by Educational Levels Surveys Q1 and Q2

		Primary	Secondary	Technical	University
Q1	Statistical sample	35	35	21	63
	Snow ball	78	74	65	154
	<b>Subtotal</b>	<b>113</b>	<b>109</b>	<b>86</b>	<b>217</b>
Q2	Statistical sample	8	12	11	78
	Snow ball	30	40	26	187
	<b>Subtotal</b>	<b>38</b>	<b>52</b>	<b>37</b>	<b>265</b>
<b>Total</b>		<b>151</b>	<b>161</b>	<b>123</b>	<b>482</b>

Table 3.2. Sample Size and Total Number of Responses by Country

Country	Q1				Q2				Q3						
	Sample size*	Responses statistical sample	Responses snowball	Total responses	Sample size basic education	Number of universities	Number of emails	Total Q2 statistical sample	Responses statistical sample	Responses snowball	Total responses	Sample size*	Responses statistical sample	Responses snowball	Total responses
Argentina	61	2	10	12	160	14	53	213	2	31	33		2	6	8
Barbados										1	1				
Belize			1	1											
Bolivia			5	5						1	1				
Brazil	115	8	39	47	163	28	238	401	16	60	76	16	16	42	58
Chile	71	3	5	8	160	11	98	258	4	14	18	6	4	7	11
Colombia	111	21	53	74	176	20	78	254	20	38	58	78	20	72	92
Costa Rica	54	5	6	11	161	6	69	230	10	14	24	3	10	5	15
Cuba												4	0	0	
Dominican Republic	0	0	1	1											
Ecuador	43	3	3	6	149	14	48	197	6	3	9	8	6	11	17
El Salvador			4	4										1	1
Grenada			1	1											
Guatemala												4	0	1	1
Guyana			1	1										1	1
Haiti			1	1											
Honduras			4	4						2	2			6	6
Mexico	80	12	33	45	159	46	211	370	29	56	85	1189	29	28	57
Nicaragua			1	1											
Panama										3	3				
Paraguay			1	1								8	0	1	1
Peru	66	23	23	46	161	13	106	267	4	13	17	17	4	15	19
Uruguay			3	3						4	4			1	1
Venezuela			2	2						2	2			1	1
International**	15														
<b>Total</b>	<b>616</b>	<b>77</b>	<b>197</b>	<b>274</b>	<b>1289</b>		<b>901</b>	<b>2190</b>	<b>91</b>	<b>242</b>	<b>333</b>	<b>1333</b>	<b>91</b>	<b>198</b>	<b>289</b>

\* Some organization had more than one email; therefore the number of emails sent was of 1956  
\*\* Refers to those organizations that don't mention where is the headquarter  
\*\*\* The total by county is 896; however participants had the opportunity to evaluate more than one level or program, thus the total number of responses was of 1168

# APPENDIX II. Primary Education, Secondary Education, Technical and Vocational Education and Training (TVET)

## Primary Education

Figure A1. Inclusion of forest-related curriculum as individual subjects in primary education

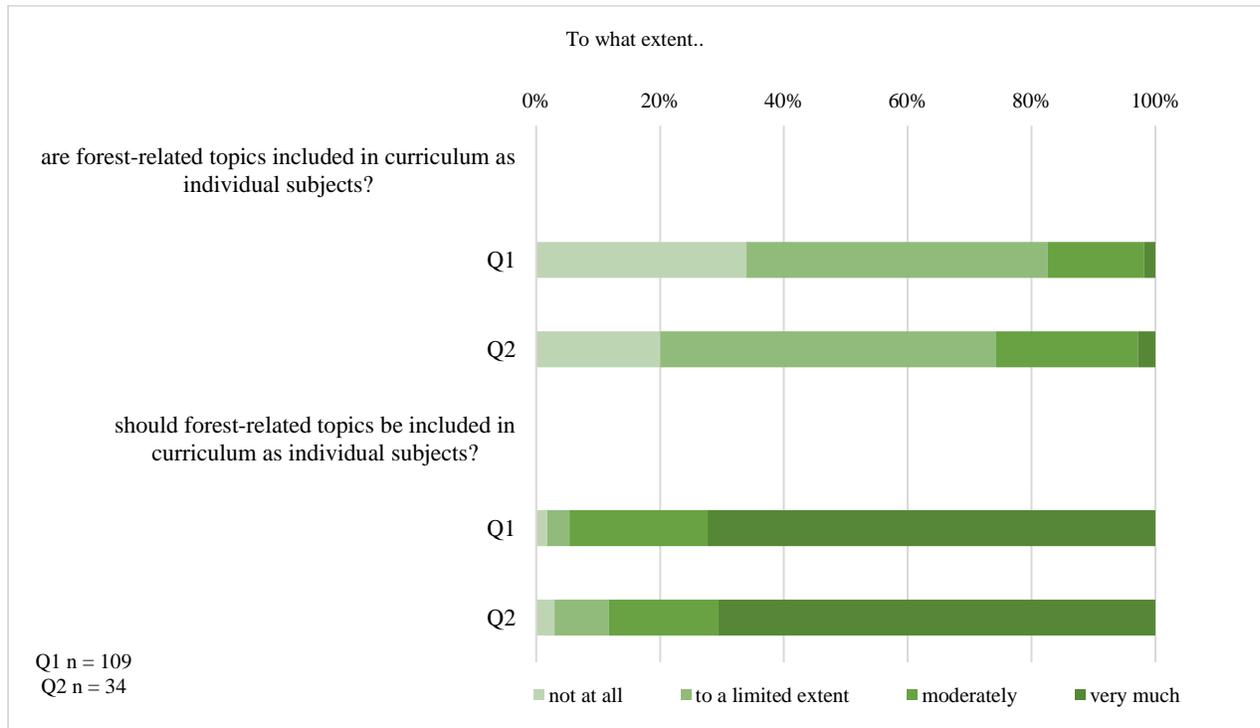


Figure A2.1. Coverage of forest-related topics and skills in primary education

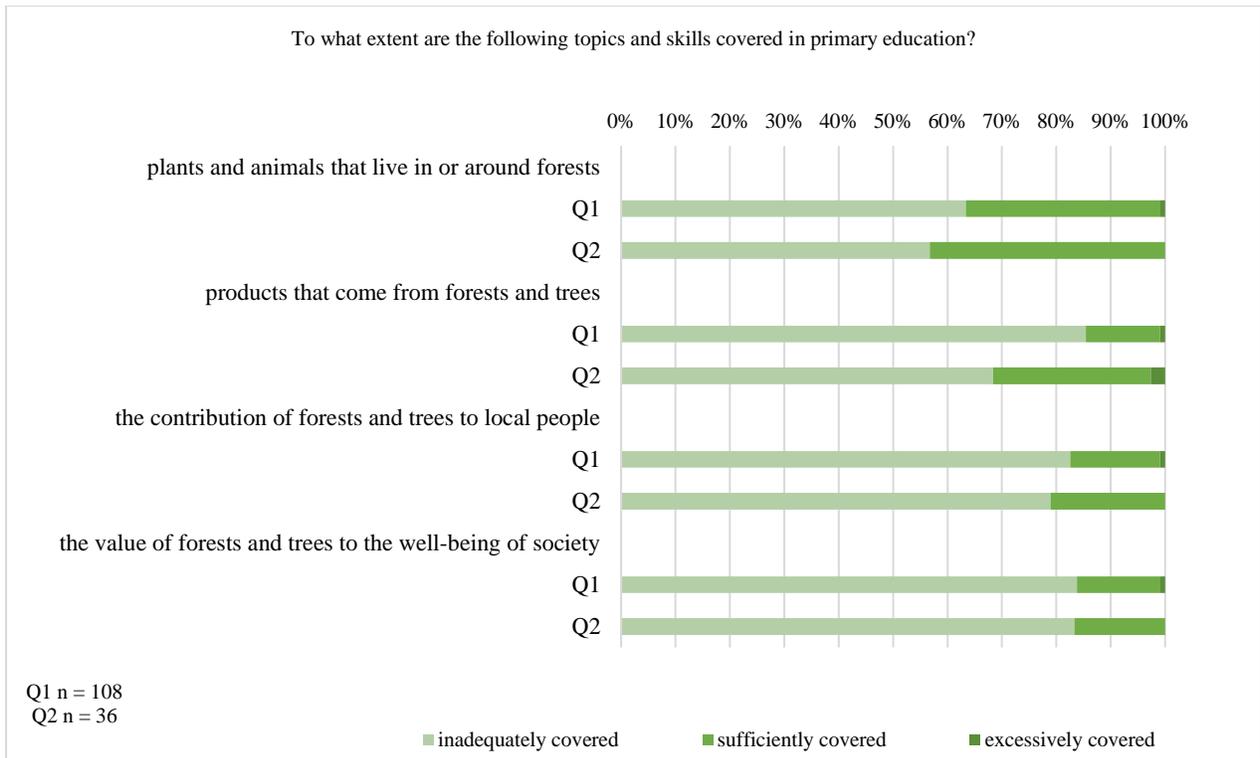


Figure A2.2. Coverage of forest-related topics and skills in primary education

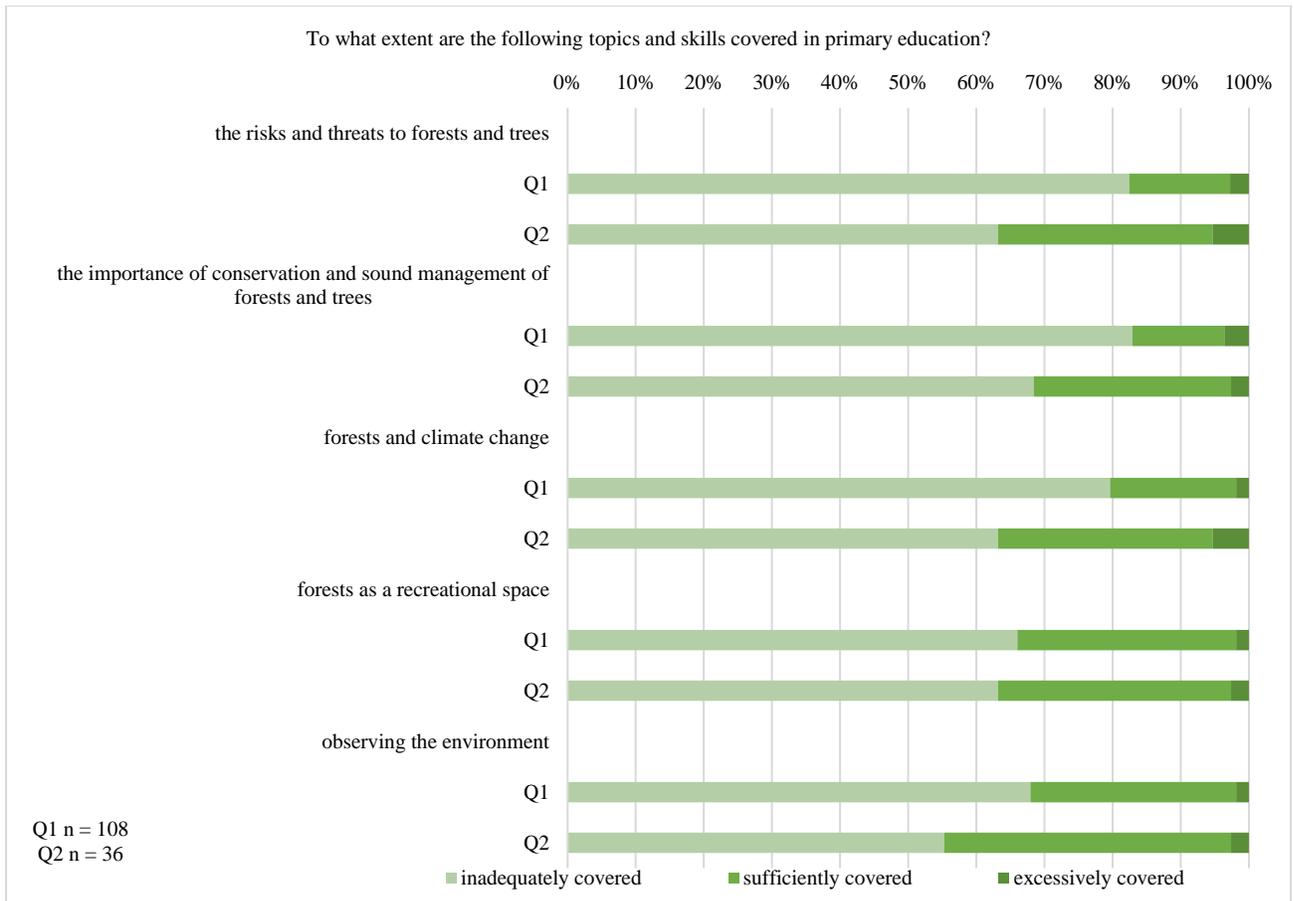


Figure A2.3. Coverage of forest-related topics and skills in primary education

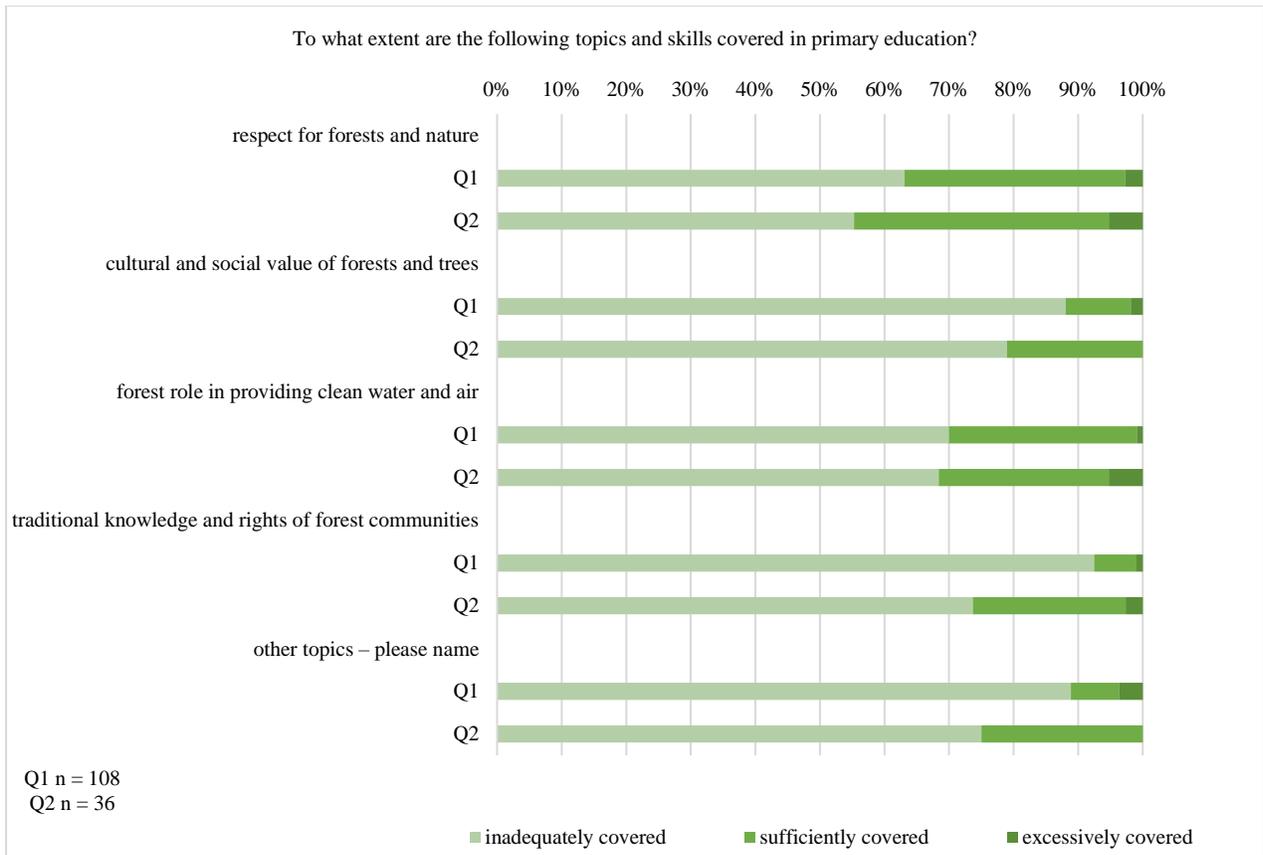


Figure A3. Inclusion of forest-related curriculum in other subjects in primary education

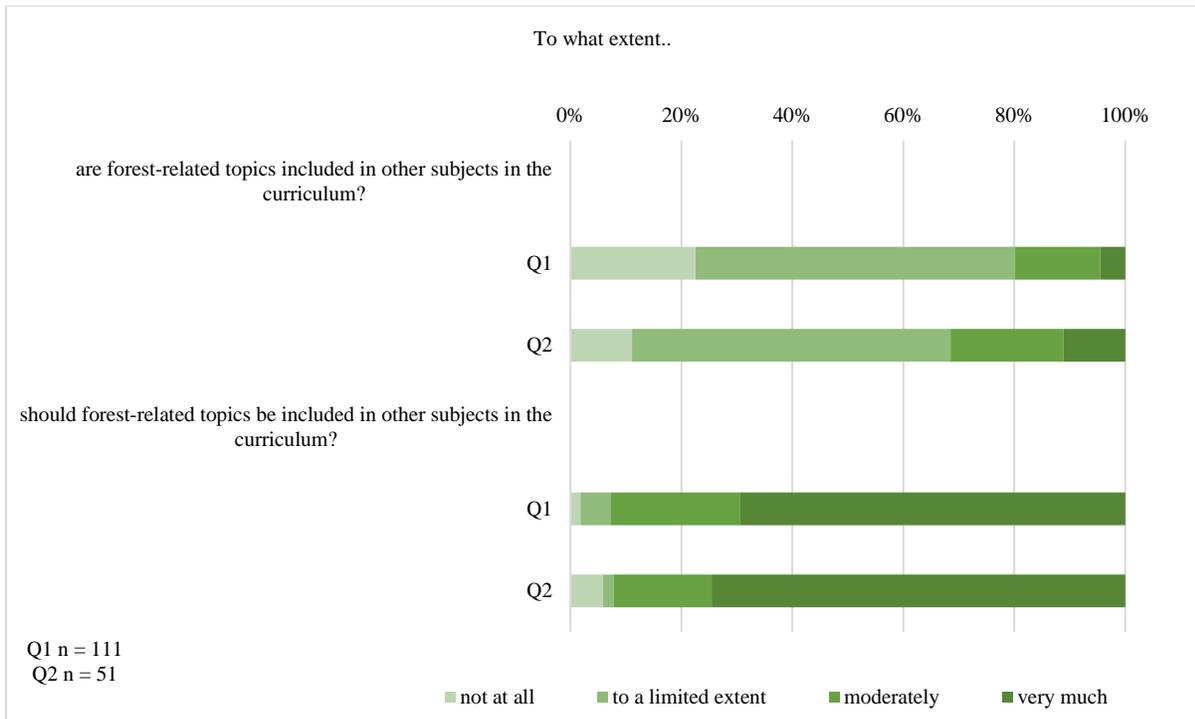


Figure A4. Policies or strategies leading to improved forest-related curriculum in primary schools

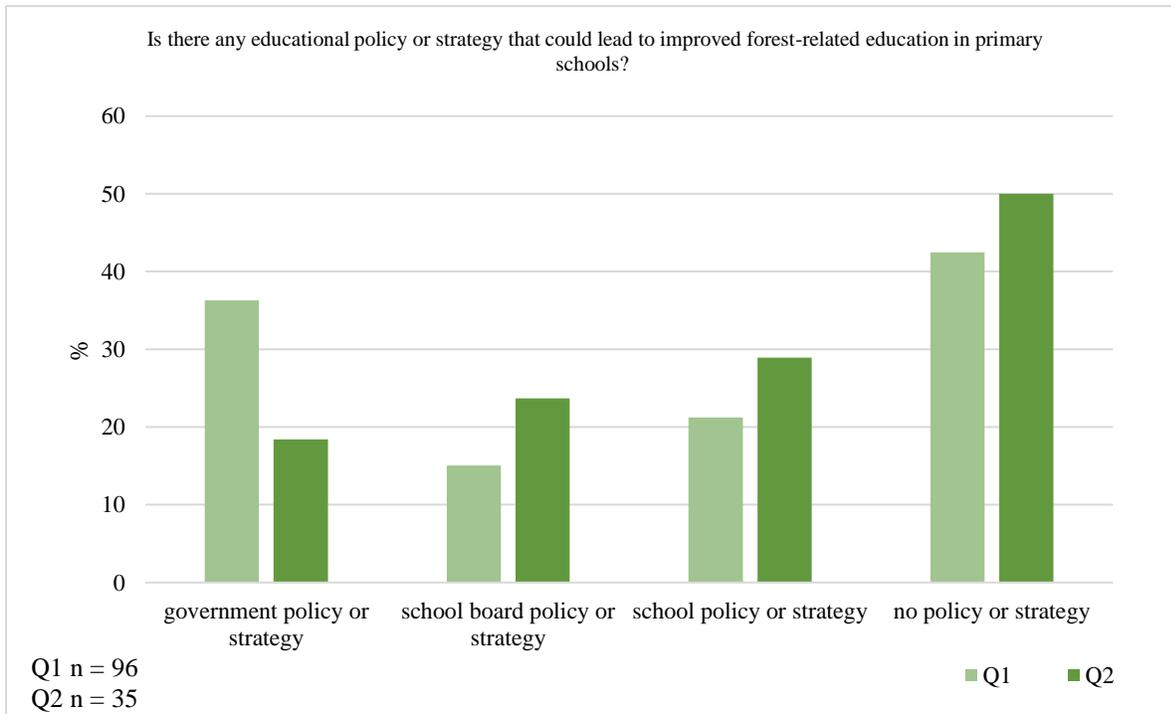


Figure A5. Forest-education teaching knowledge and skills

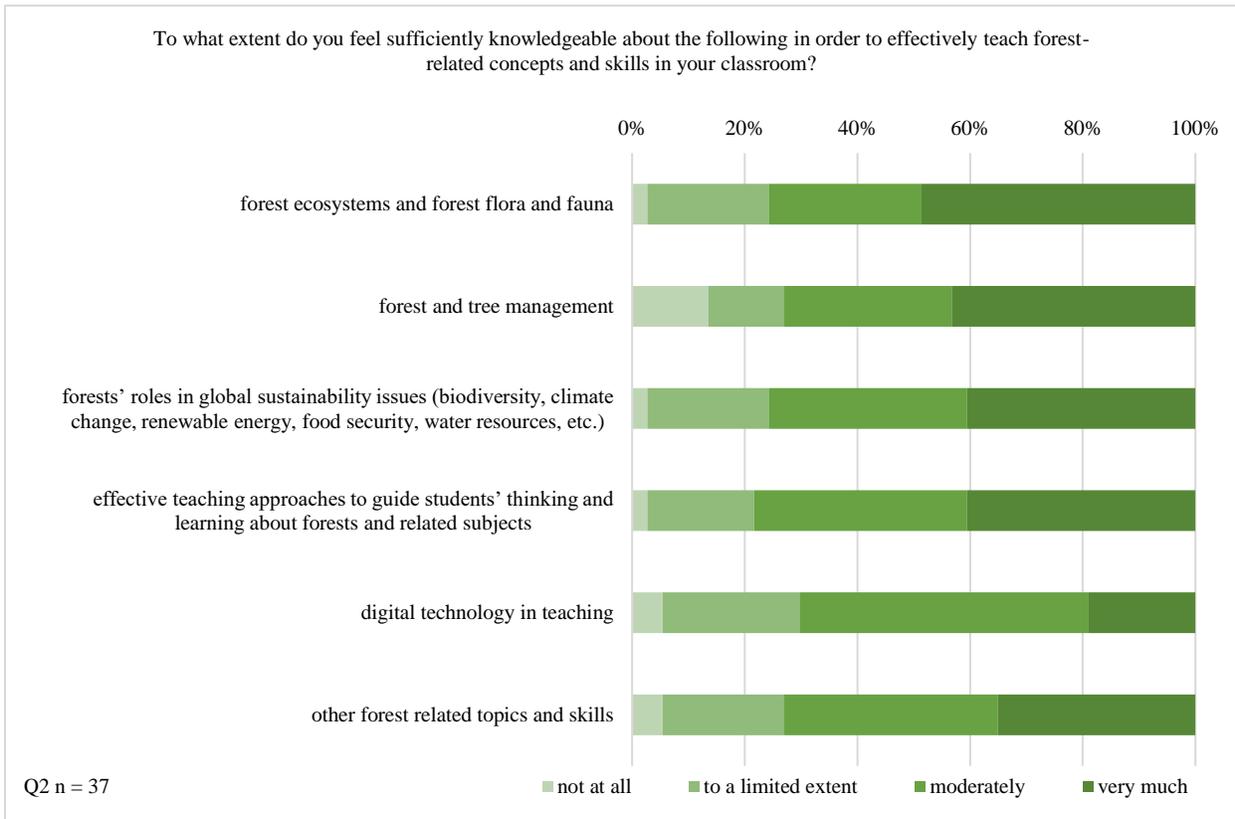


Figure A6. Forests used as a teaching environment or classroom

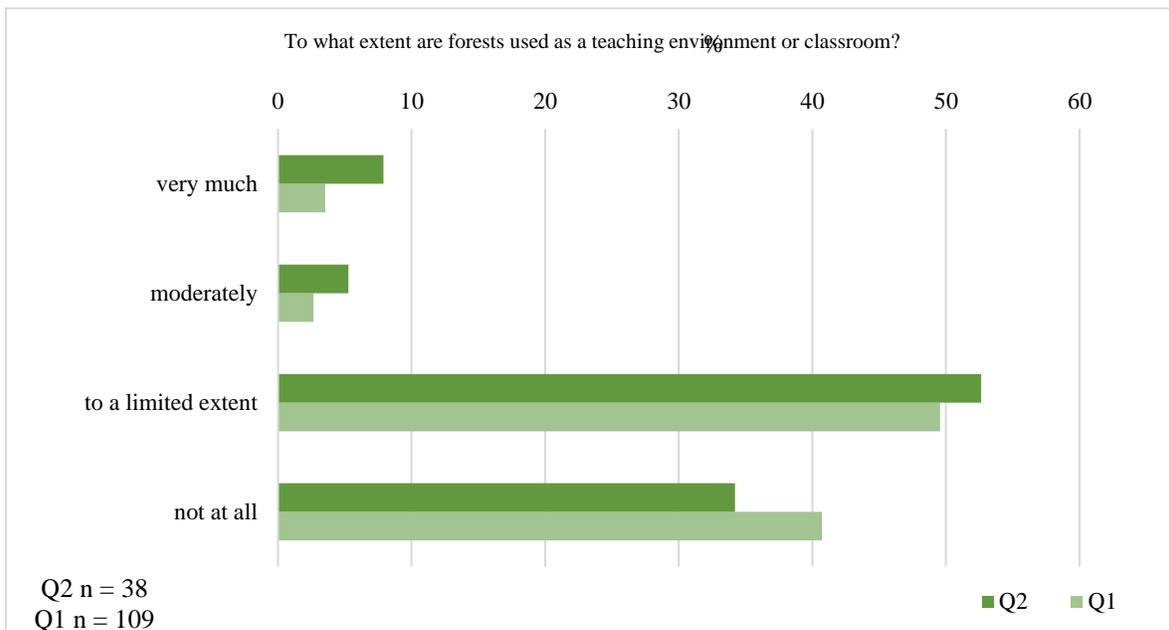


Figure A7. Availability of forest education resources in primary schools

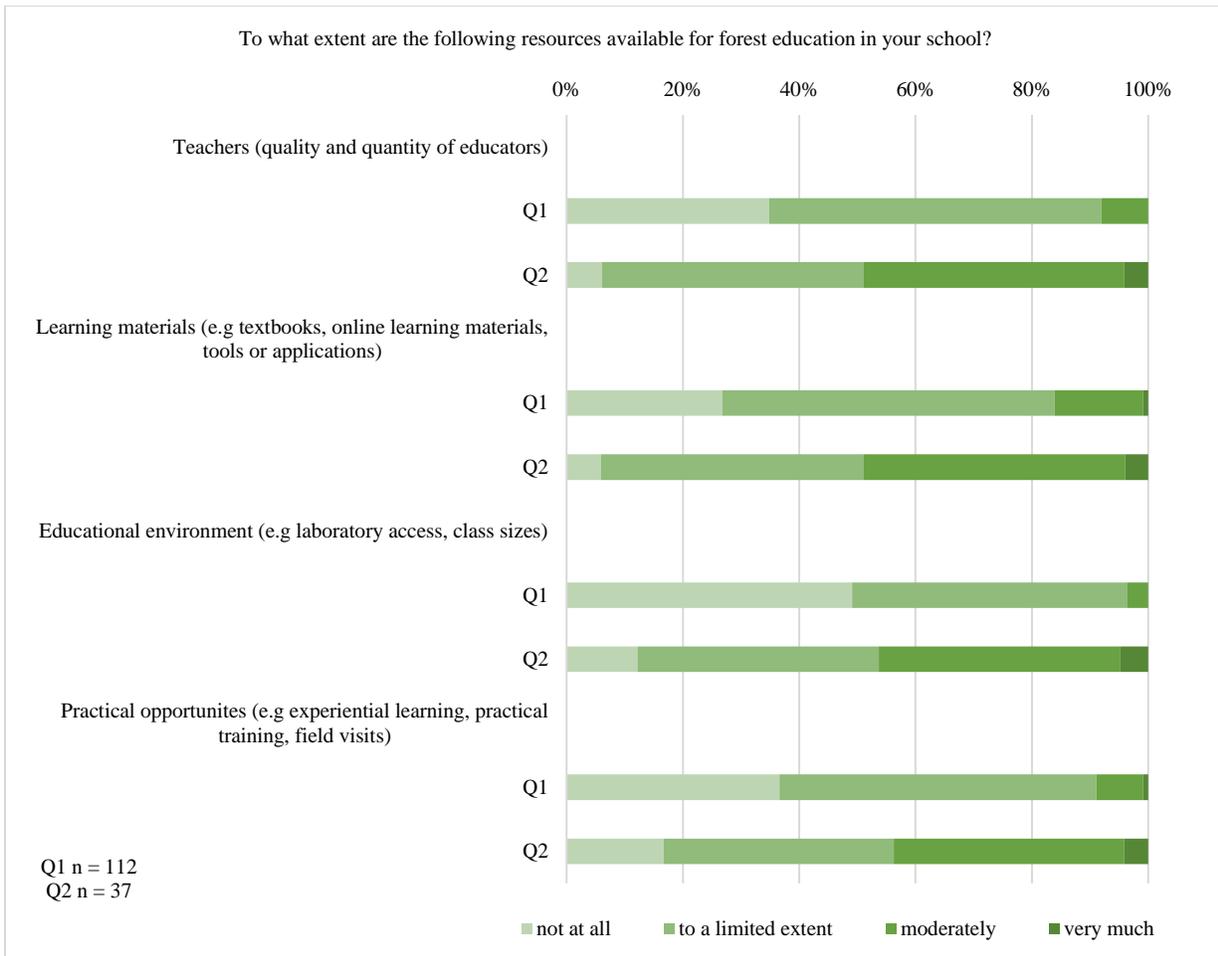


Figure A8. Impact of primary education to increase student interest in nature and natural resources

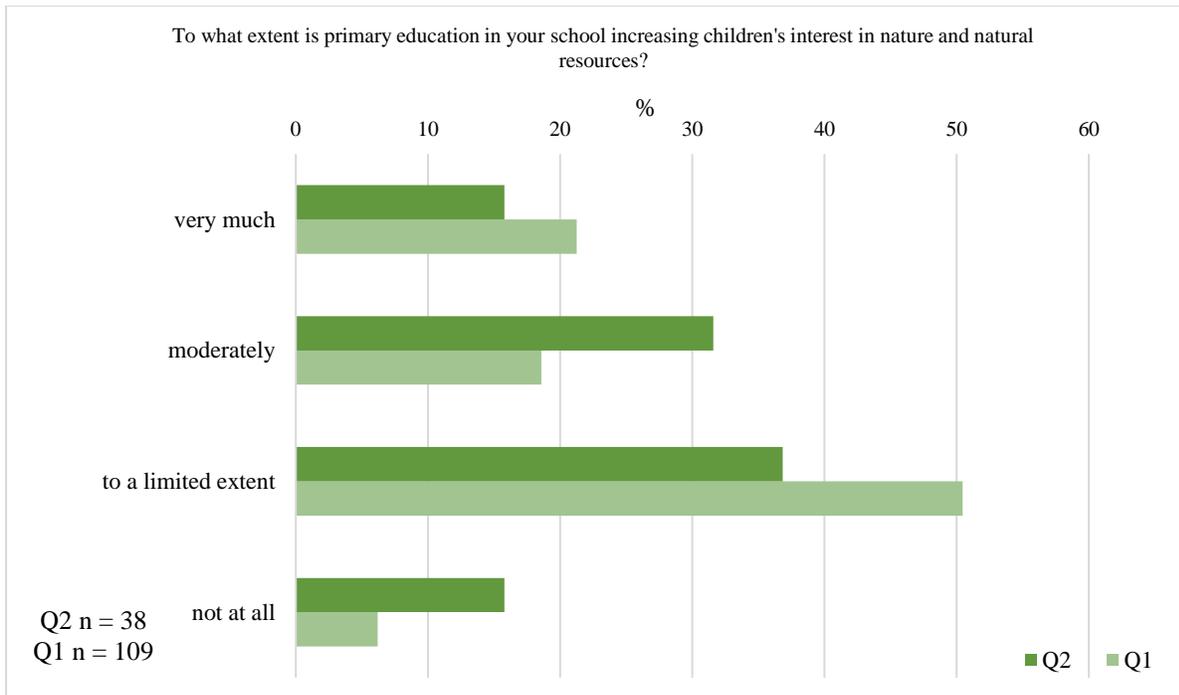


Figure A9. Common teaching and learning approaches

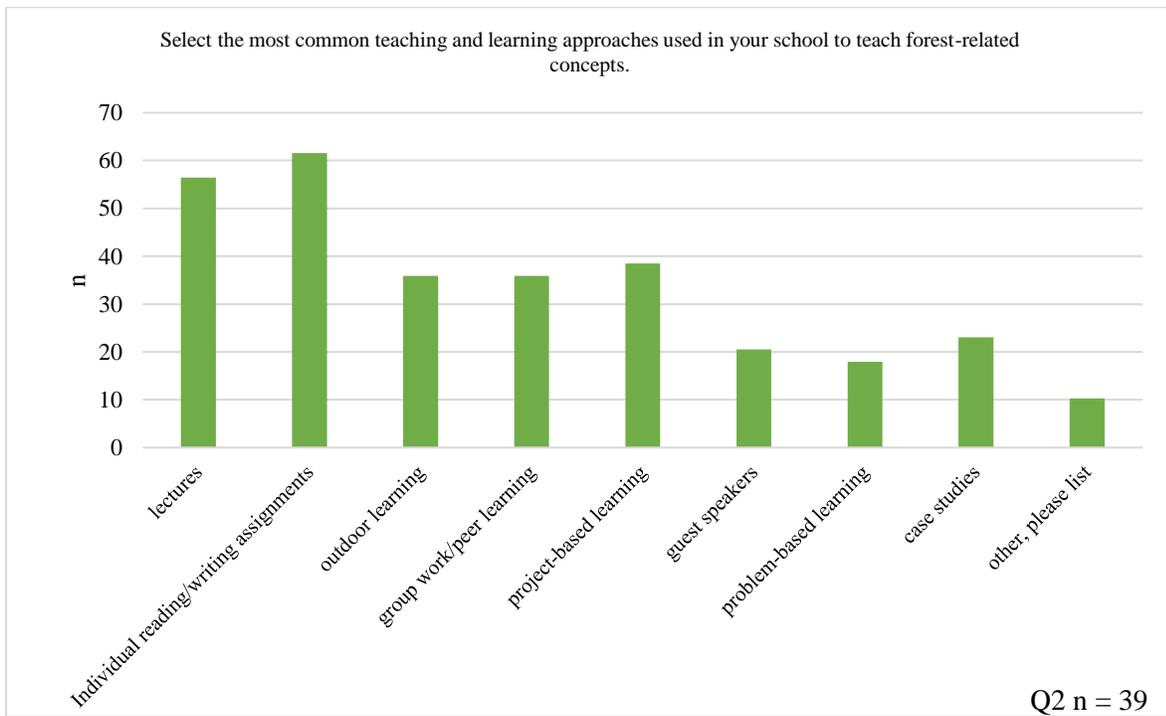


Figure A10. Recommended improvements to learning and increased student interest in forest-related concepts.

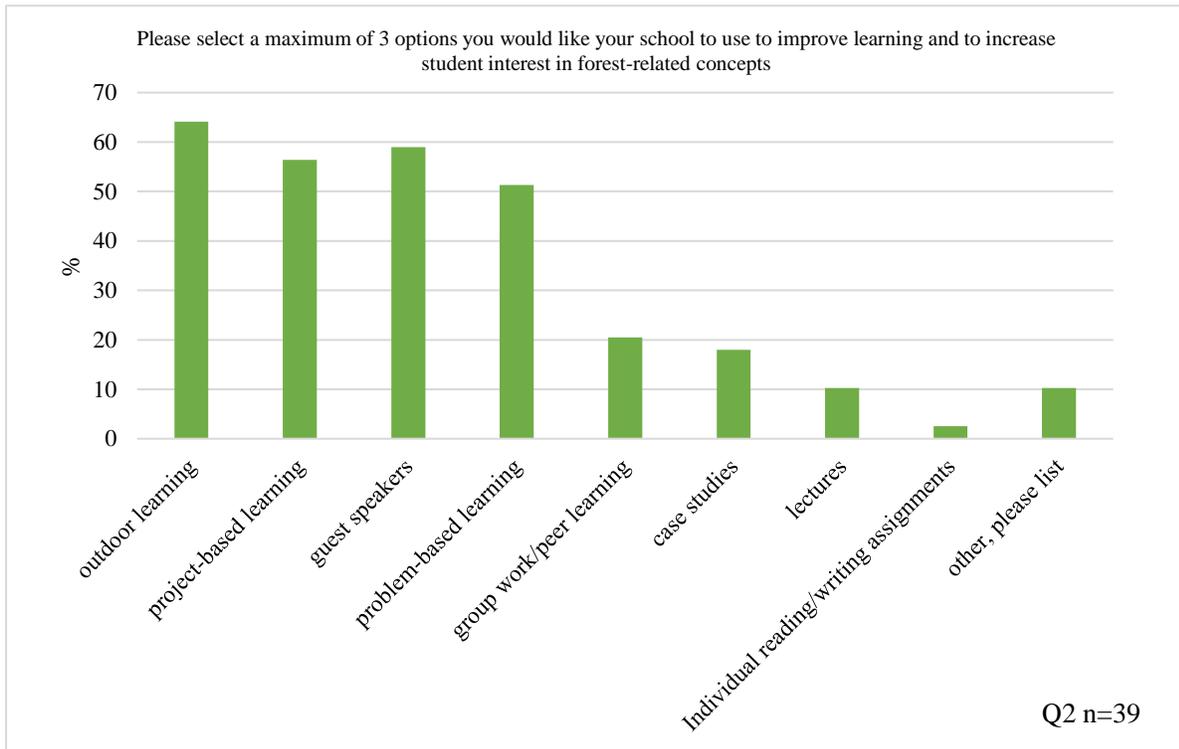


Figure A11. Forest learning through out-of-school activities

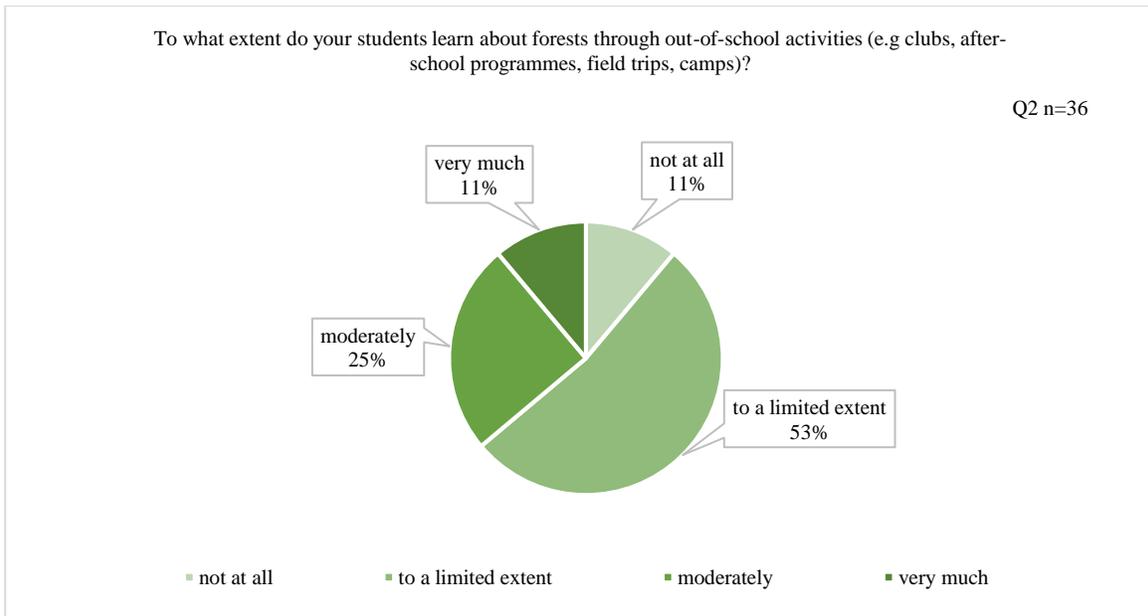
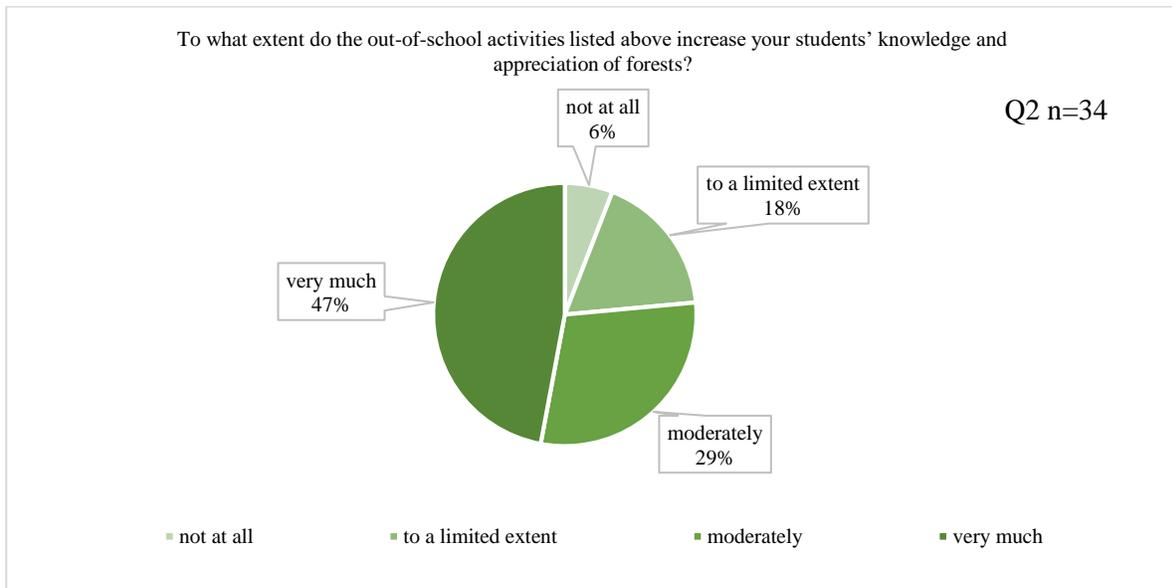


Figure A12. Ability of out-of school activities to increase forest knowledge and appreciation



## Secondary Education

Figure A13. Inclusion of forest-related curriculum as individual subjects in secondary education

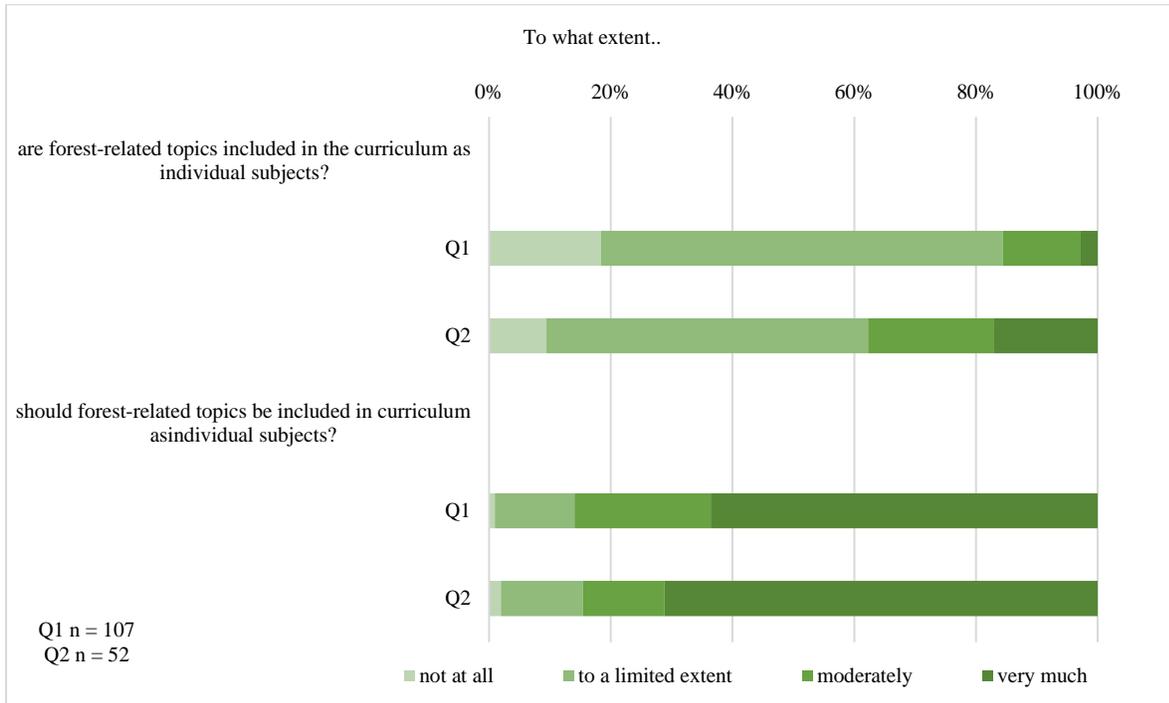


Figure A14. Inclusion of forest-related curriculum in other subjects in secondary education

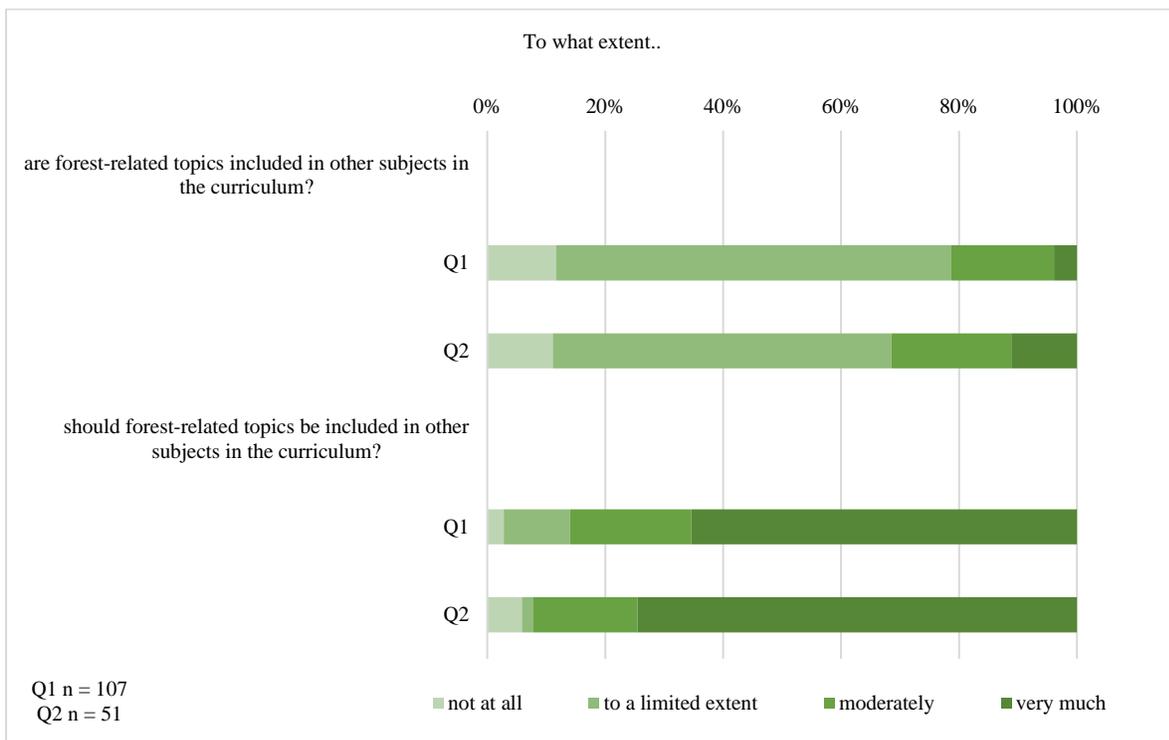


Figure A15. Availability of forest education resources in secondary schools

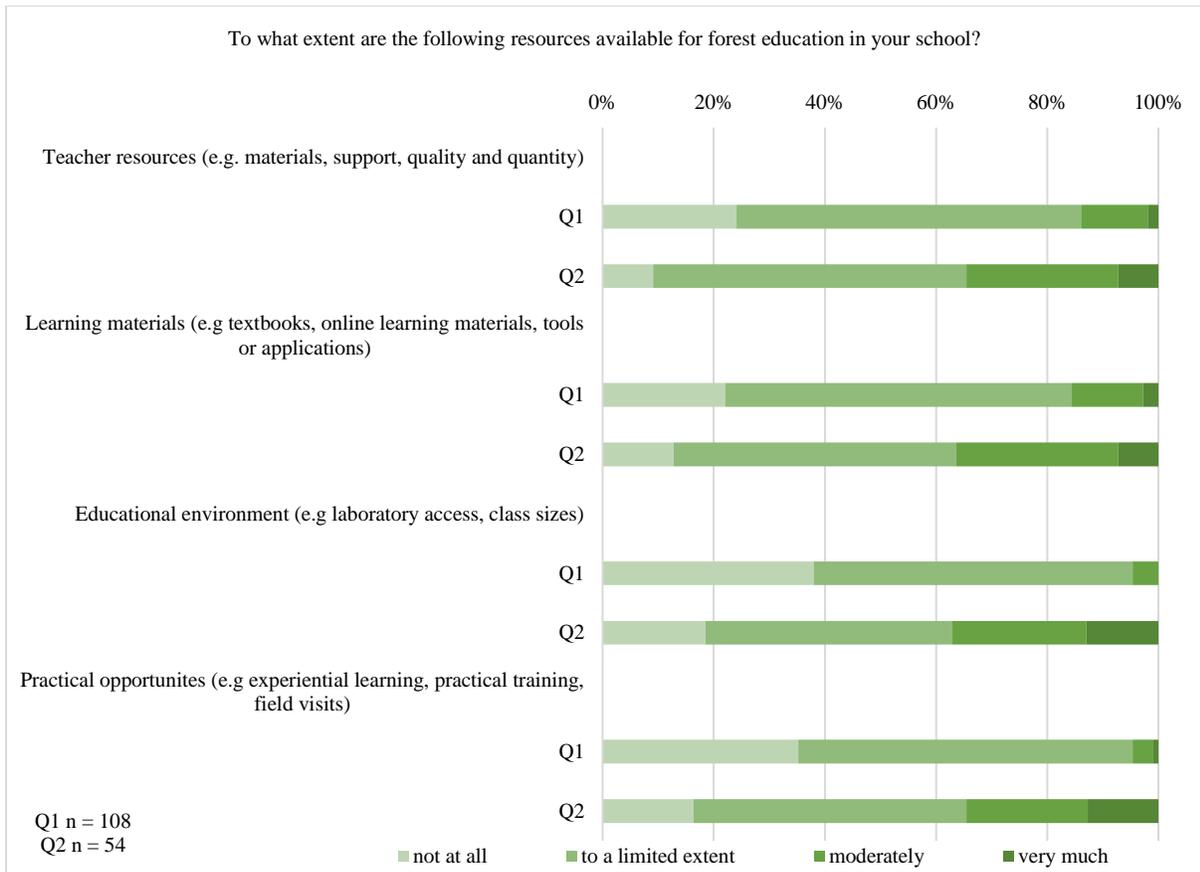


Figure A16. Policies or strategies leading to improved forest-related curriculum in secondary schools

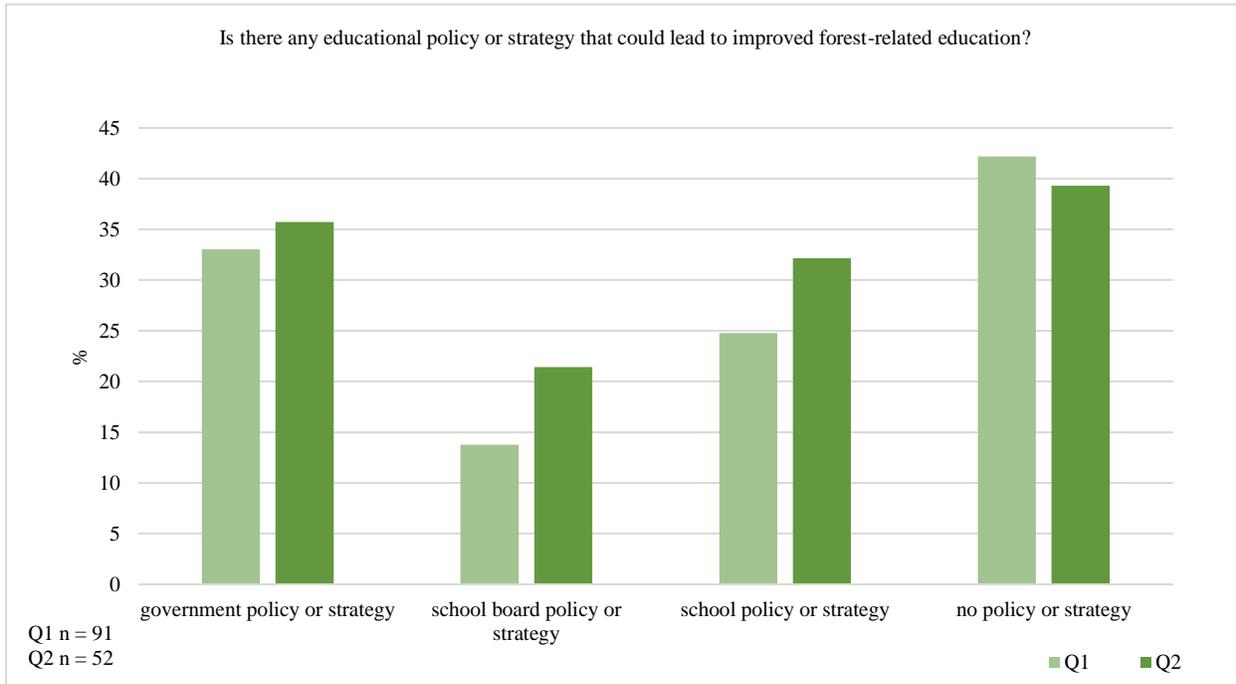


Figure A17. Forest-education teaching knowledge and skills

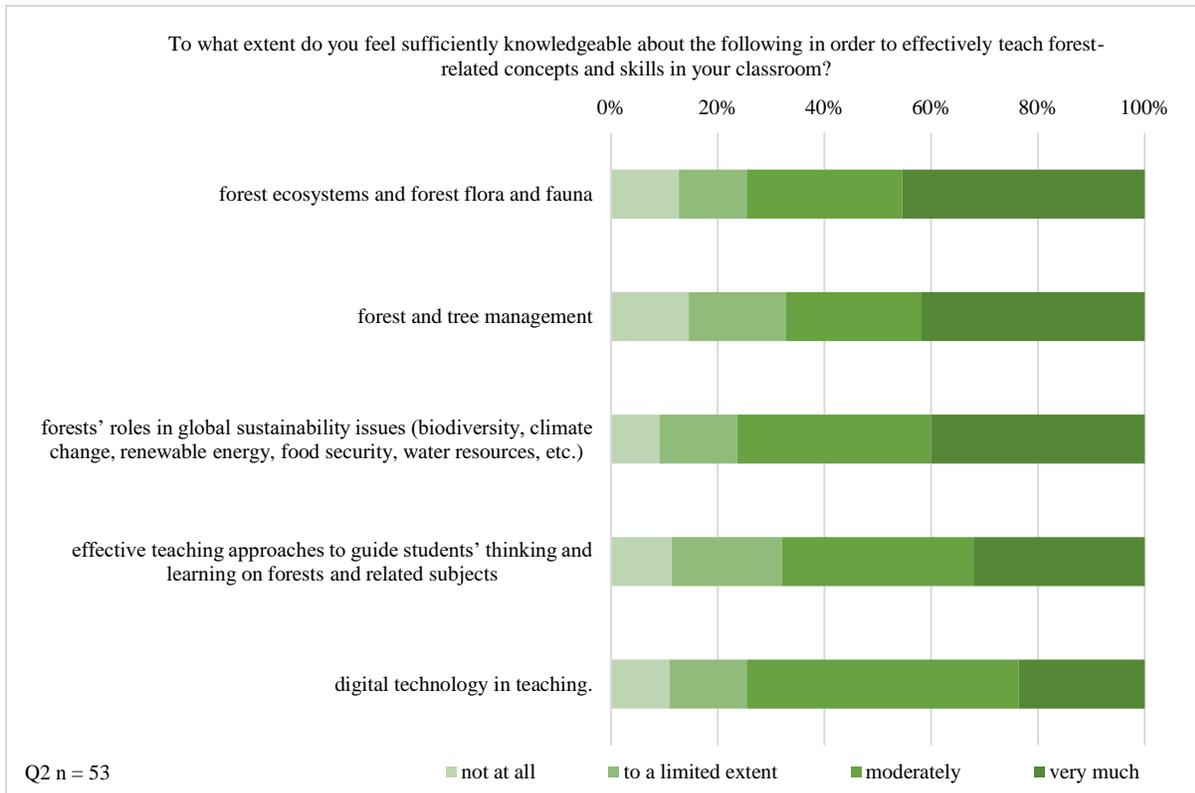


Figure A18. Forests used as a teaching environment or classroom

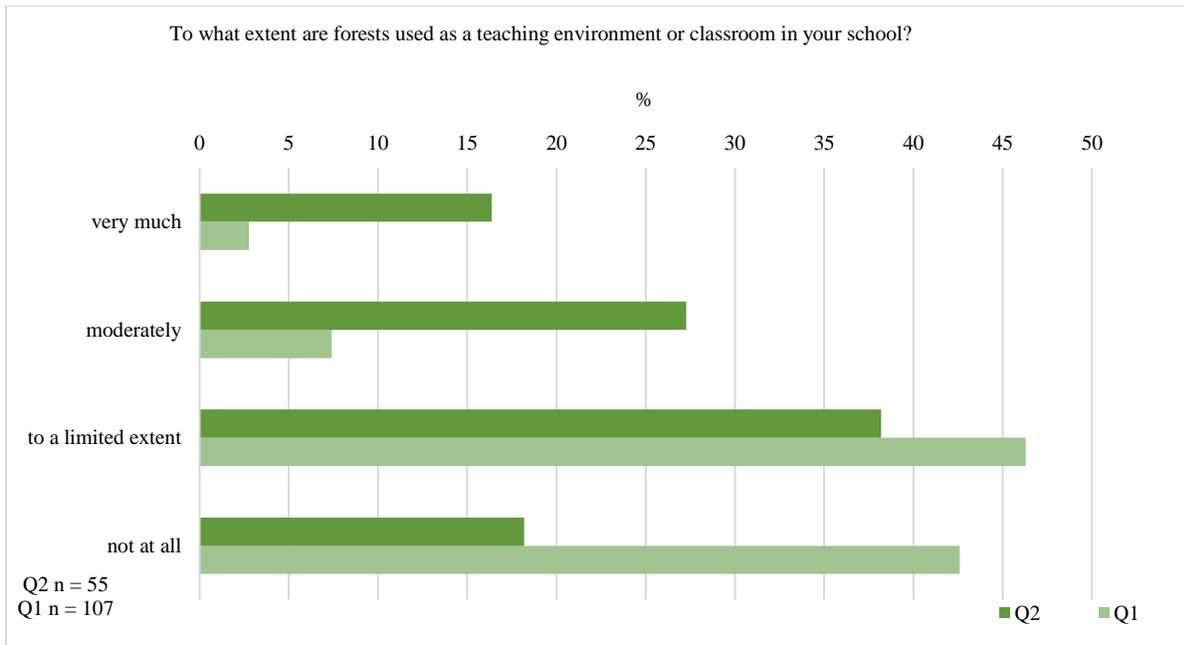


Figure A19. Students' exposure to forests through out-of-school activities and impact on forest knowledge and appreciation

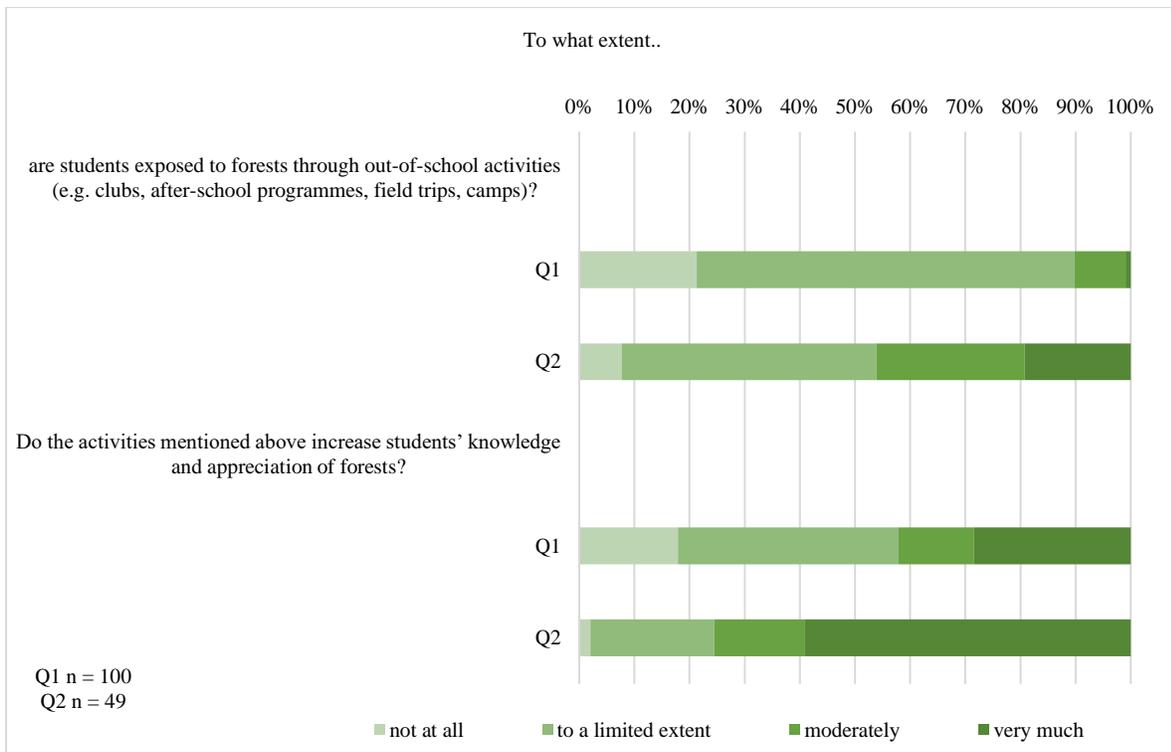


Figure A20. Impact of secondary education to increase student interest in nature and natural resources

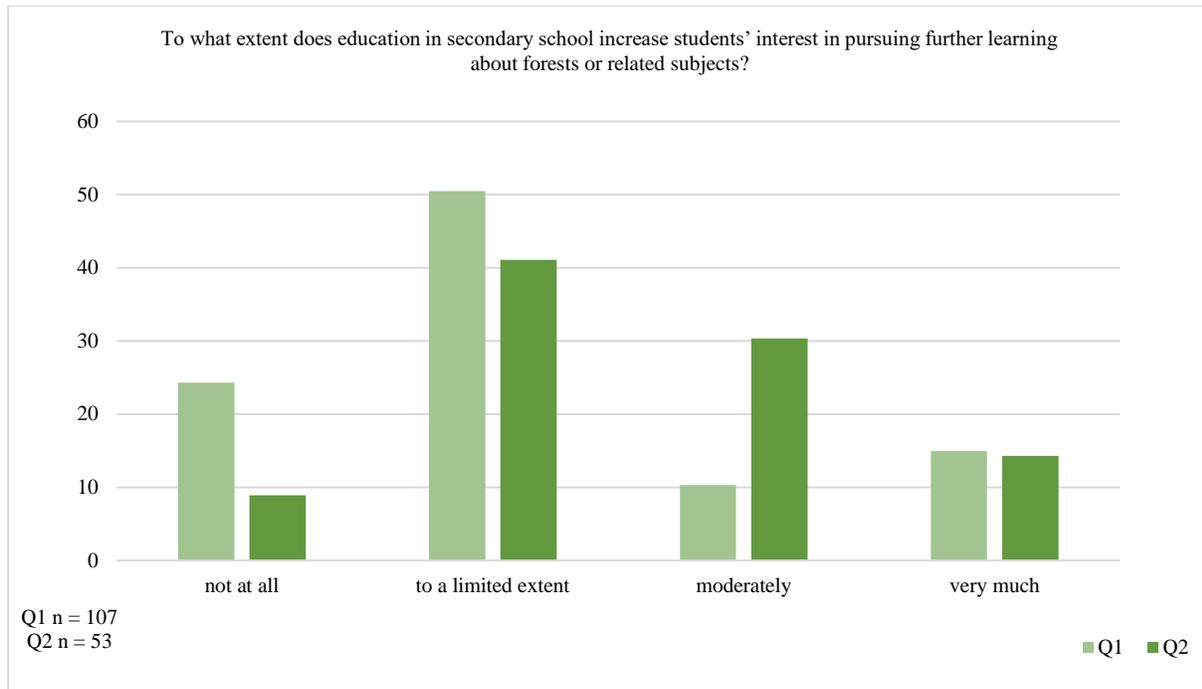


Figure A21.1 Coverage of forest-related topics and skills in secondary education

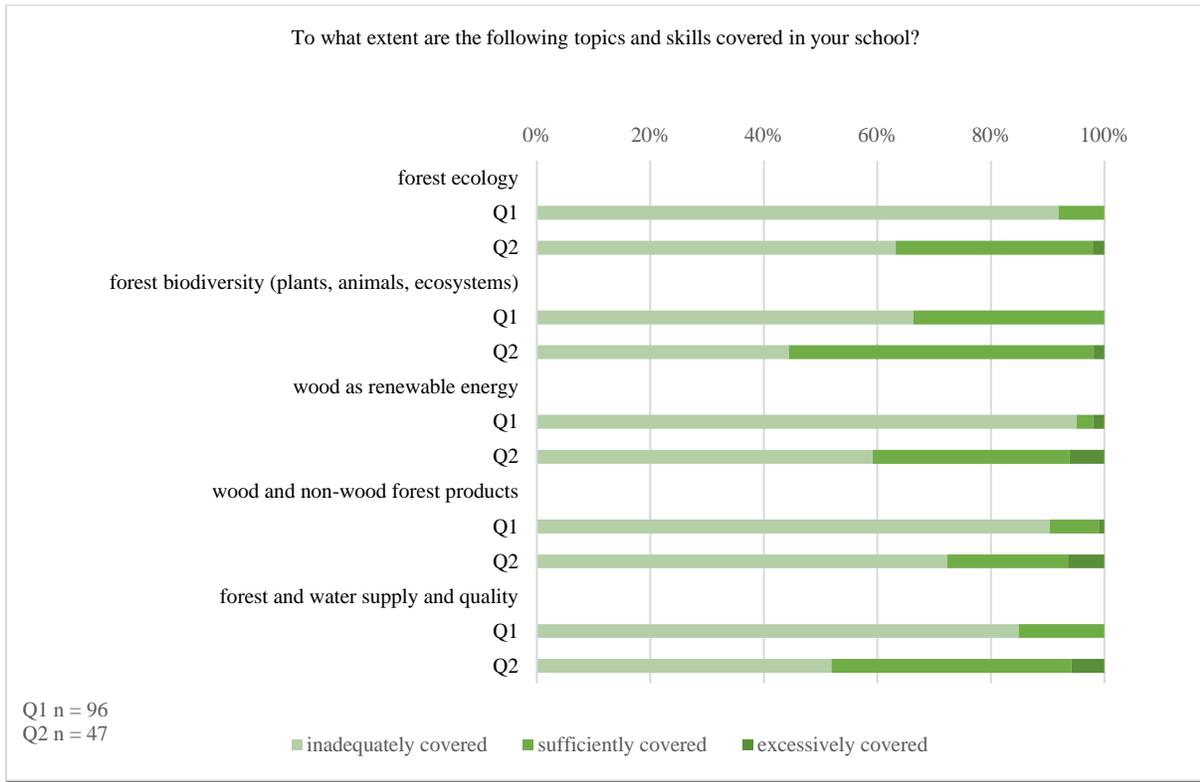


Figure A21.2 Coverage of forest-related topics and skills in secondary education

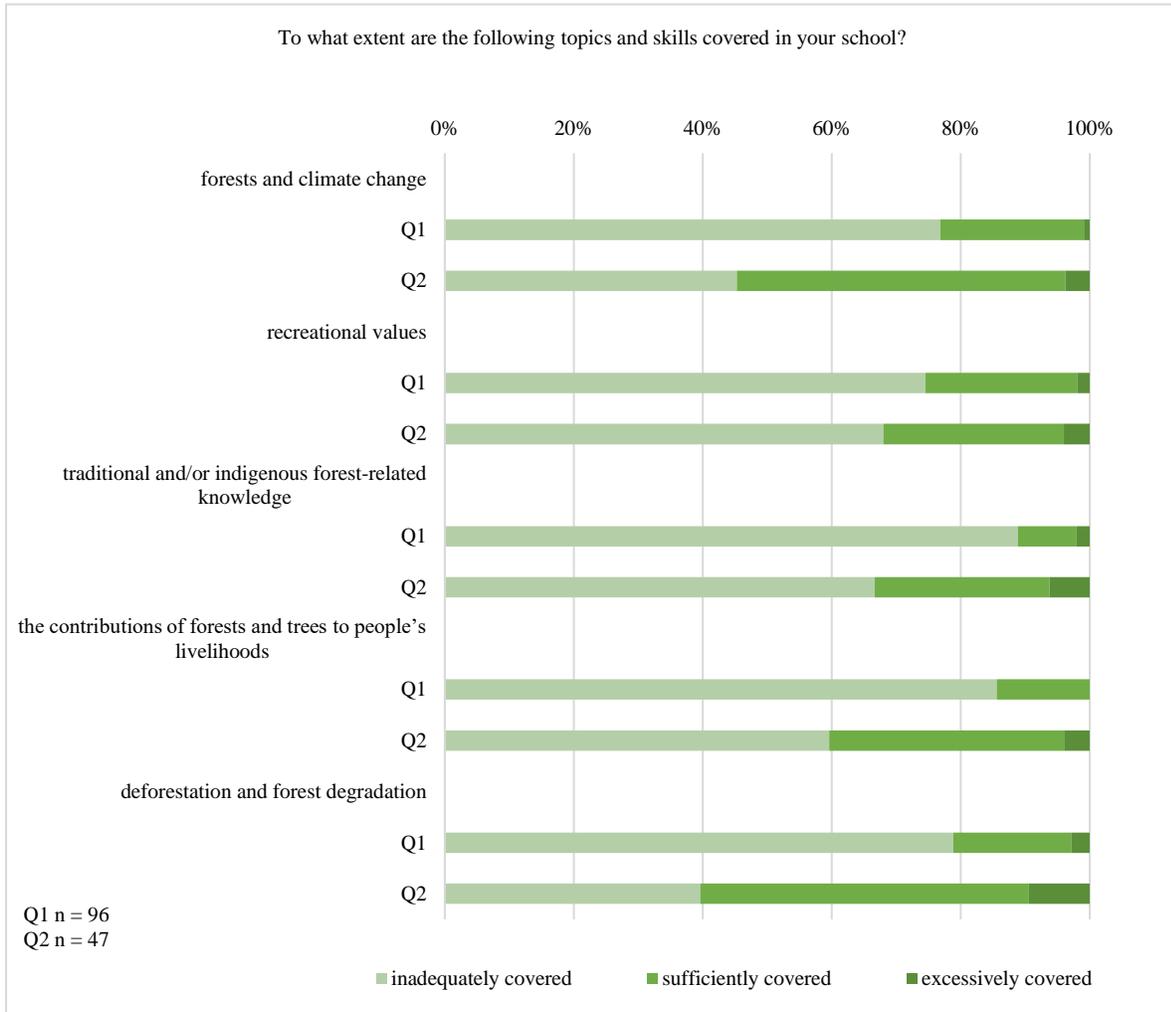


Figure A21.3 Coverage of forest-related topics and skills in secondary education

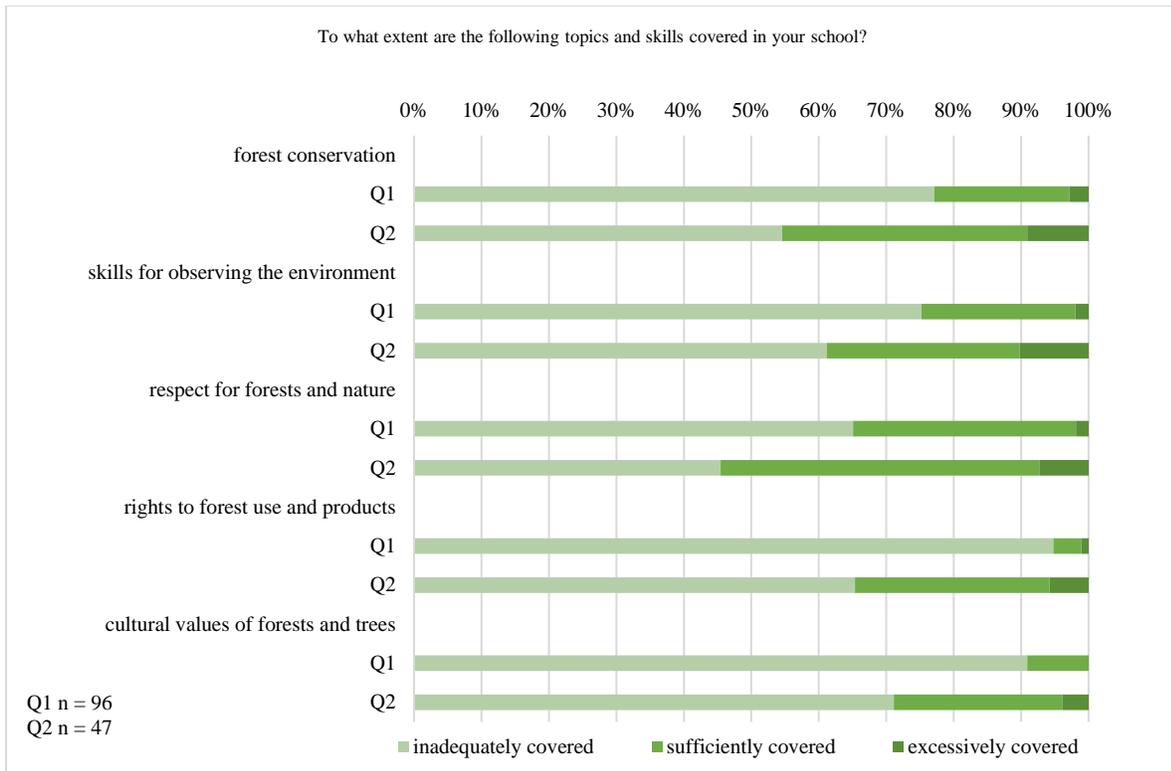
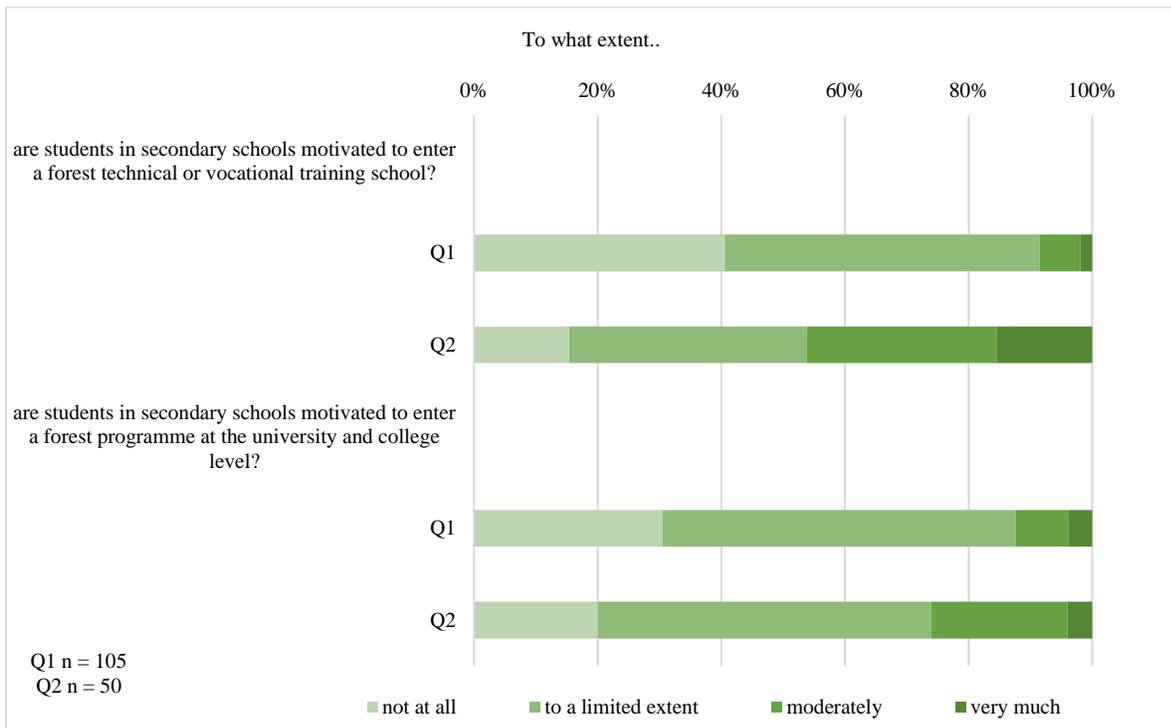


Figure A22. Student motivation to enter higher-level forest course or programme following secondary education



## Technical and vocational education and training (TVET)

Figure A23. Availability of resources in TVET forest programmes

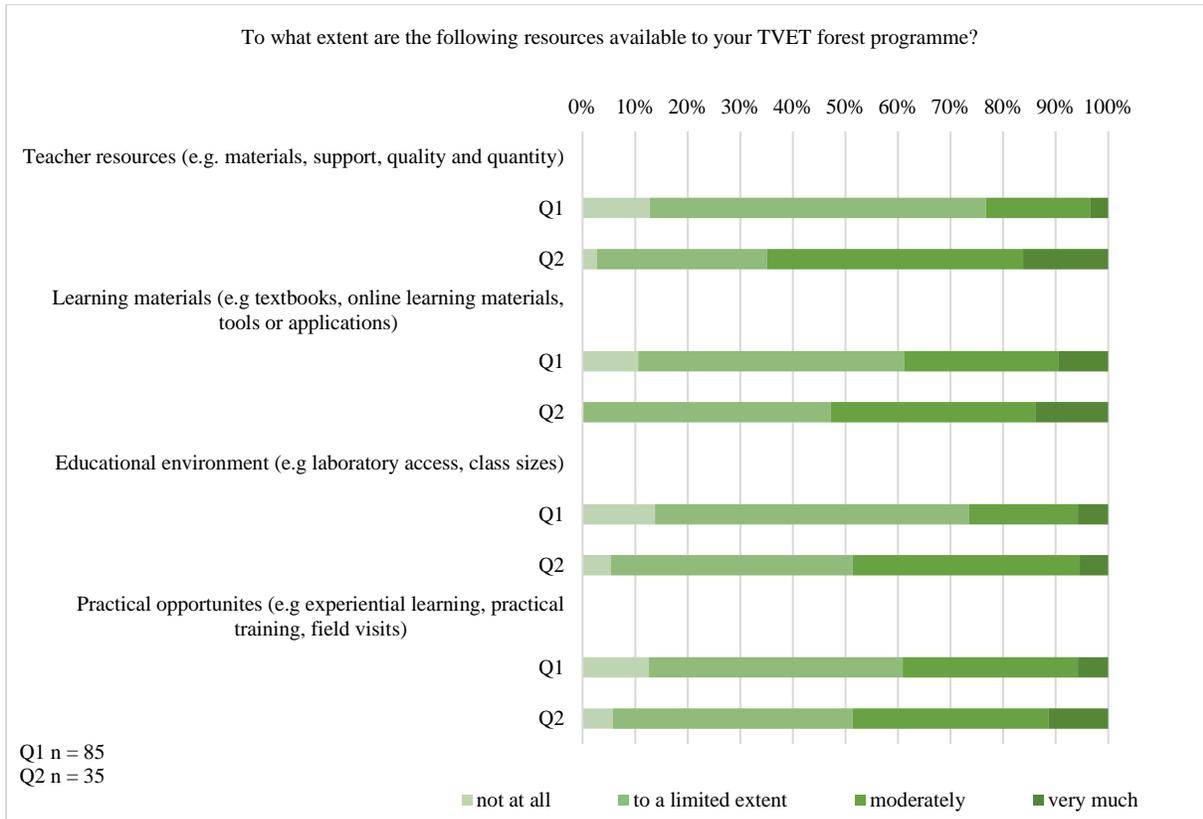


Figure A24. Policies or strategies leading to improved forest education in TVET schools

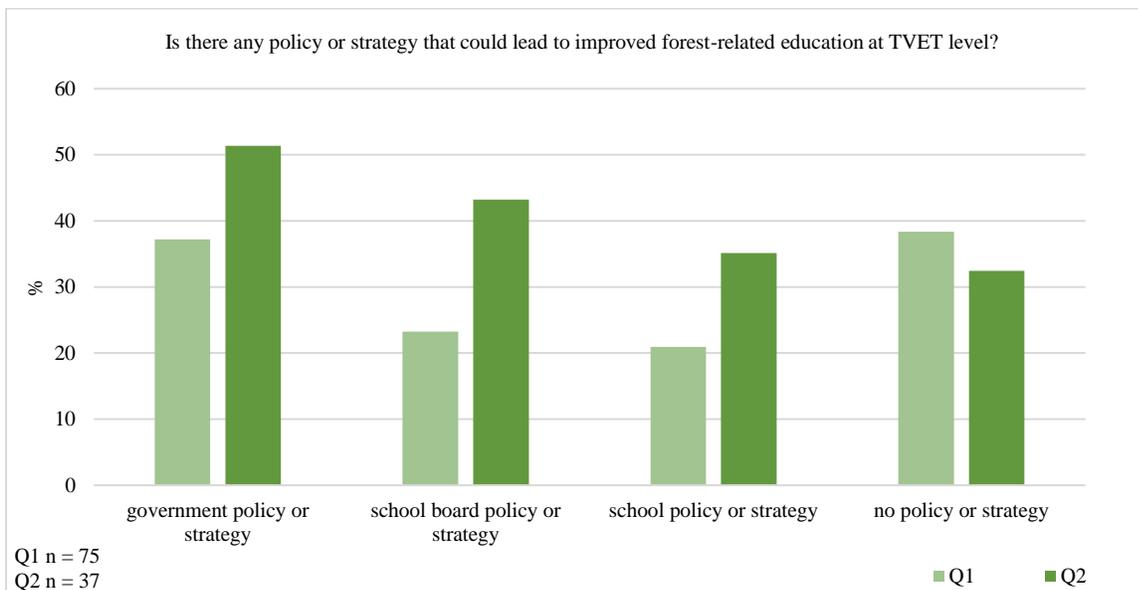


Figure A25. Availability of resources for continuing education

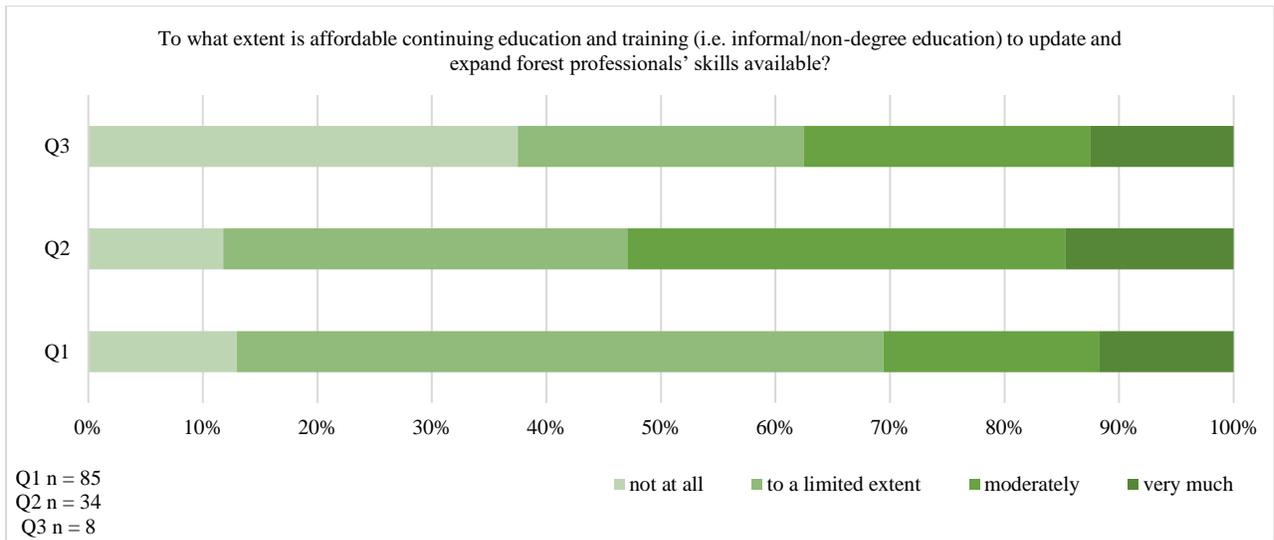


Figure A26. Student engagement in forest-related out-of-school activities and wider educational and professional impacts

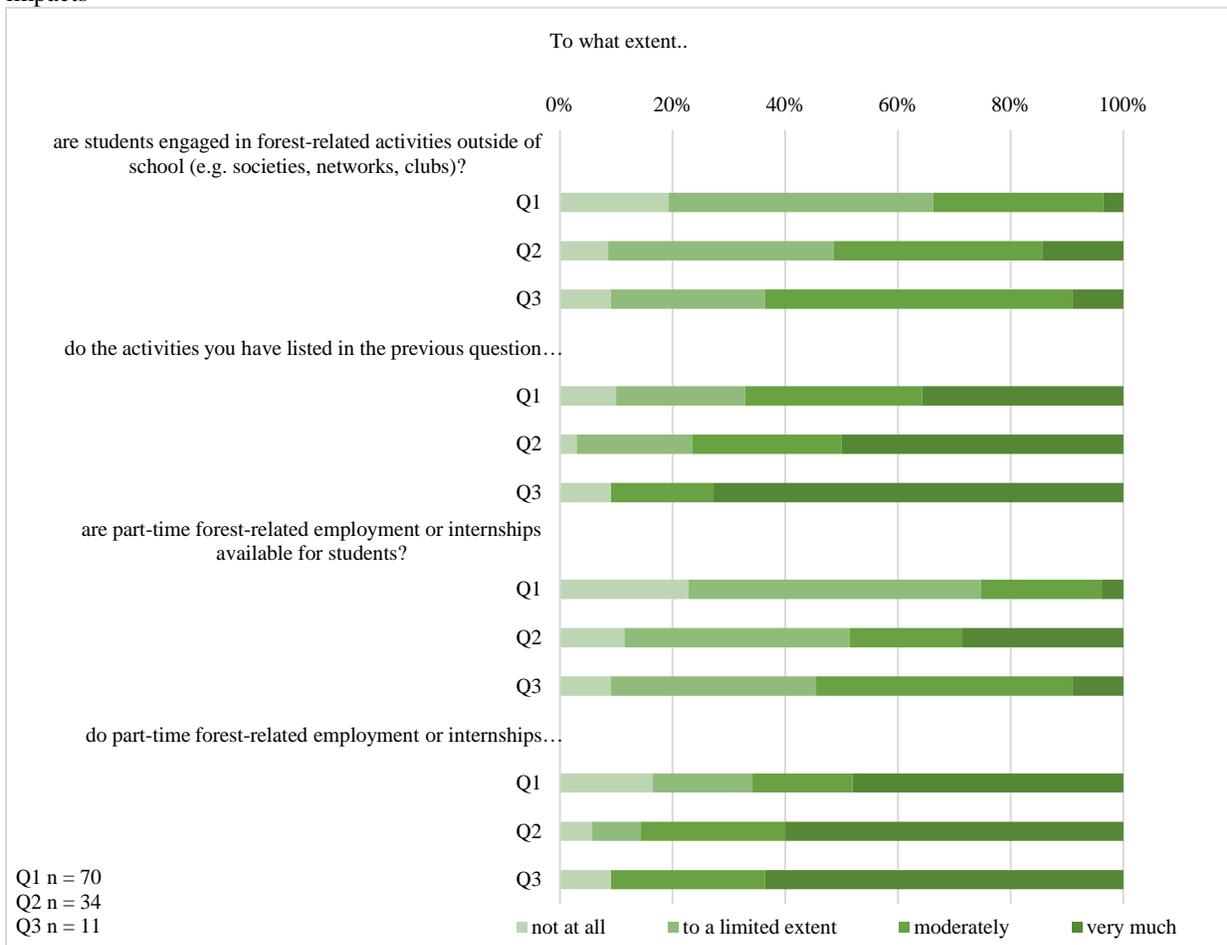


Figure A27. Use and benefit of digital learning tools within TVET forest programmes

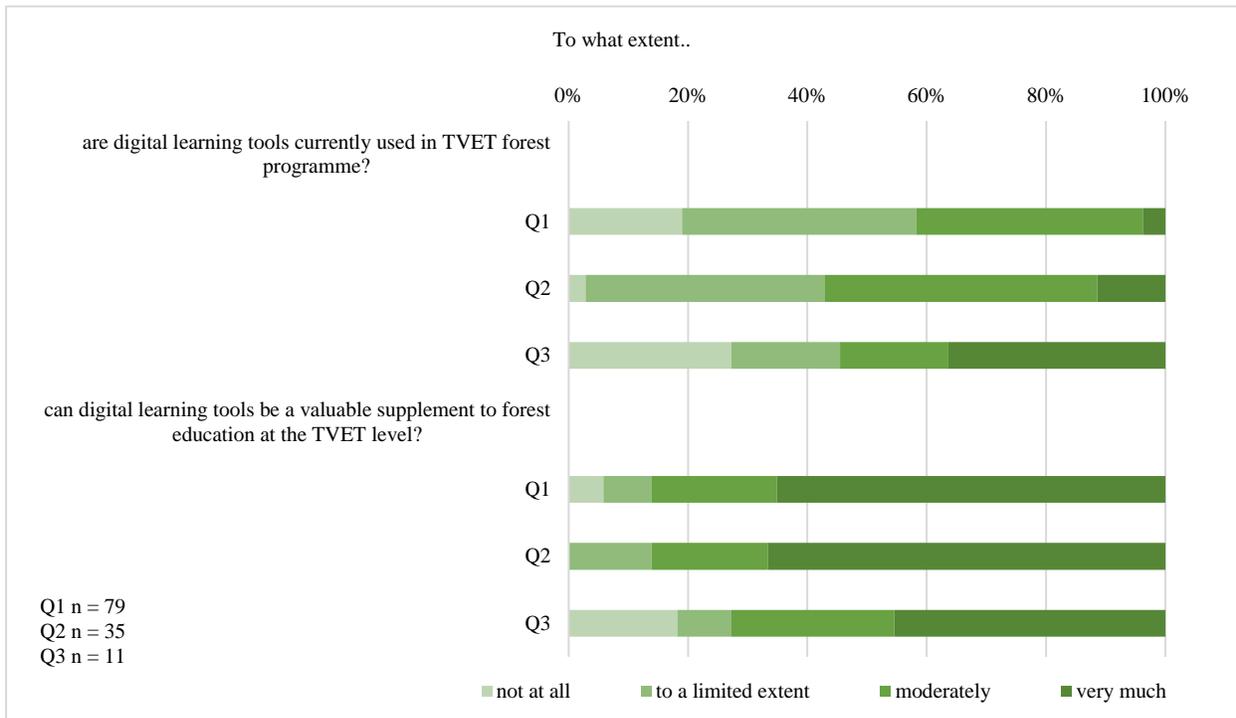


Figure A28. Coverage of forest-related topics in TVET forest programme (forest resources and forest ecology)

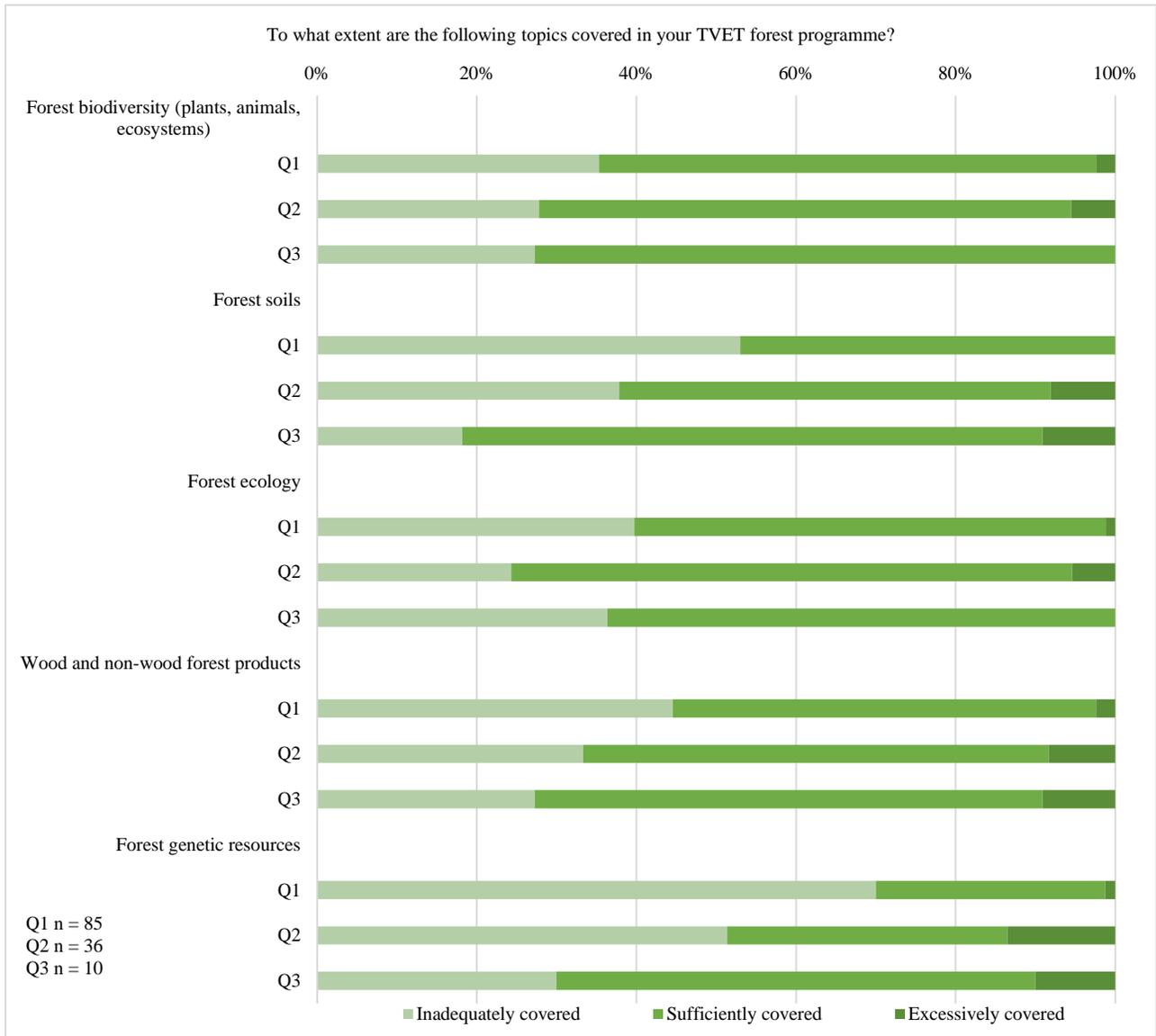


Figure A29.1. Coverage of forest-related topics in TVET forest programme (forest/tree planning and management)

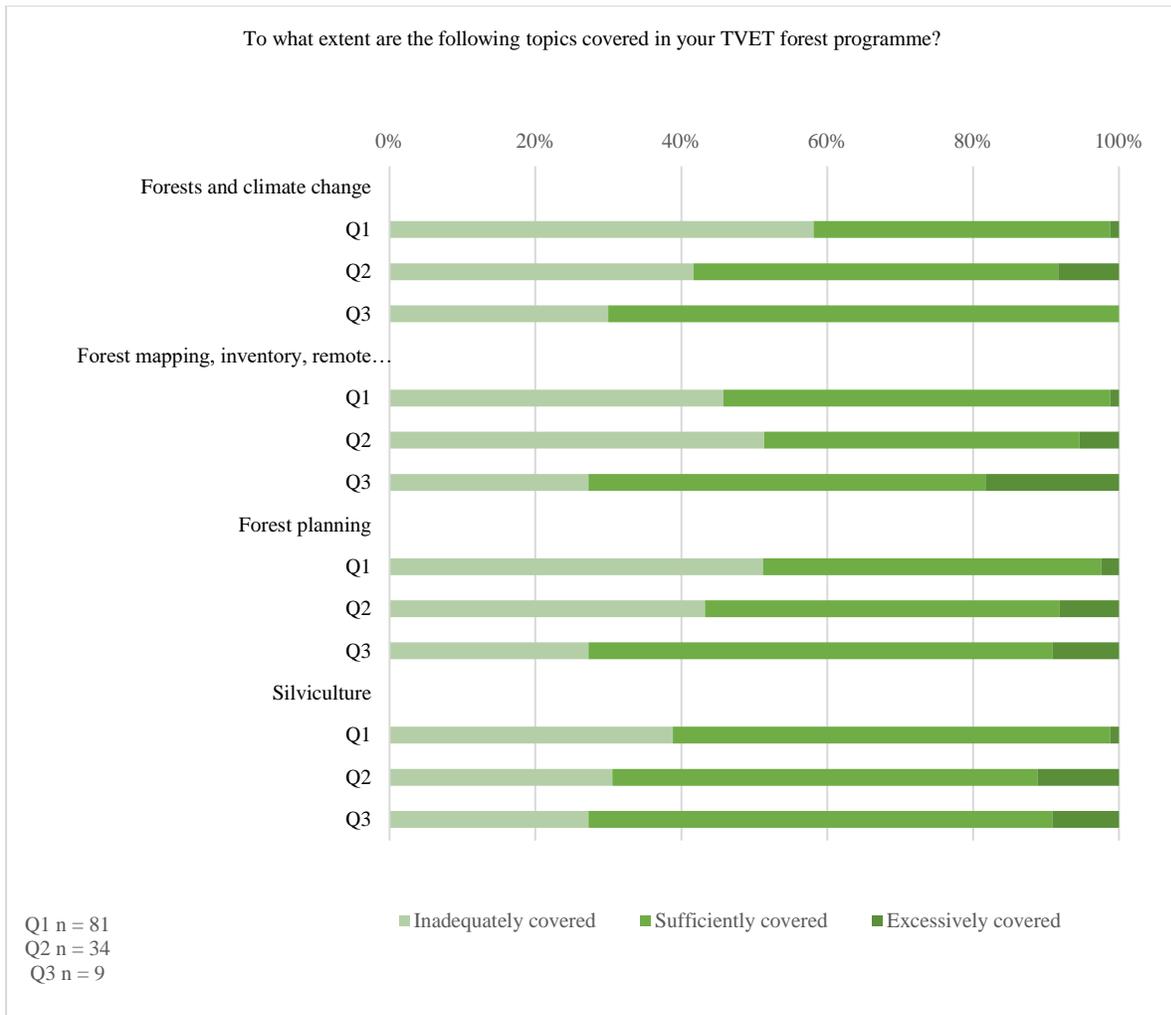


Figure A29.2. Coverage of forest-related topics in TVET forest programme (forest/tree planning and management)

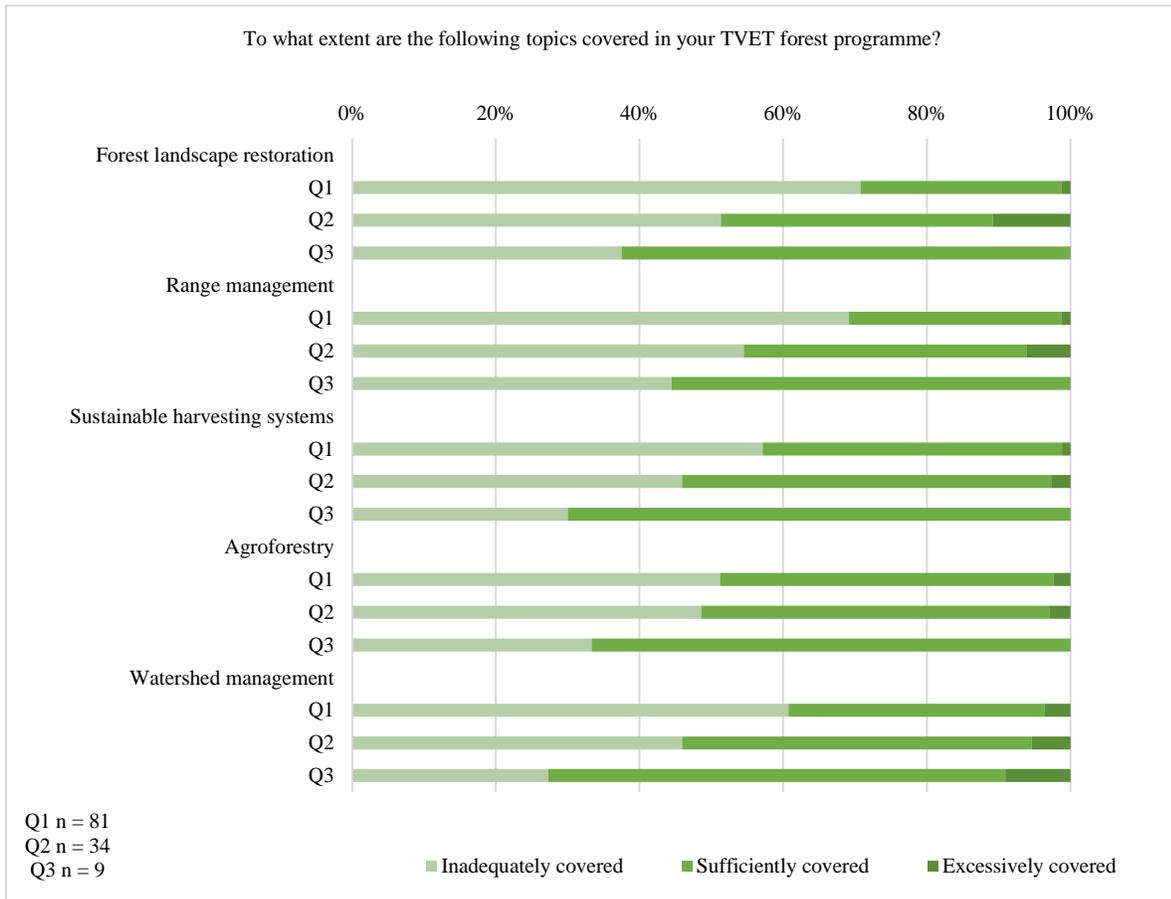


Figure A29.3. Coverage of forest-related topics in TVET forest programme (forest/tree planning and management)

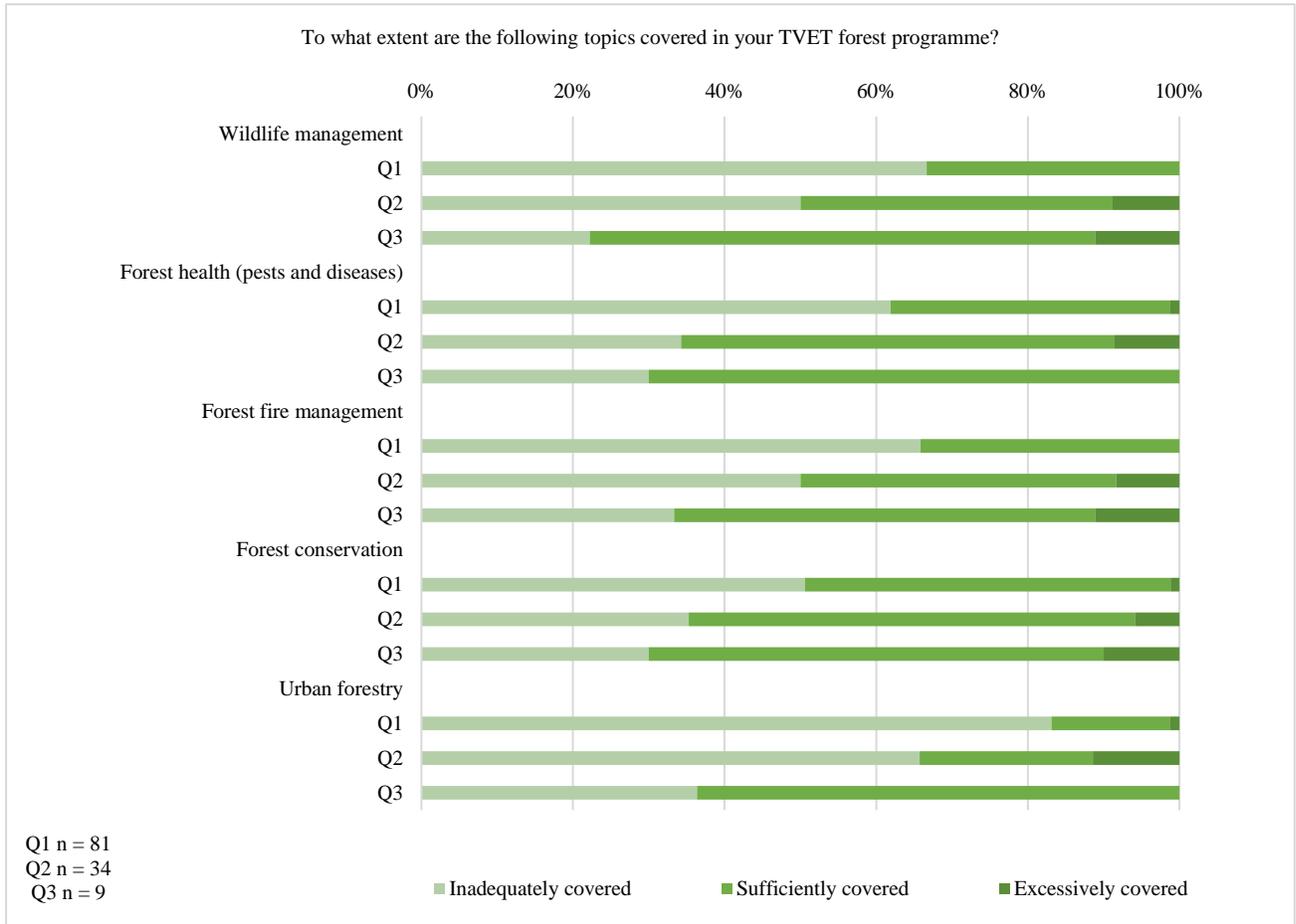


Figure A30.1. Coverage of forest-related topics in TVET forest programme (forest services and socio-cultural issues)

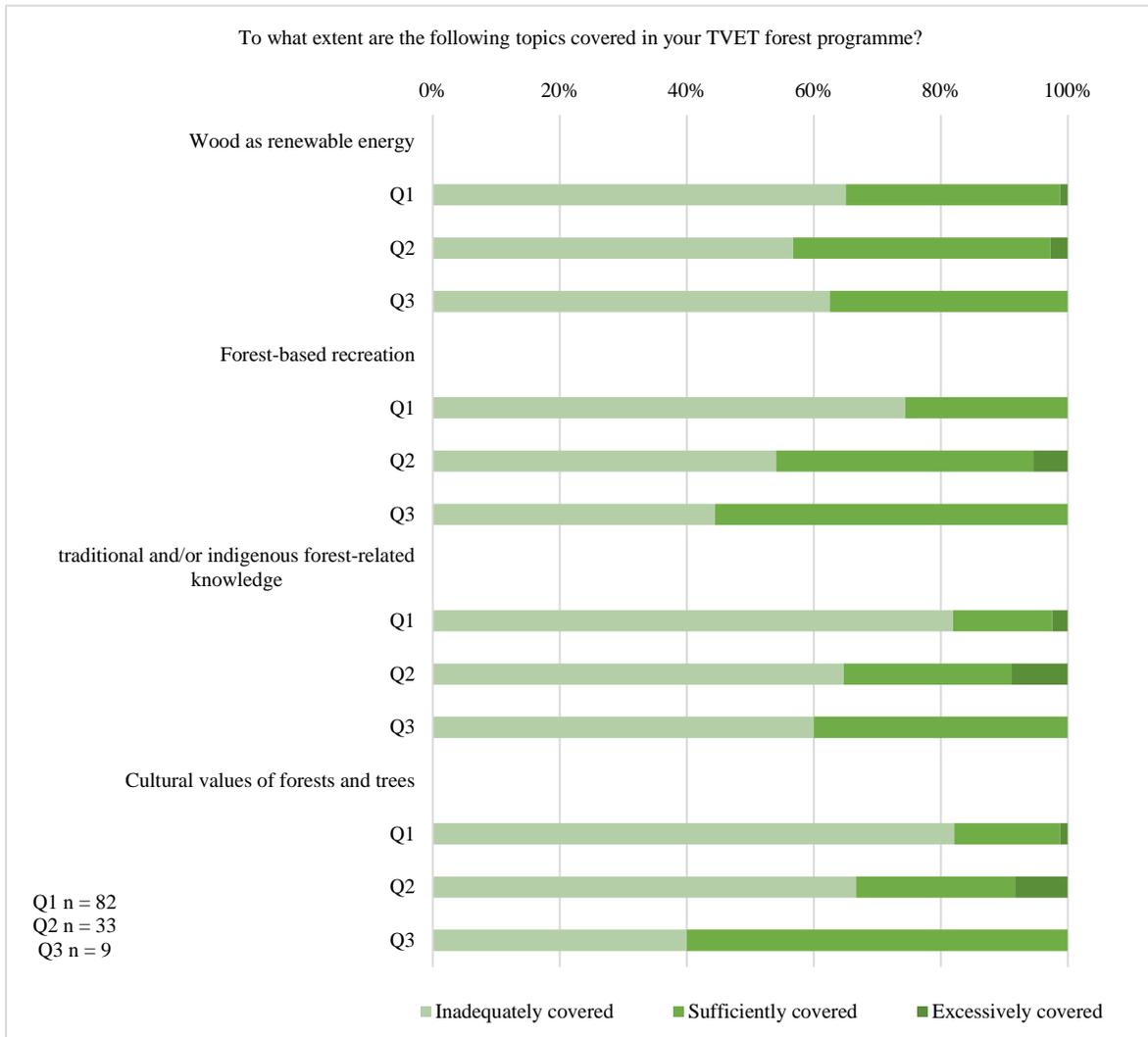


Figure A30.2. Coverage of forest-related topics in TVET forest programme (forest services and socio-cultural issues)

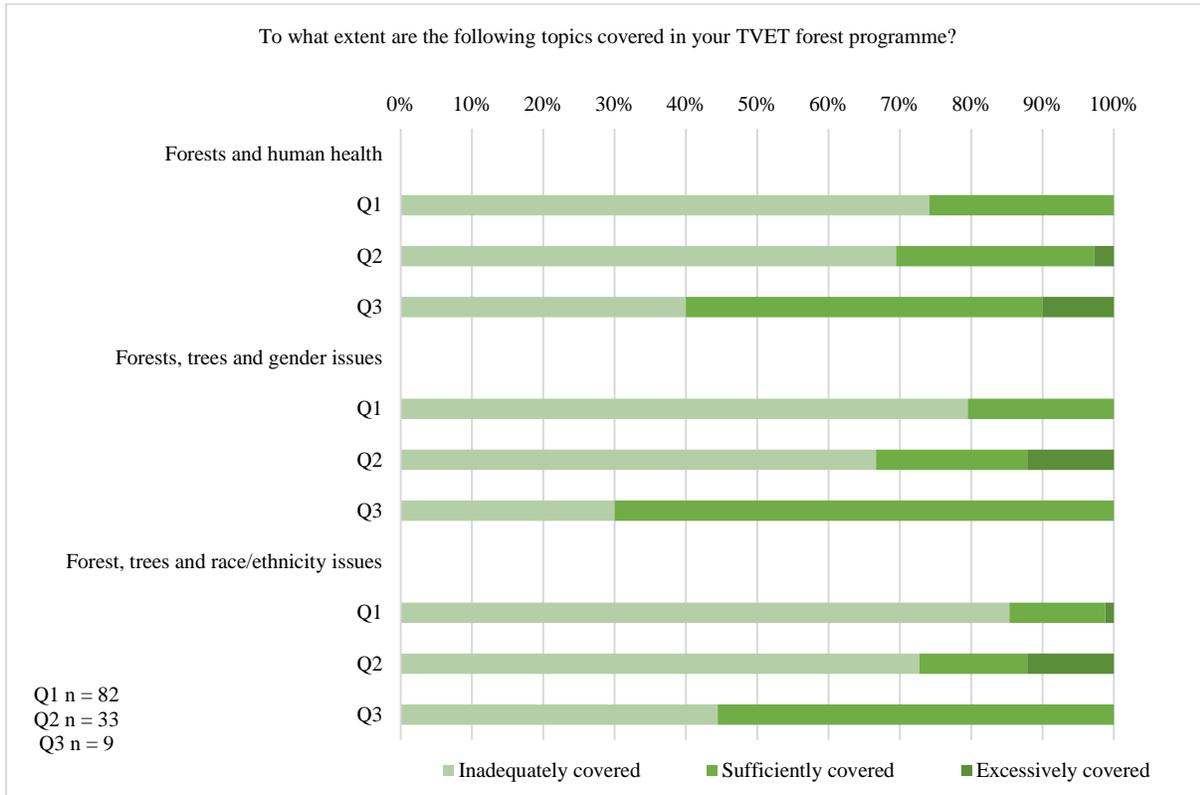


Figure A31. Coverage of forest-related topics in TVET forest programme (forest enterprise)

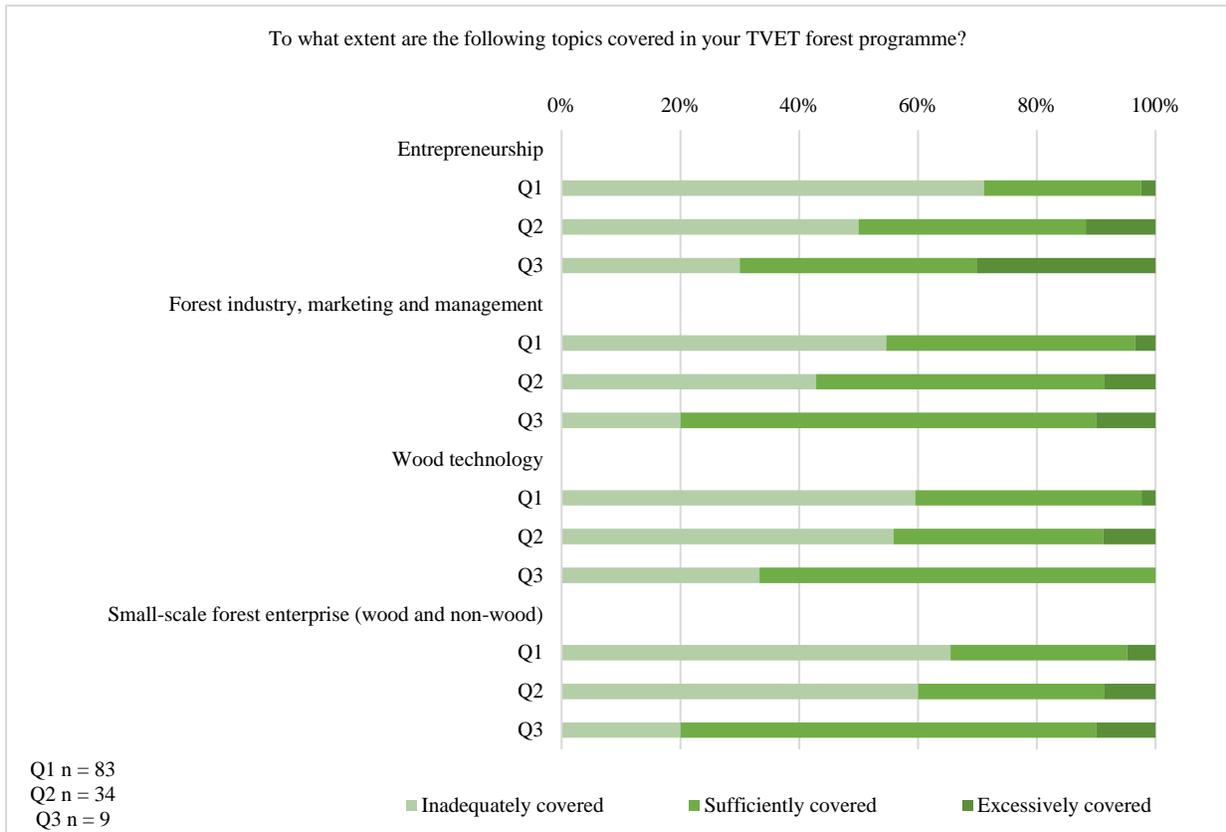


Figure A32. Coverage of forest-related topics in TVET forest programme (forest policy and economics)

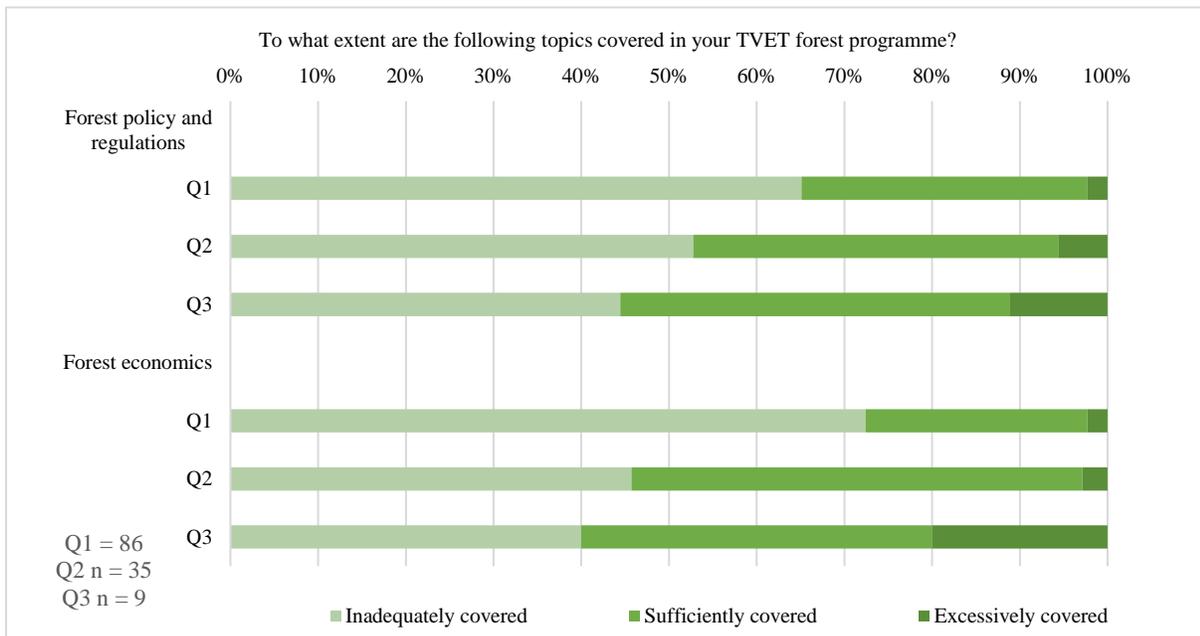


Figure A33.1. Coverage of forest-related topics in TVET forest programme

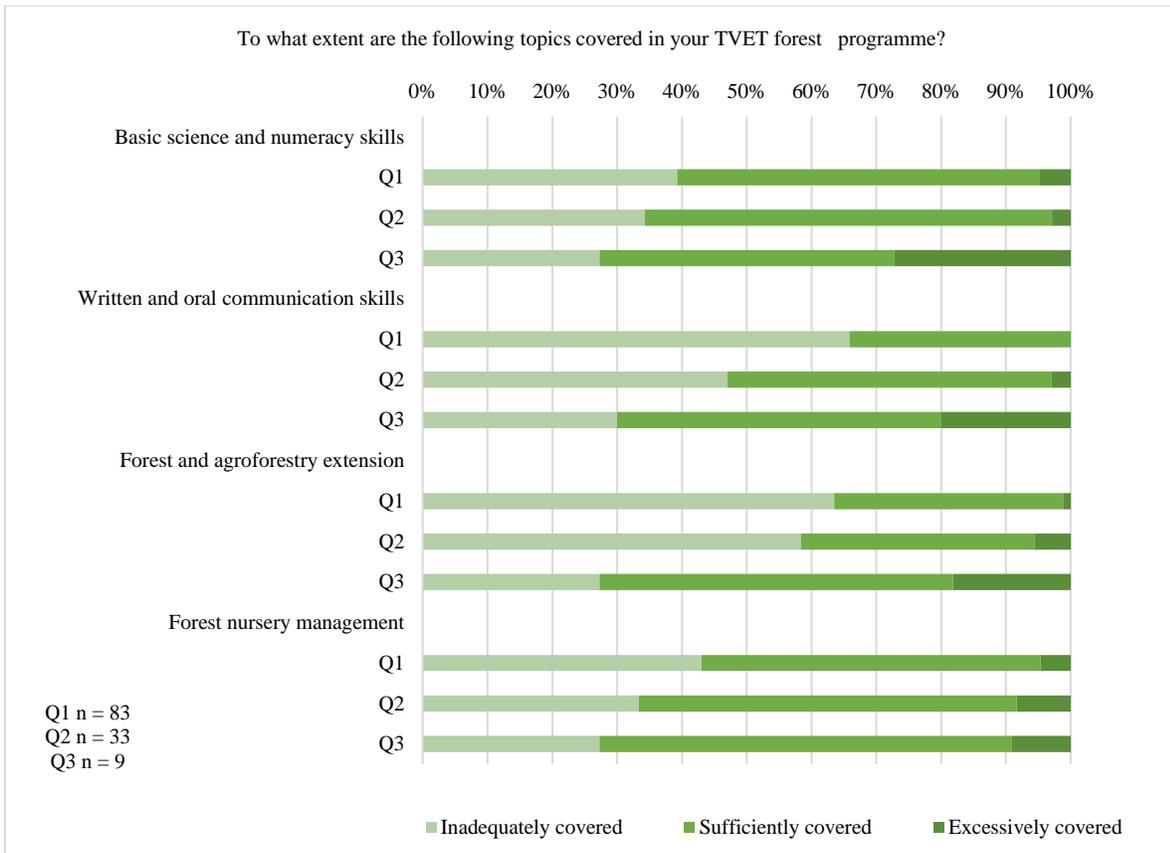


Figure A33.2. Coverage of forest-related topics in TVET forest programme

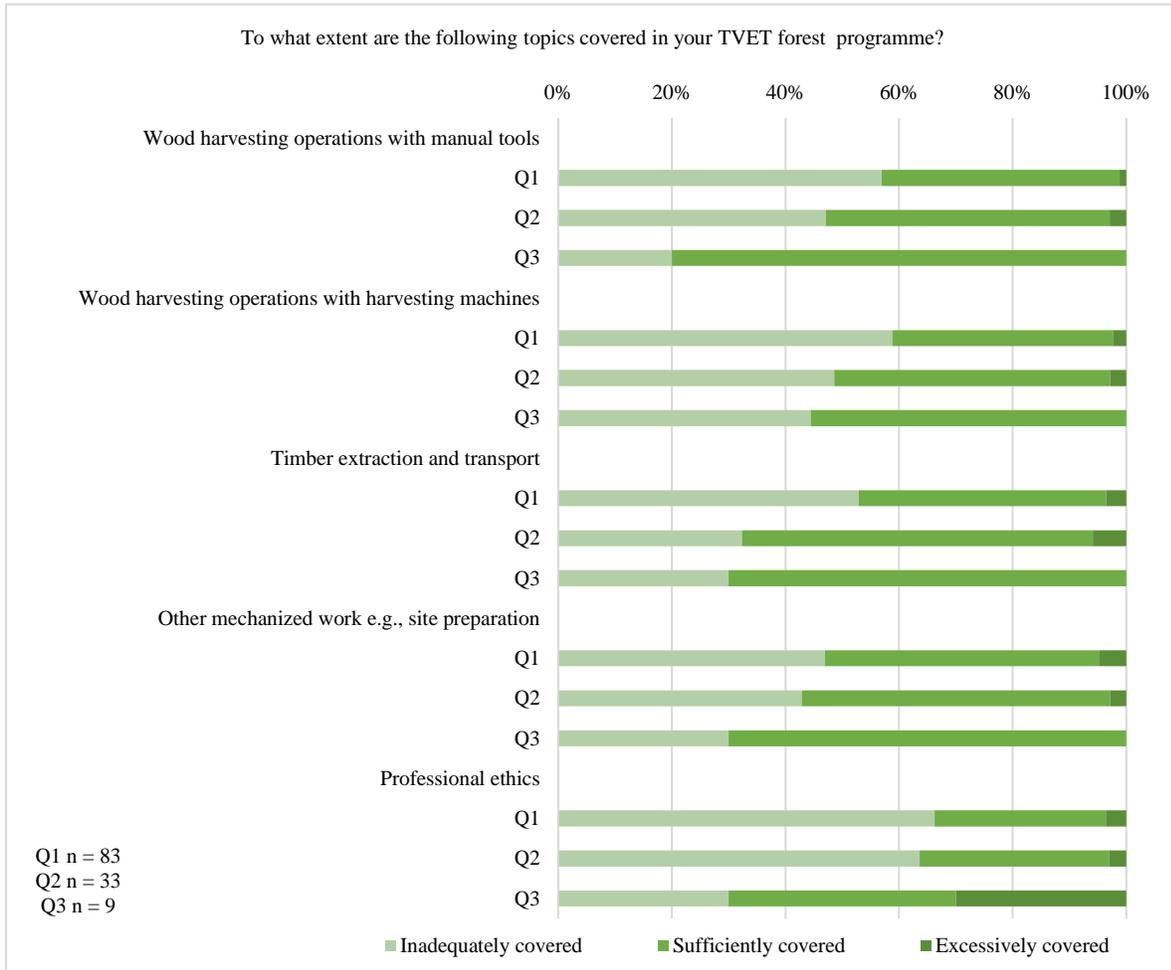


Figure A34. Workforce preparation within TVET forest programmes

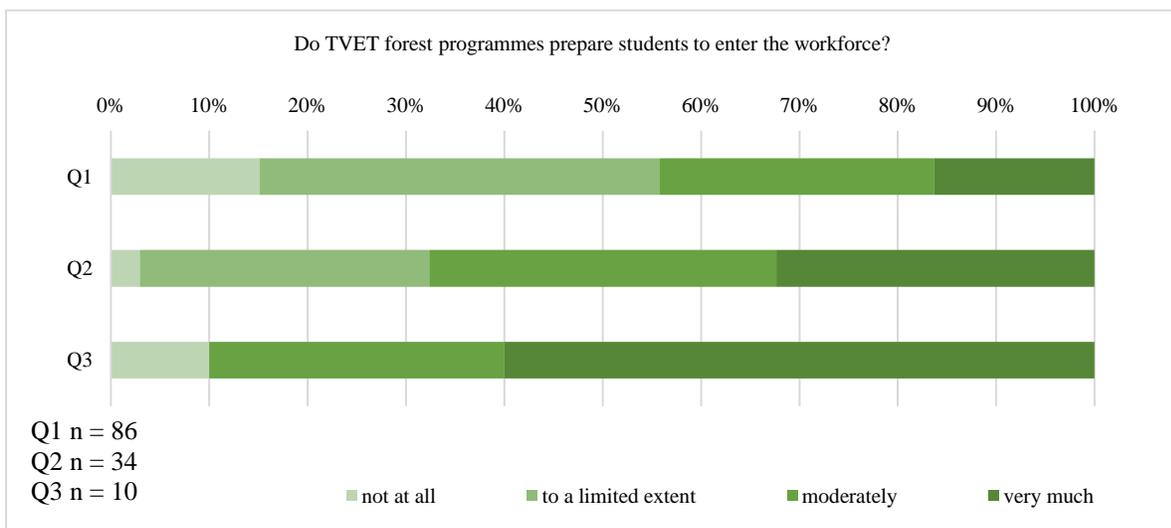


Figure A35. Influence of gender and ethnicity in the forest labor market for graduates of TVET programmes

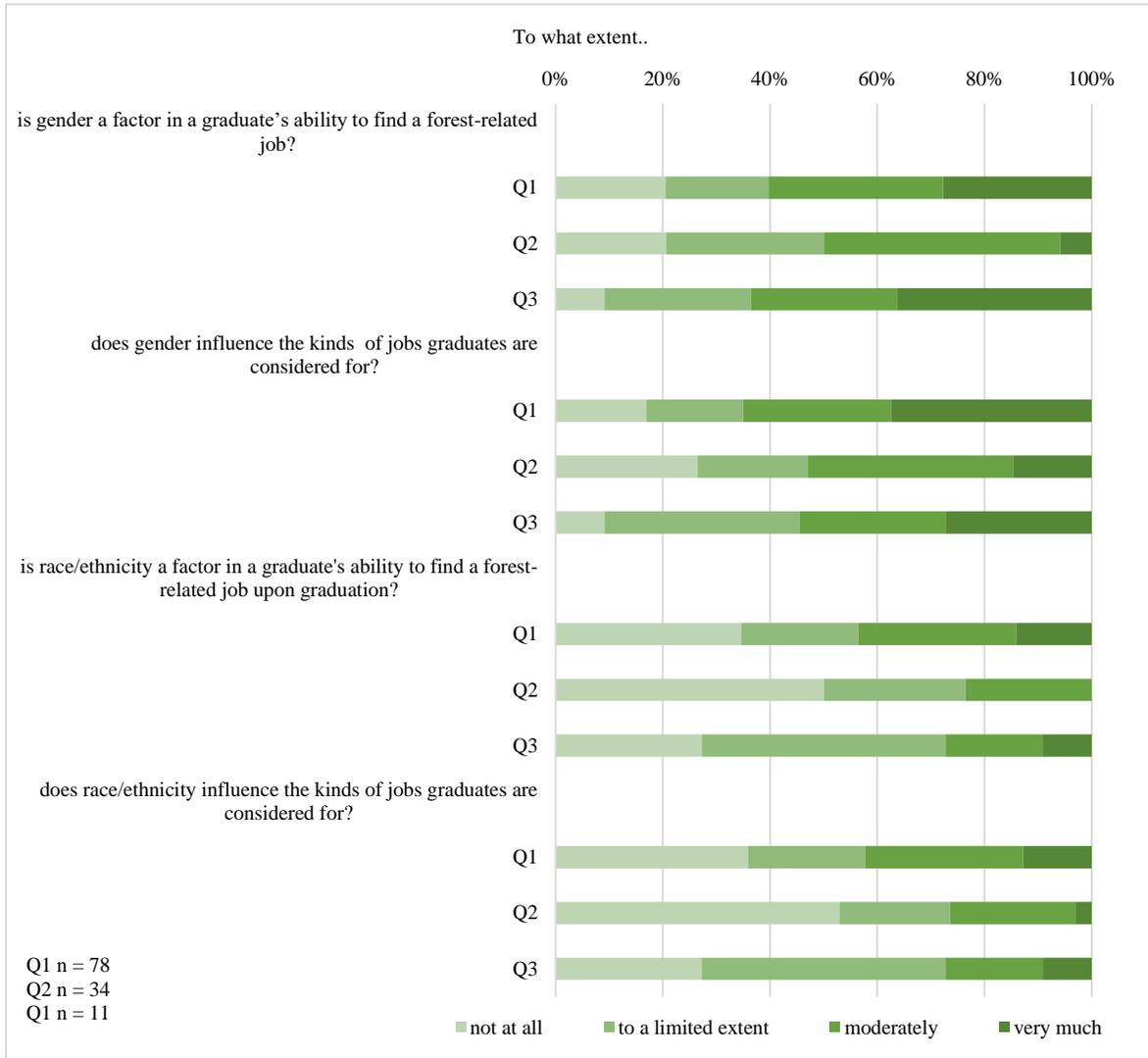
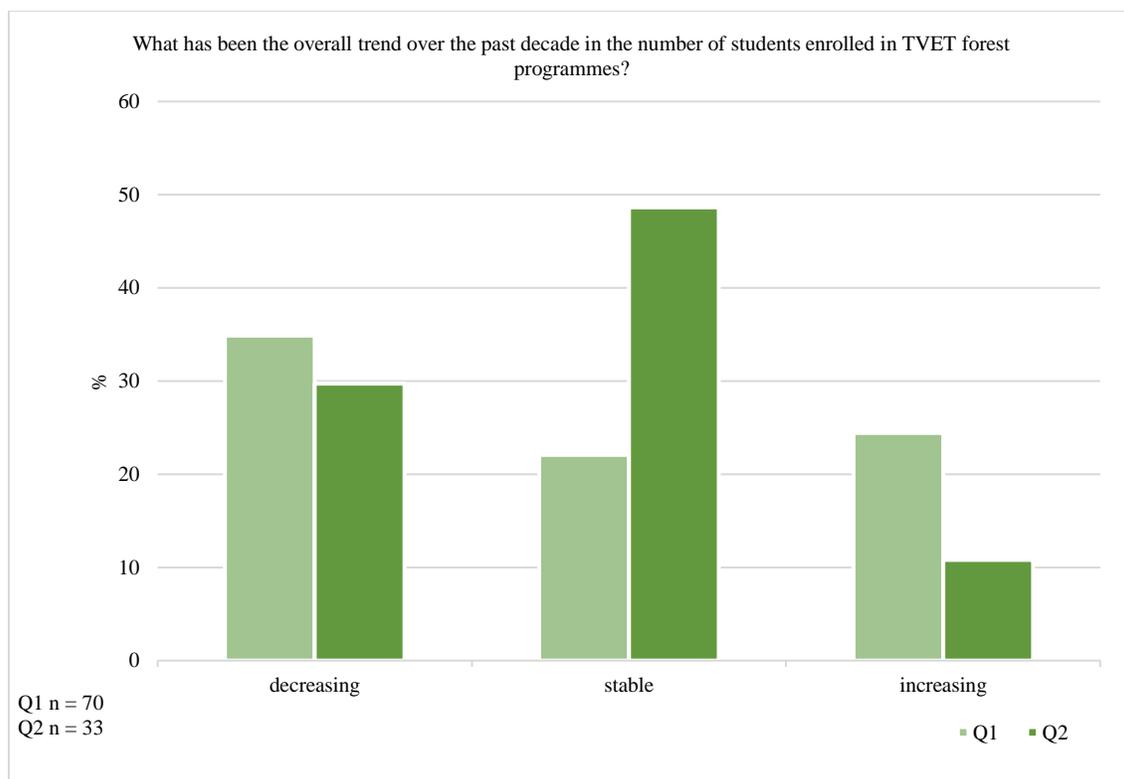


Figure A36. Overall trend in student enrollment in TVET forest programmes over the past decade (2010-2020)



# APPENDIX III – University and College level education; Bachelors, Masters & Doctoral degree level

## Bachelor’s degree programme level

Figure A37. Availability of resources in forest degree programme (Bachelors)

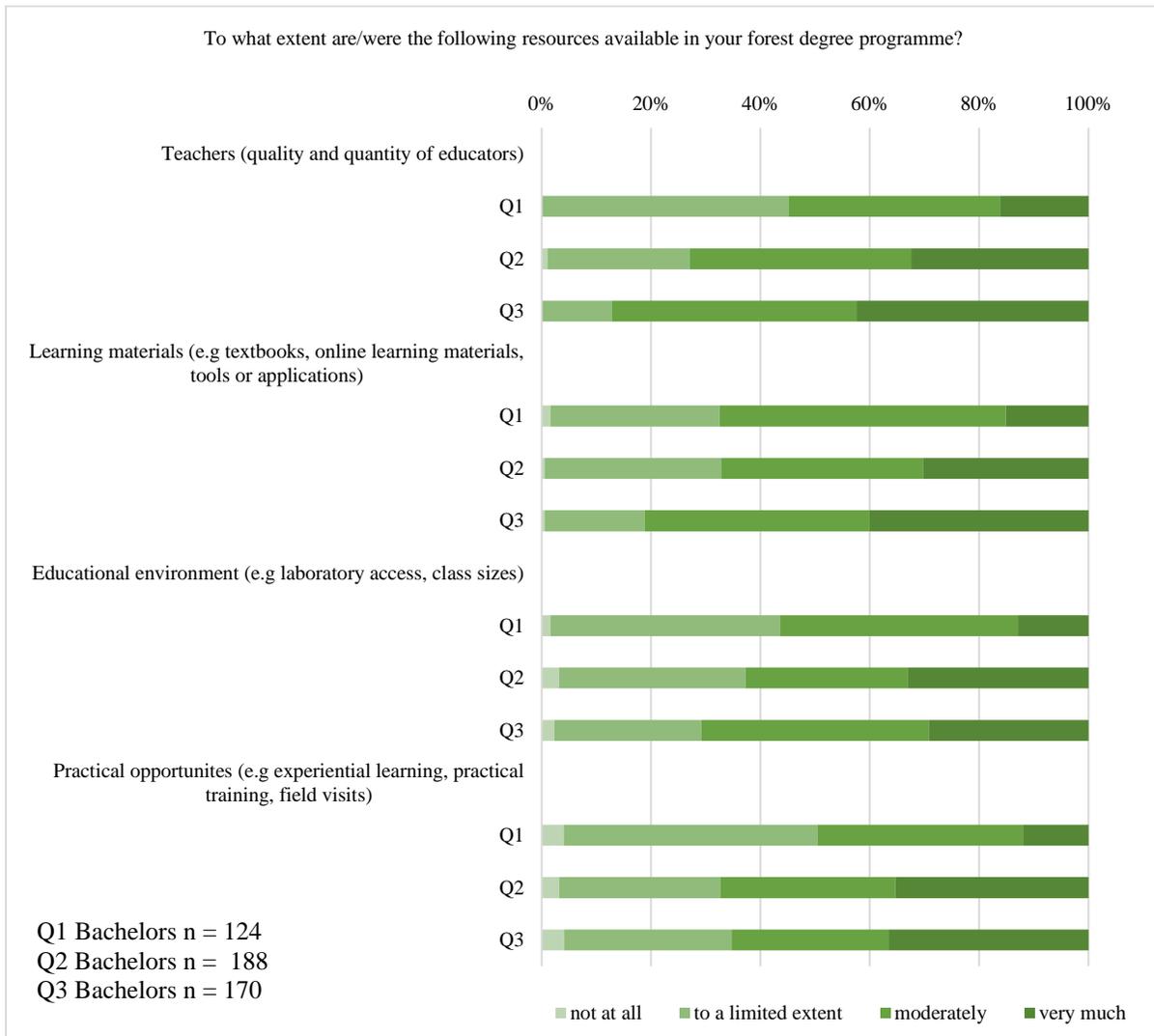


Figure A40. 1 Policies or strategies leading to improved forest-related education at university and college level

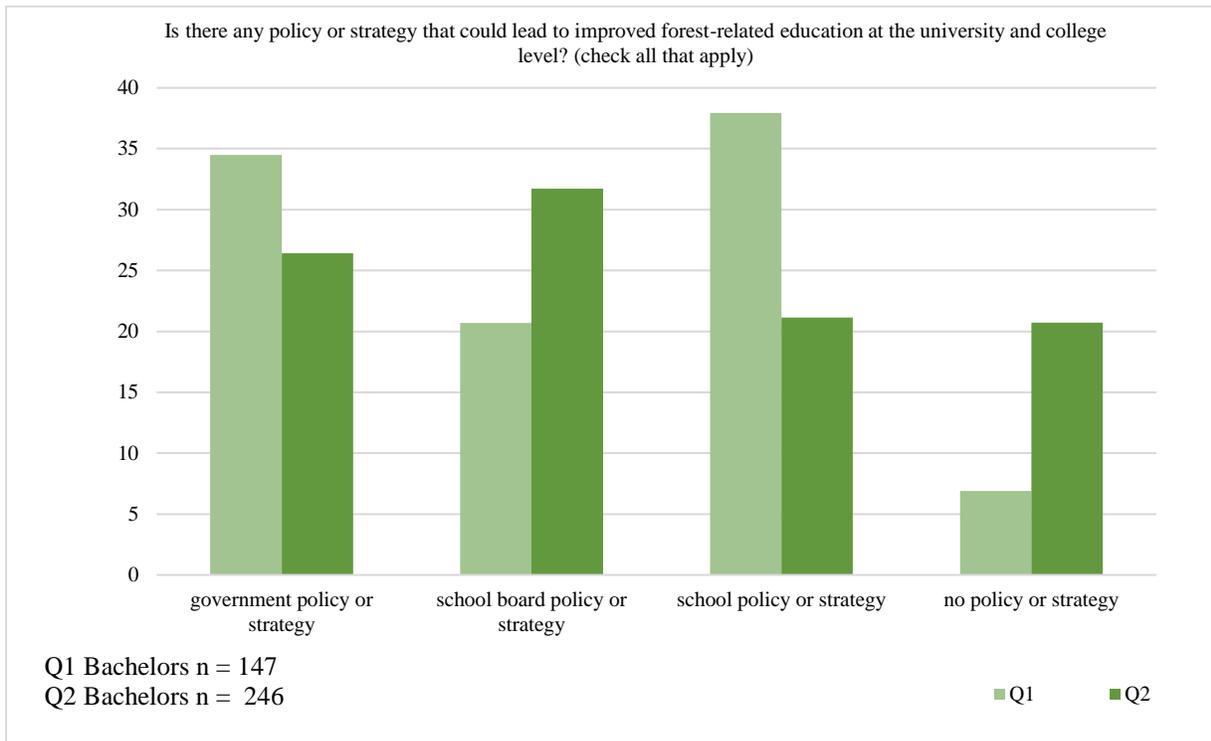


Figure A41. Student engagement in forest-related out-of-school activities

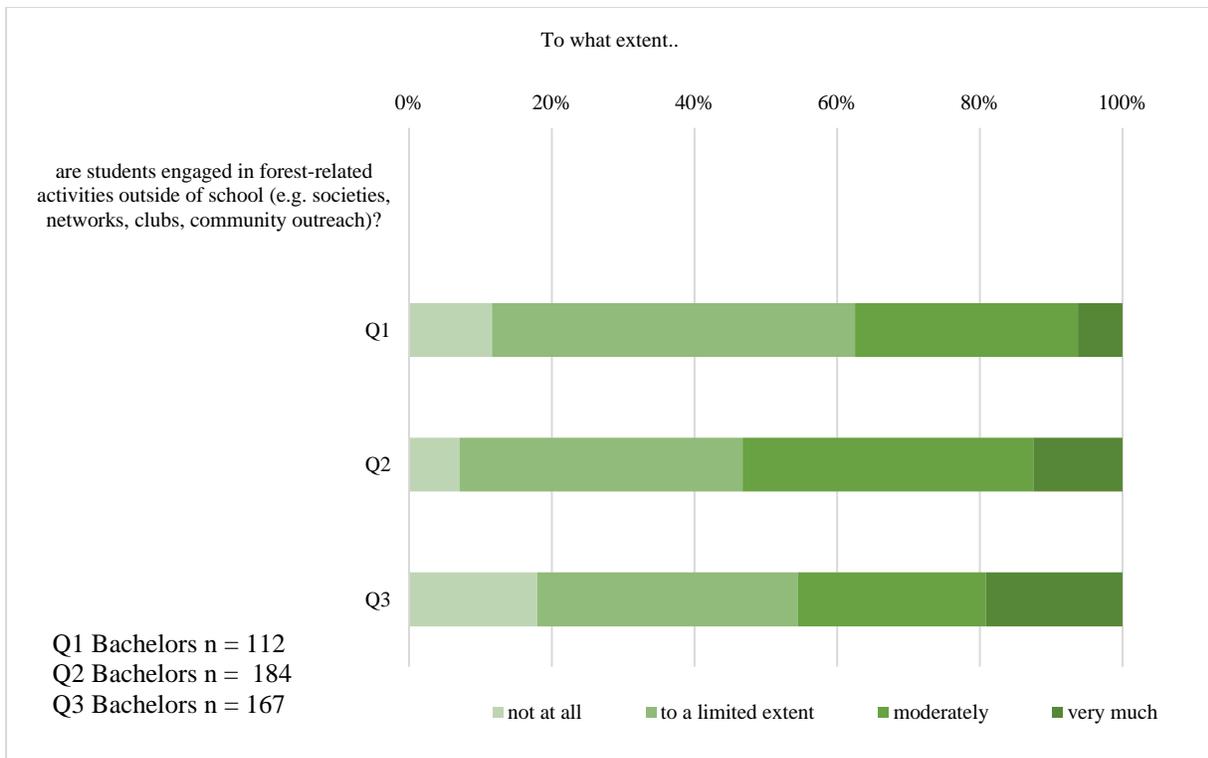


Figure A44. Use of digital learning tools at University level (Bachelors)

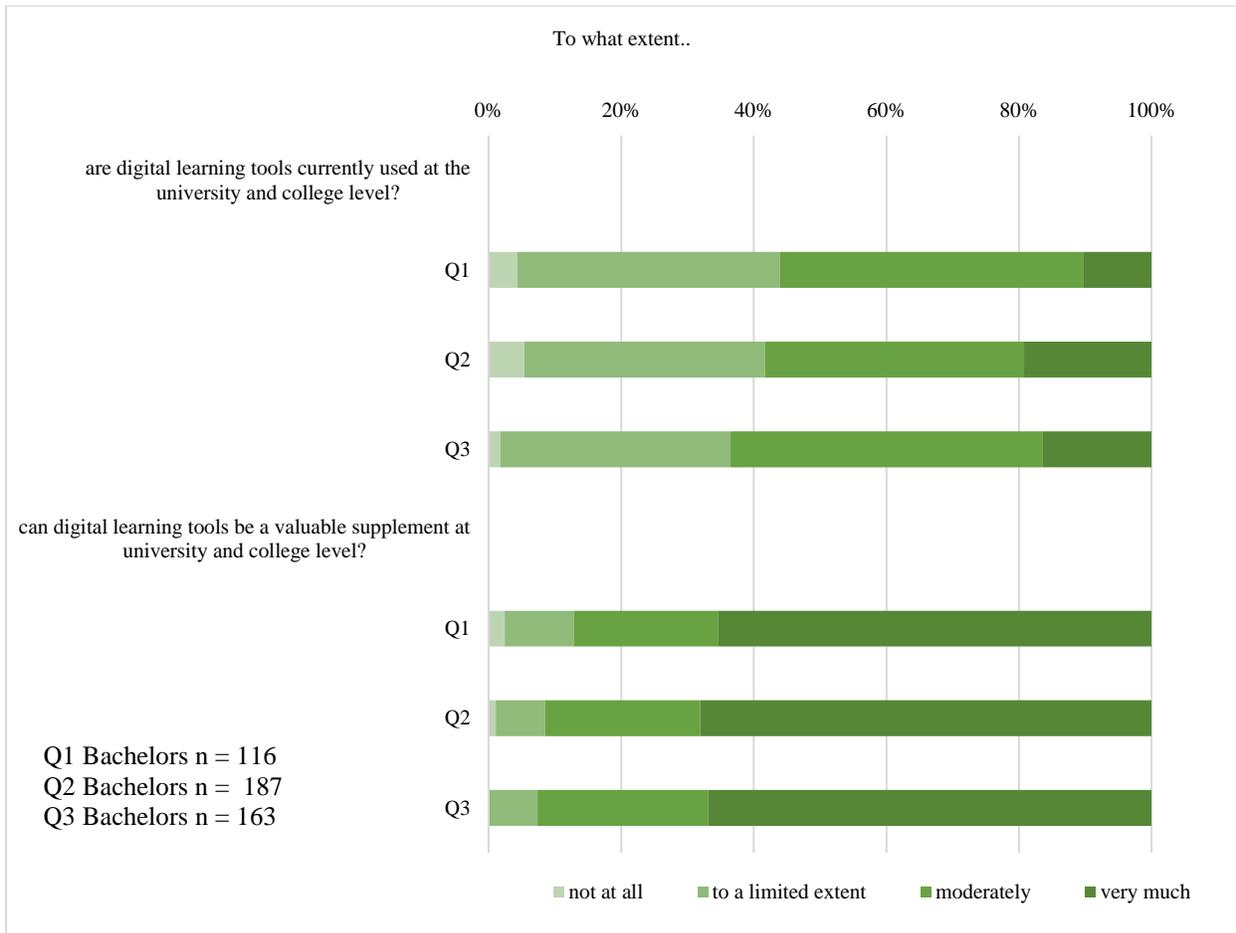


Figure A47. Use of digital learning tools in degree programme (Bachelors)

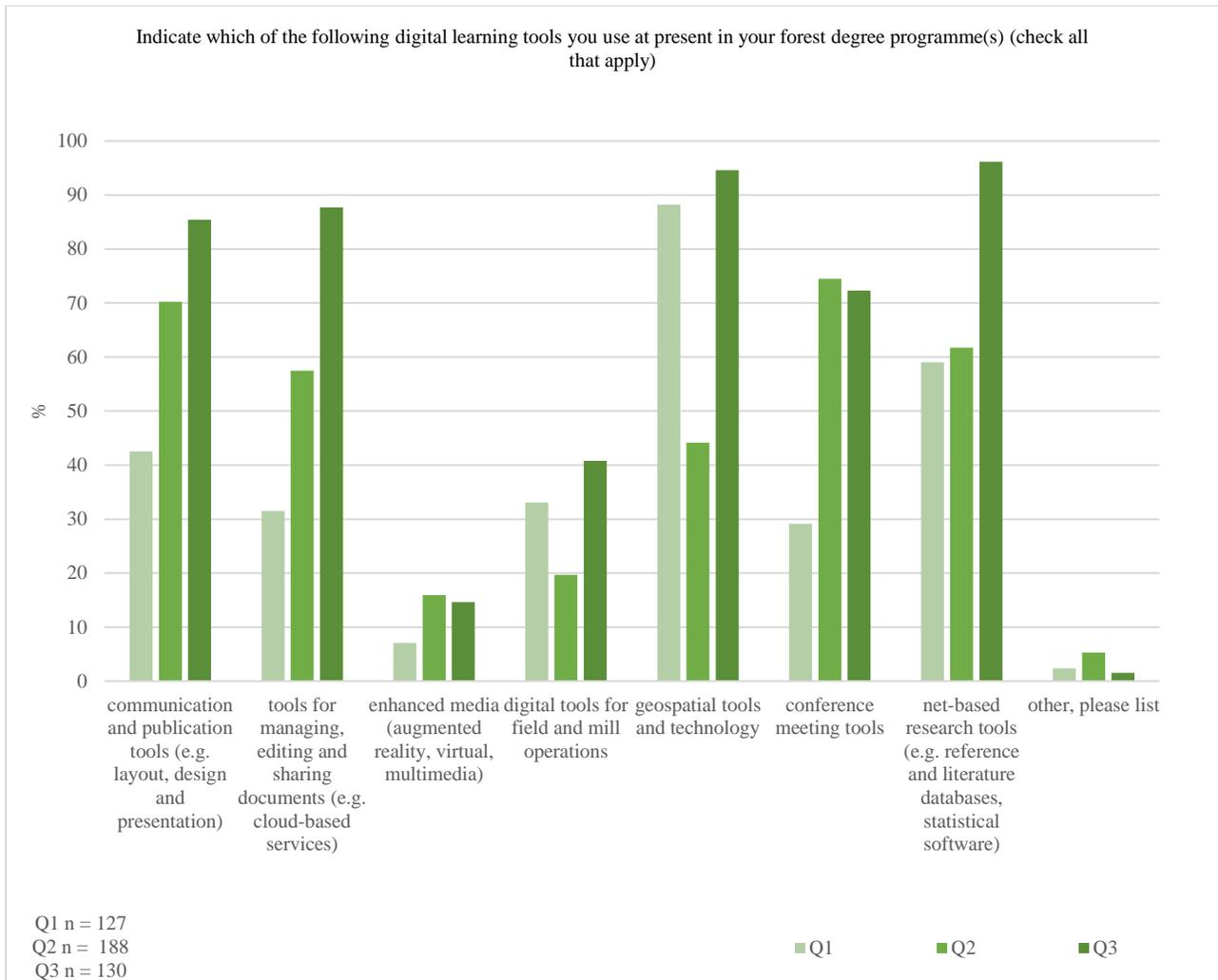


Figure A50. Desired digital learning tools for use in degree programme (Bachelors)

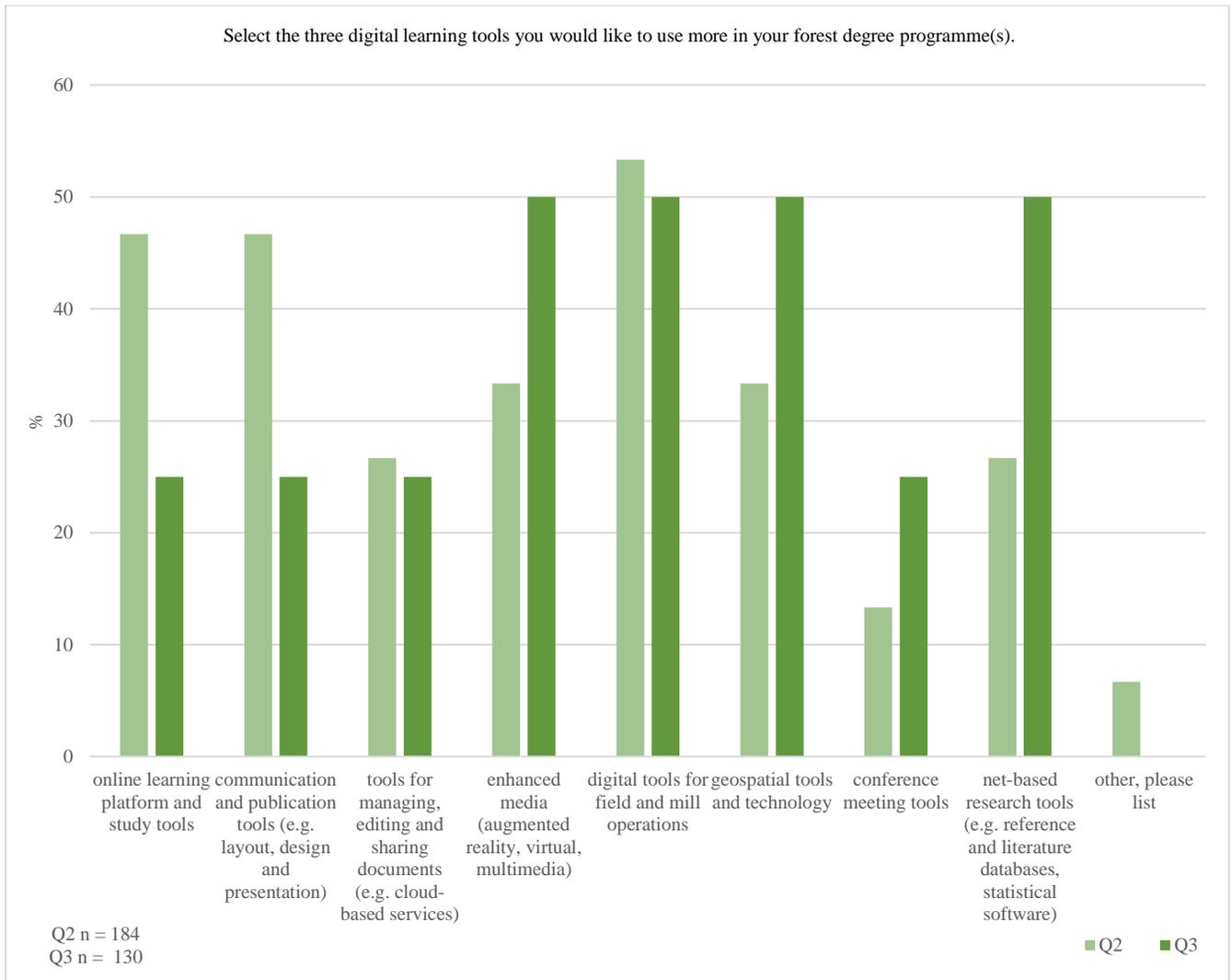


Figure A52. Familiarity with digital learning environments

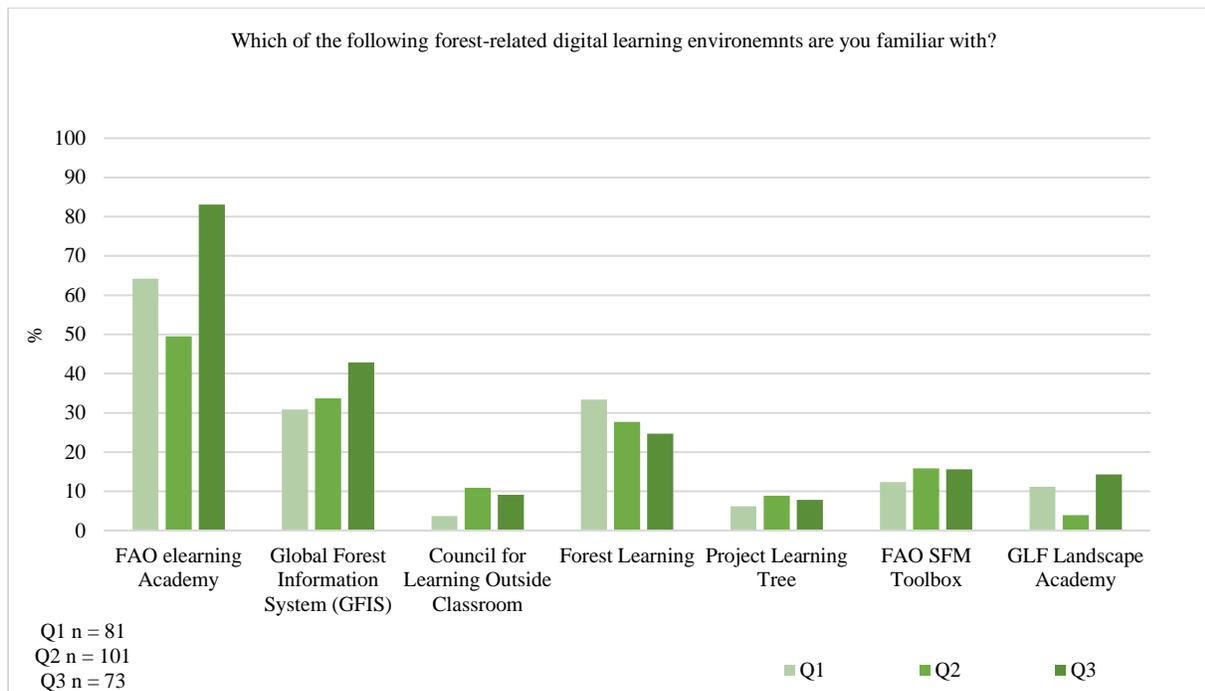


Figure A55. Coverage of forest-related topics in degree programme (Bachelors)

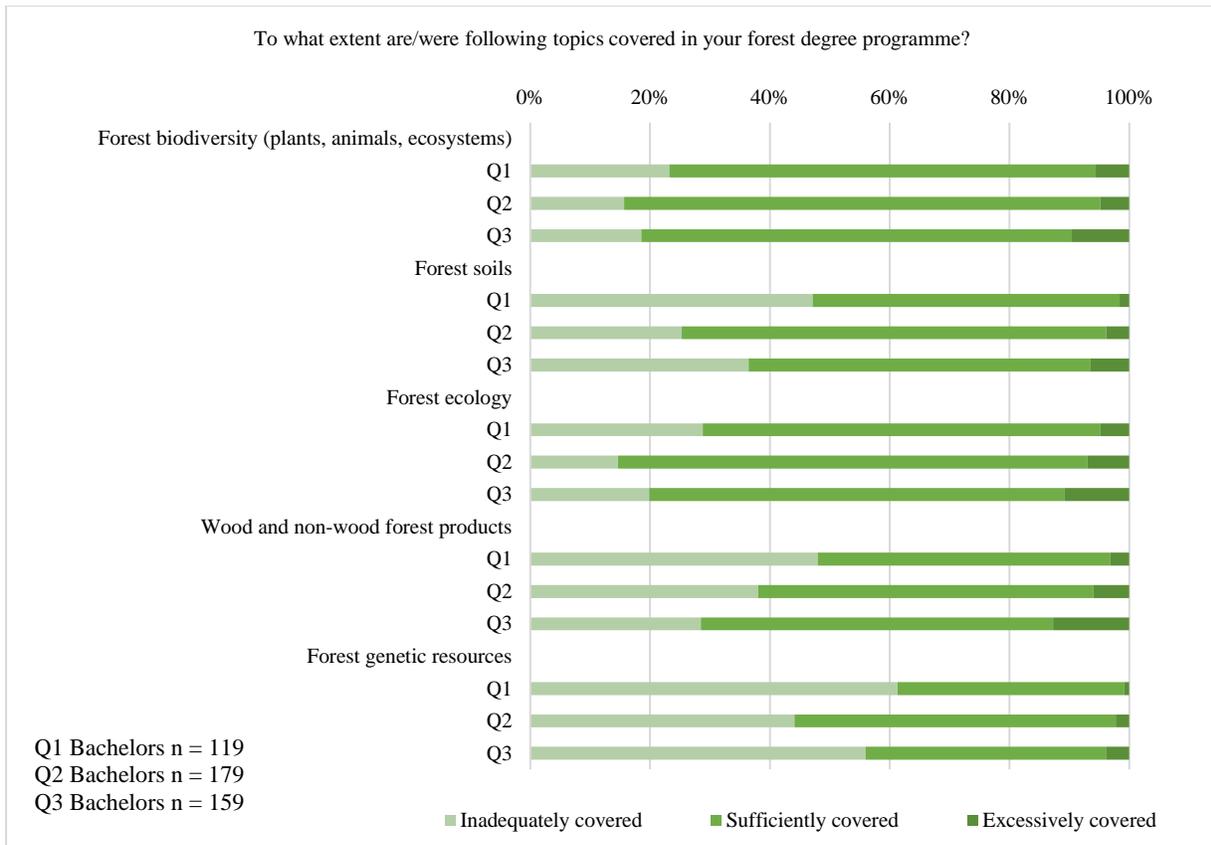


Figure A58. Coverage of forest-related topics in degree programme (Bachelors)

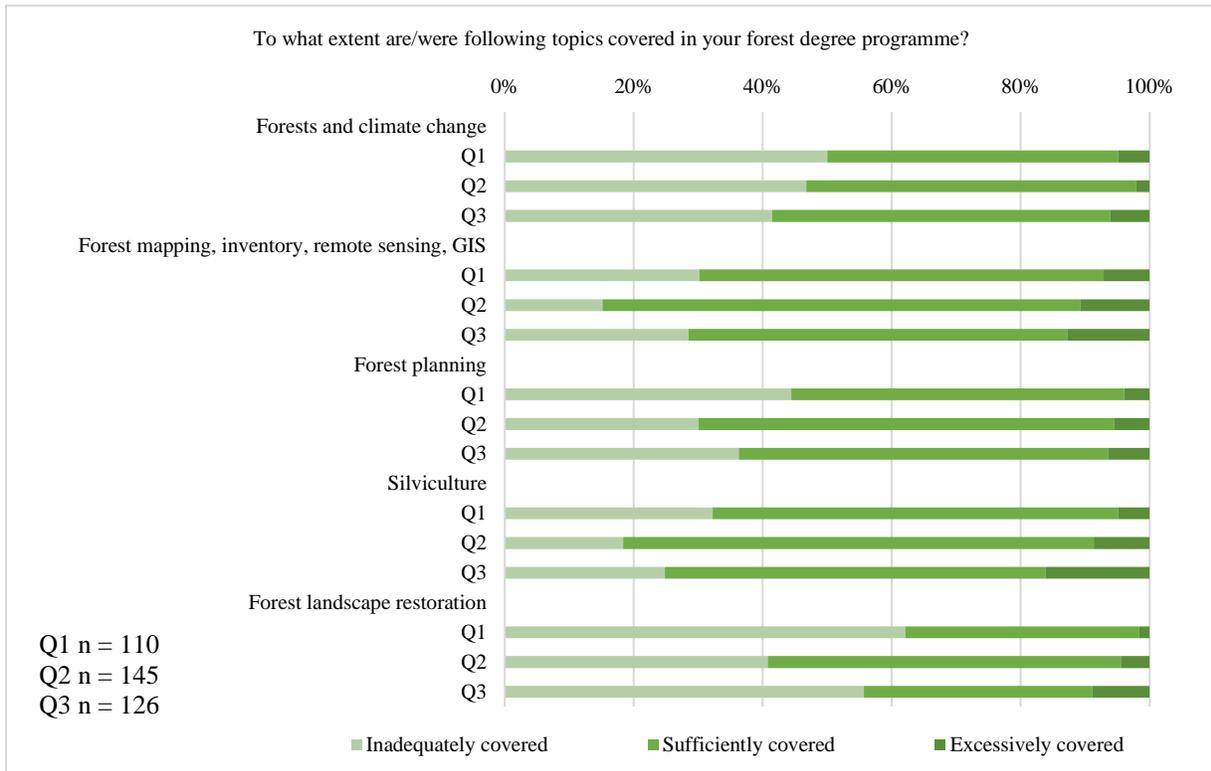


Figure A61. Coverage of forest-related topics in degree programme (Bachelors)

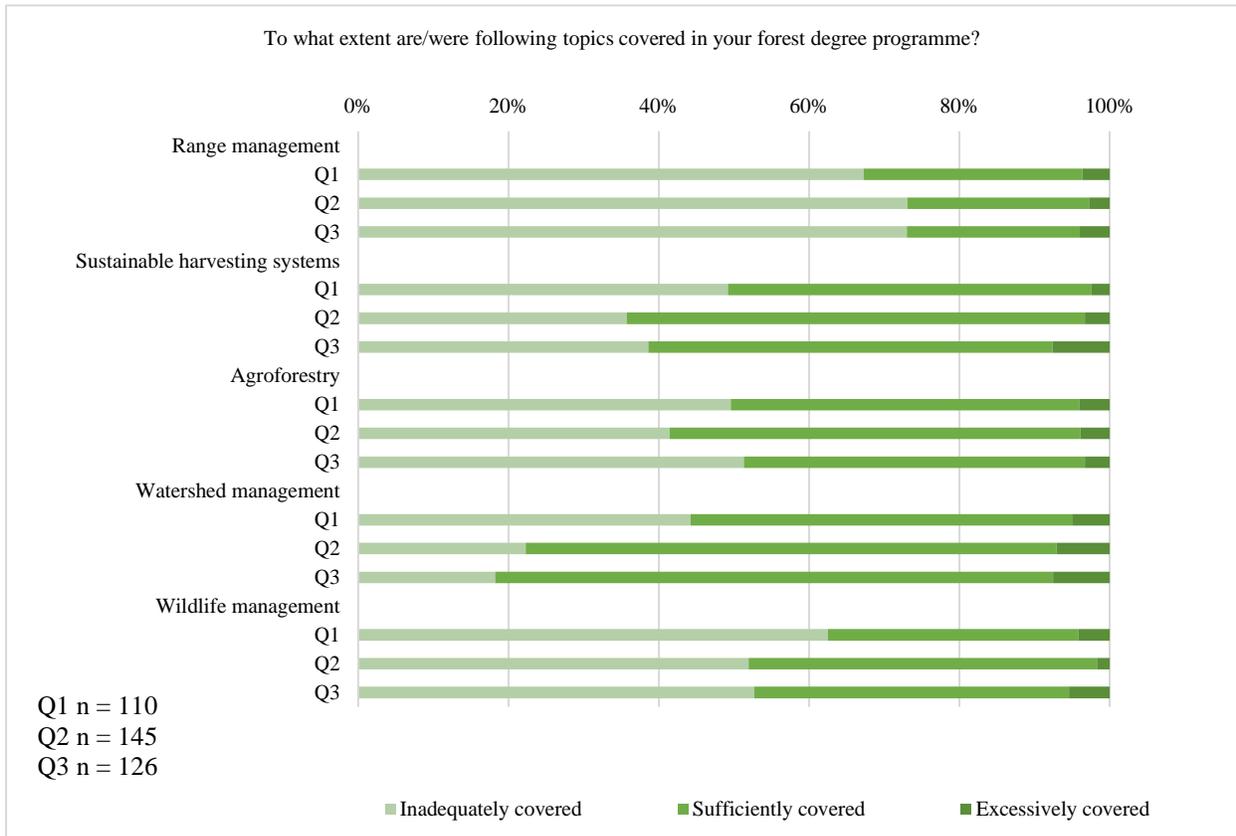


Figure A63. Coverage of forest-related topics in degree programme (Bachelors)

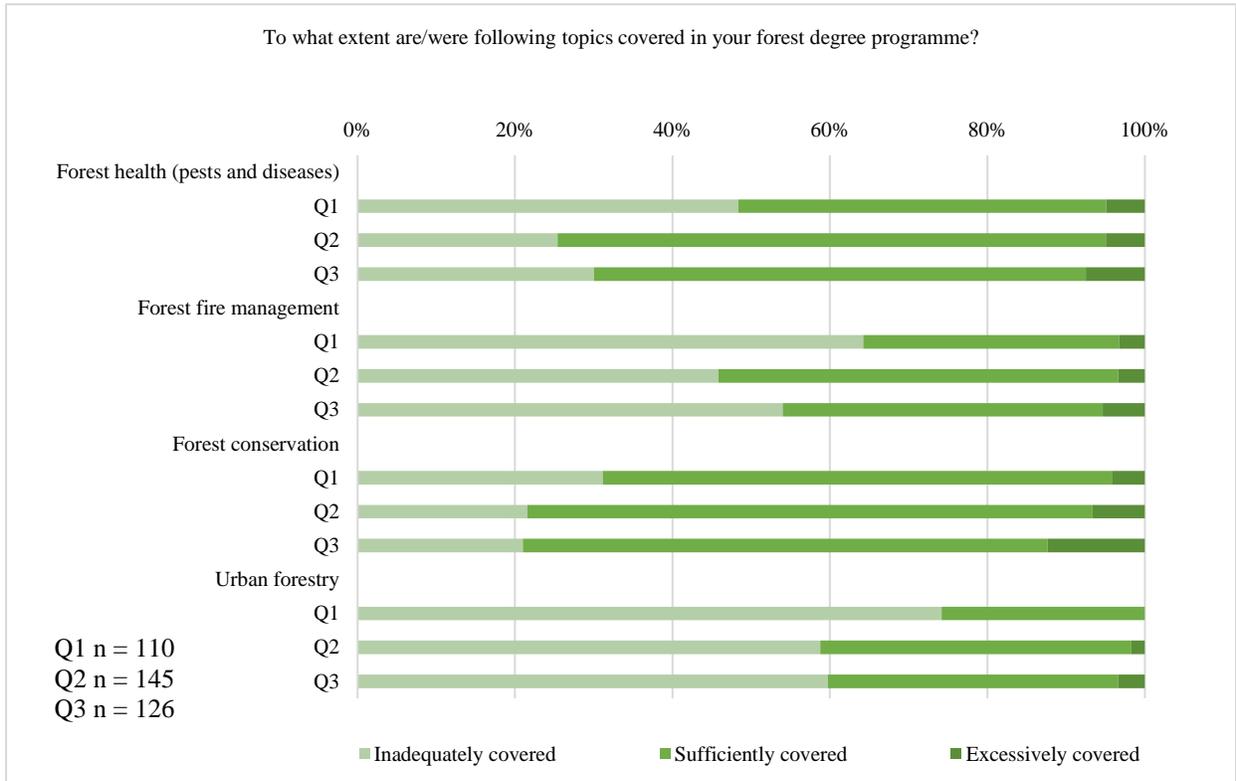


Figure A65. Coverage of forest-related topics in degree programme (Bachelors)

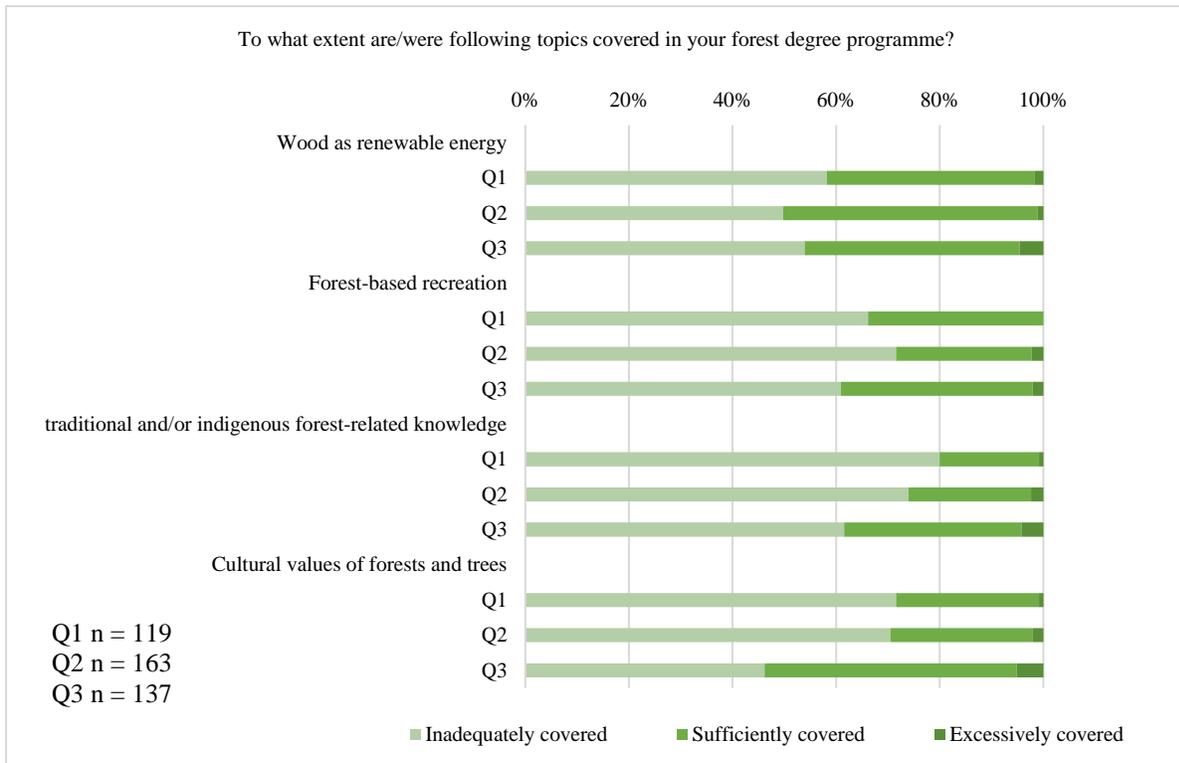


Figure A68. Coverage of forest-related topics in degree programme (Bachelors)

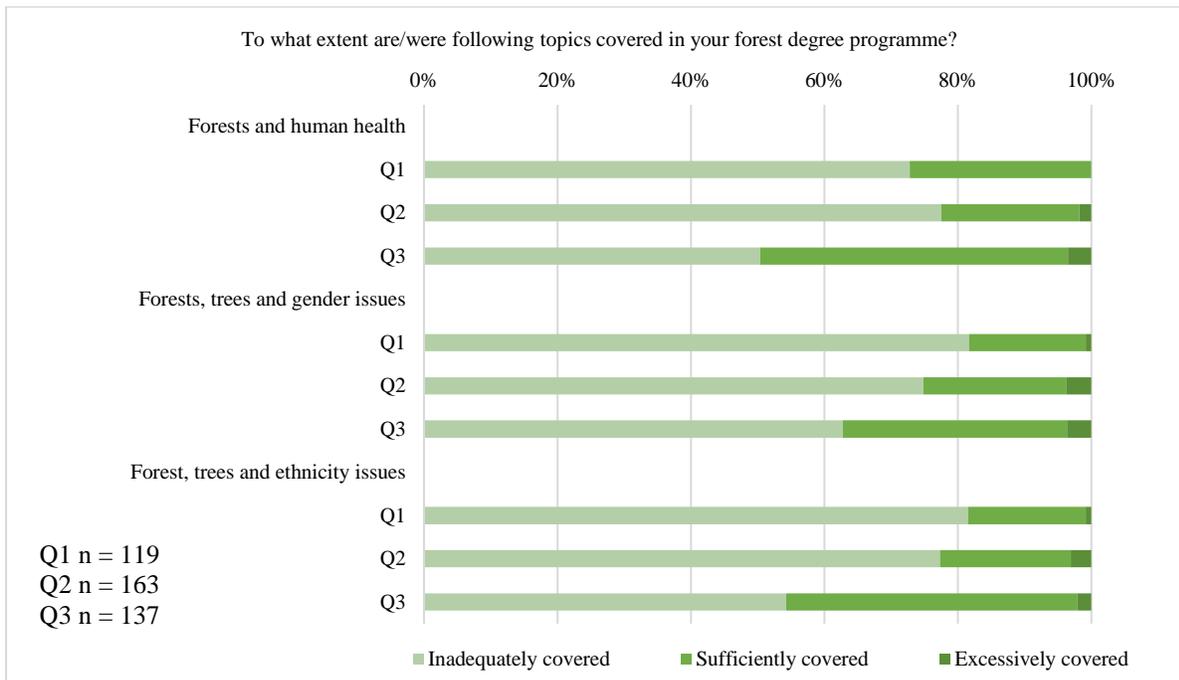


Figure A70. Coverage of forest-related topics in degree programme (Bachelors)

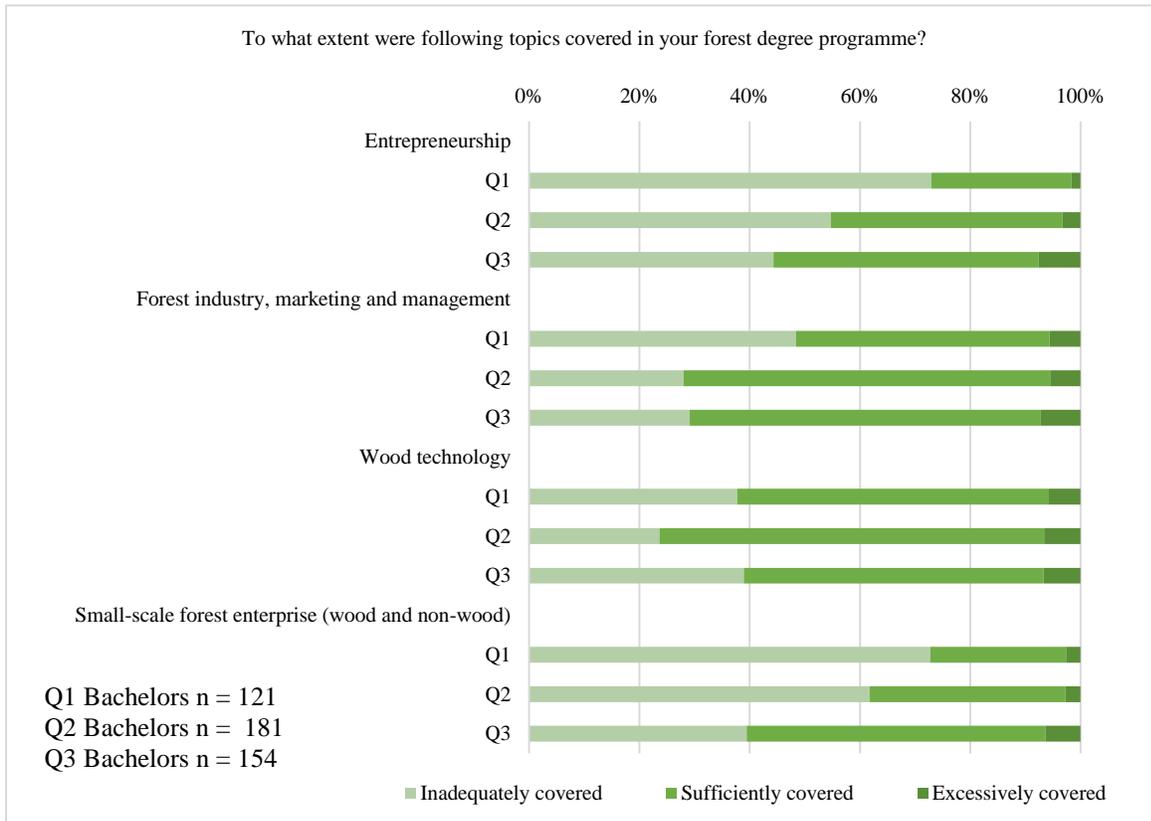


Figure A73. Coverage of forest-related topics in degree programme (Forest policy and legislation) (Bachelors)

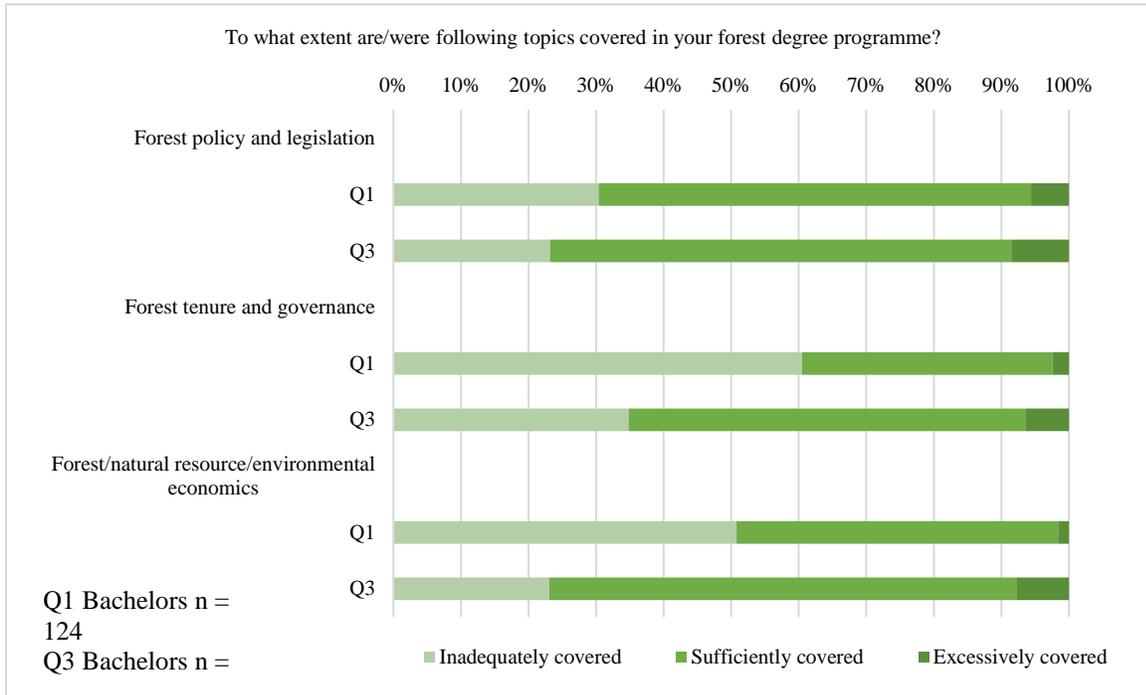


Figure A76. Availability of forest-related internships or part-time employment and effect on learning (Bachelors)

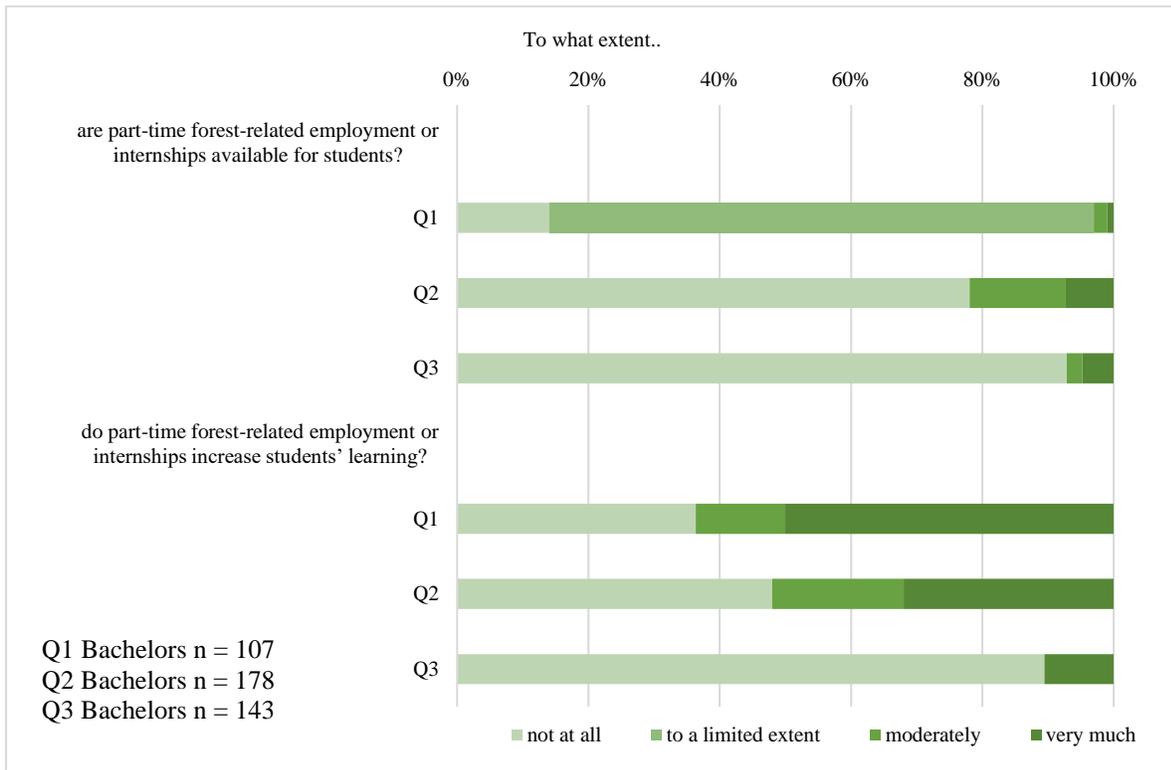


Figure A78. Workforce readiness within degree programme

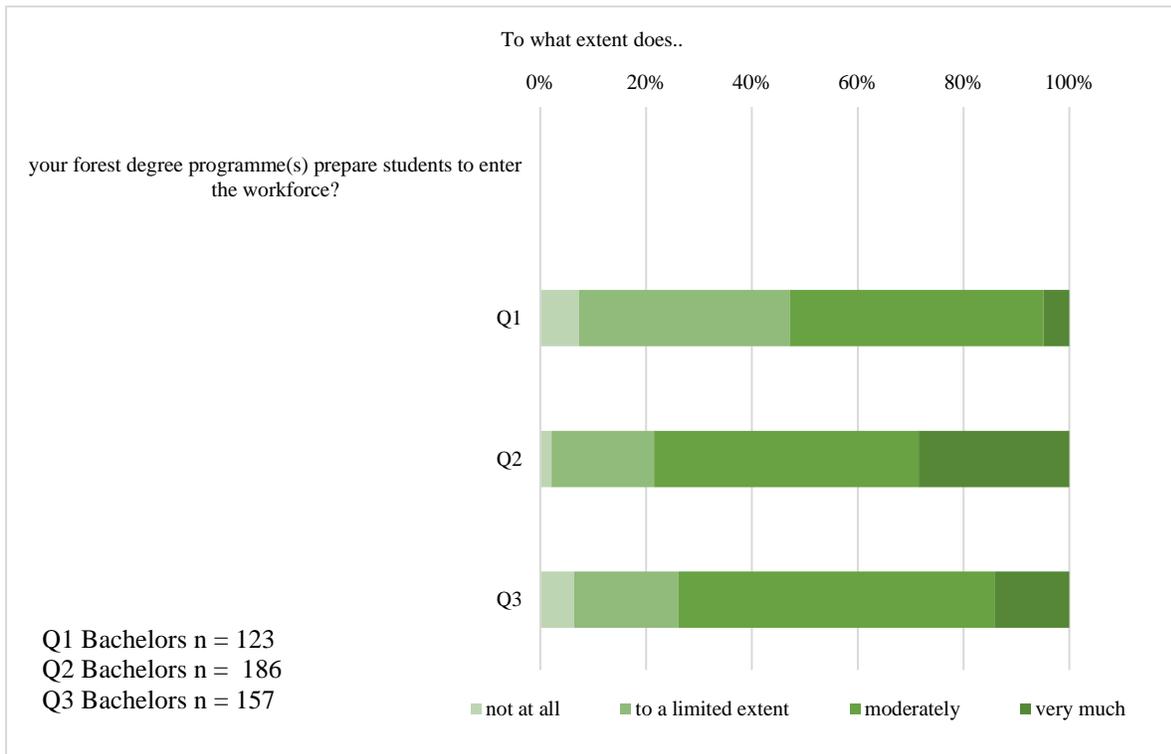


Figure A81. Gender as a factor and influence in forest-related employment

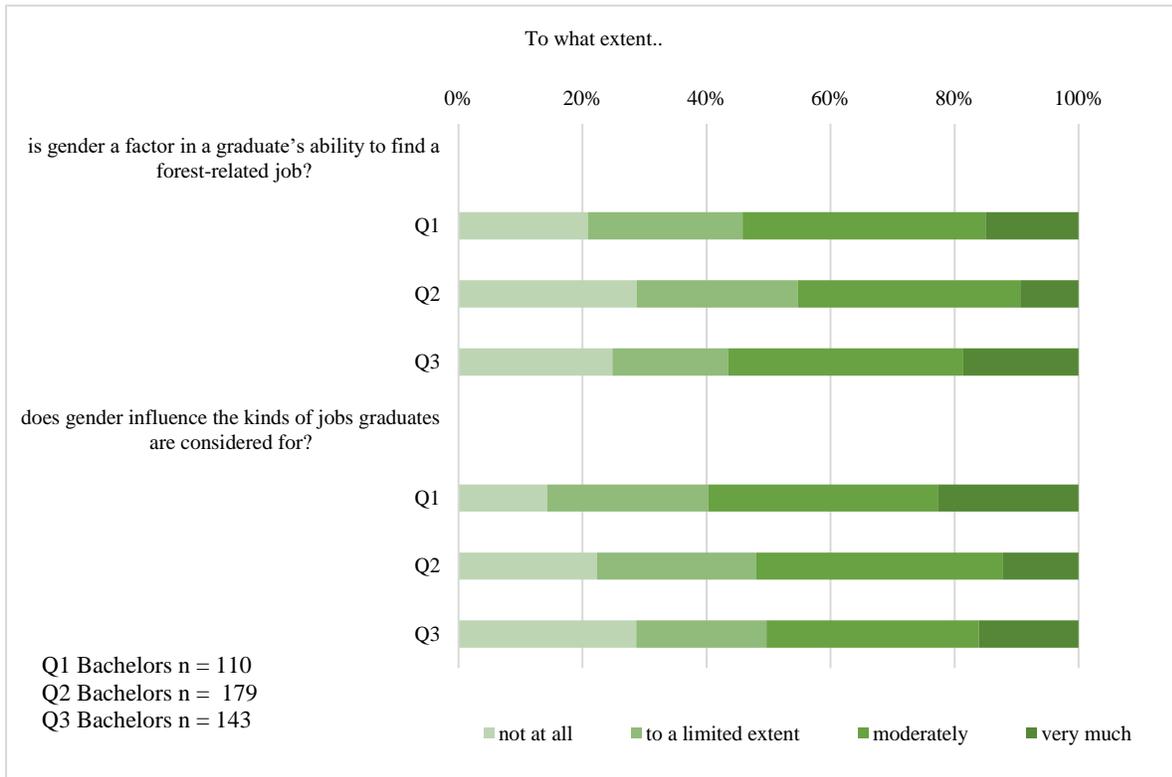


Figure A84. Race or ethnicity as a factor and influence in forest-related employment

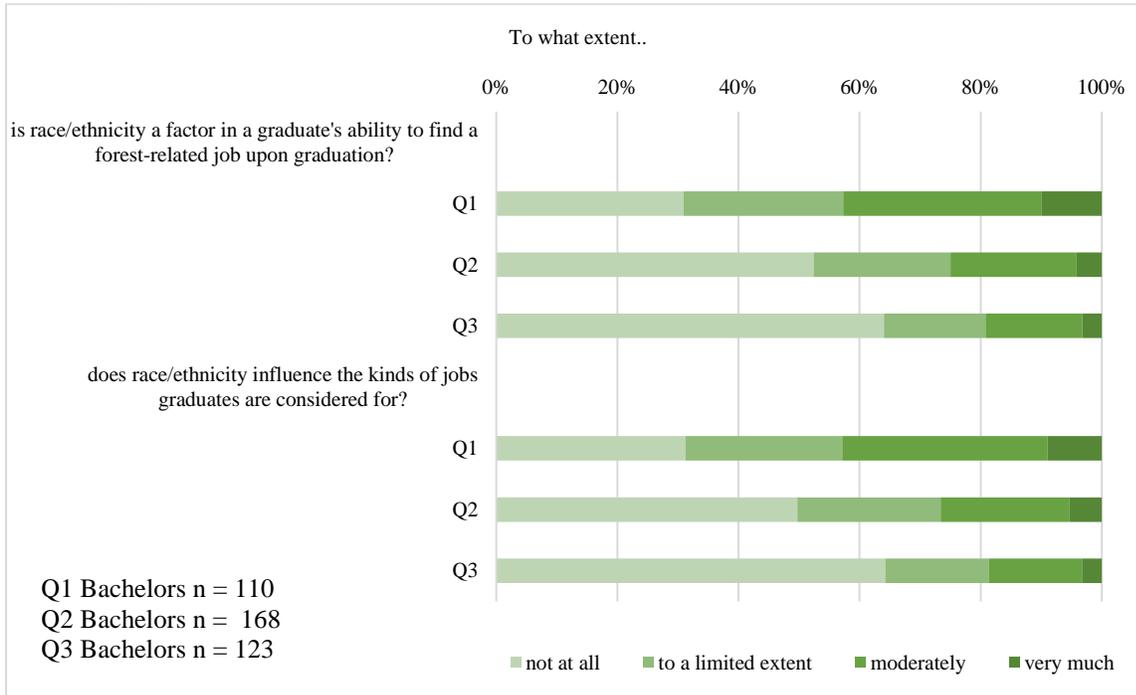


Figure A87. Availability of affordable continuing non-formal forest education

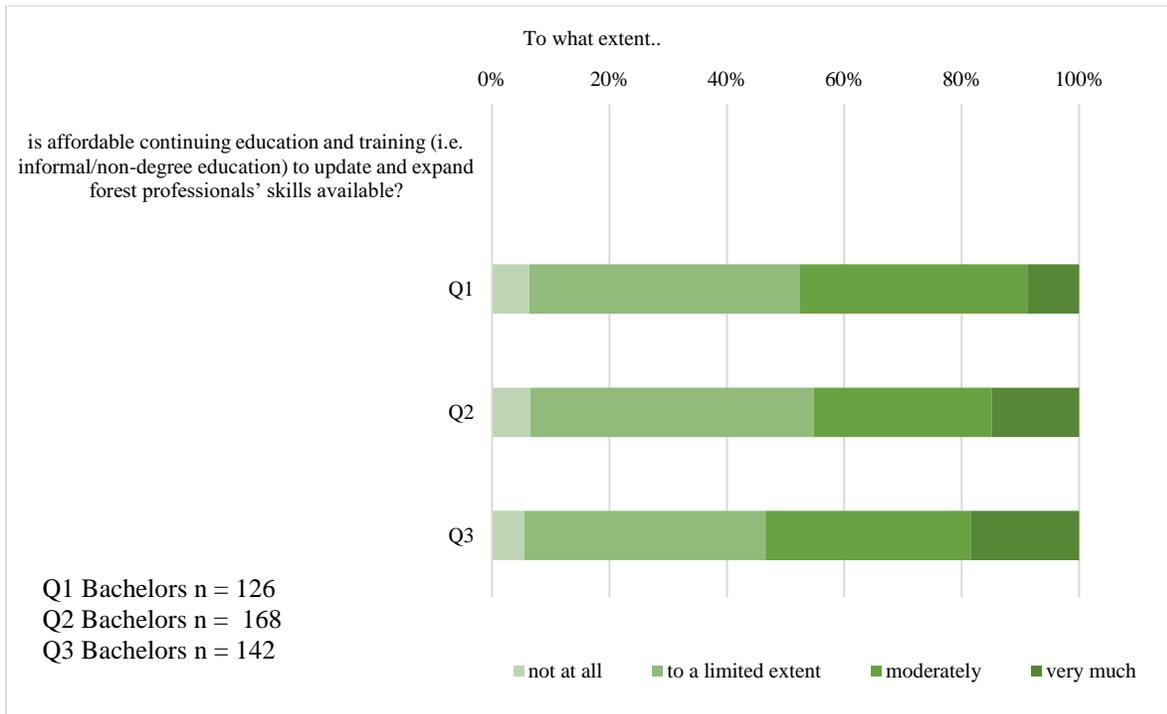


Figure A90. Overall trend in student enrolment in forest-related programmes (10-year period) (Bachelors)

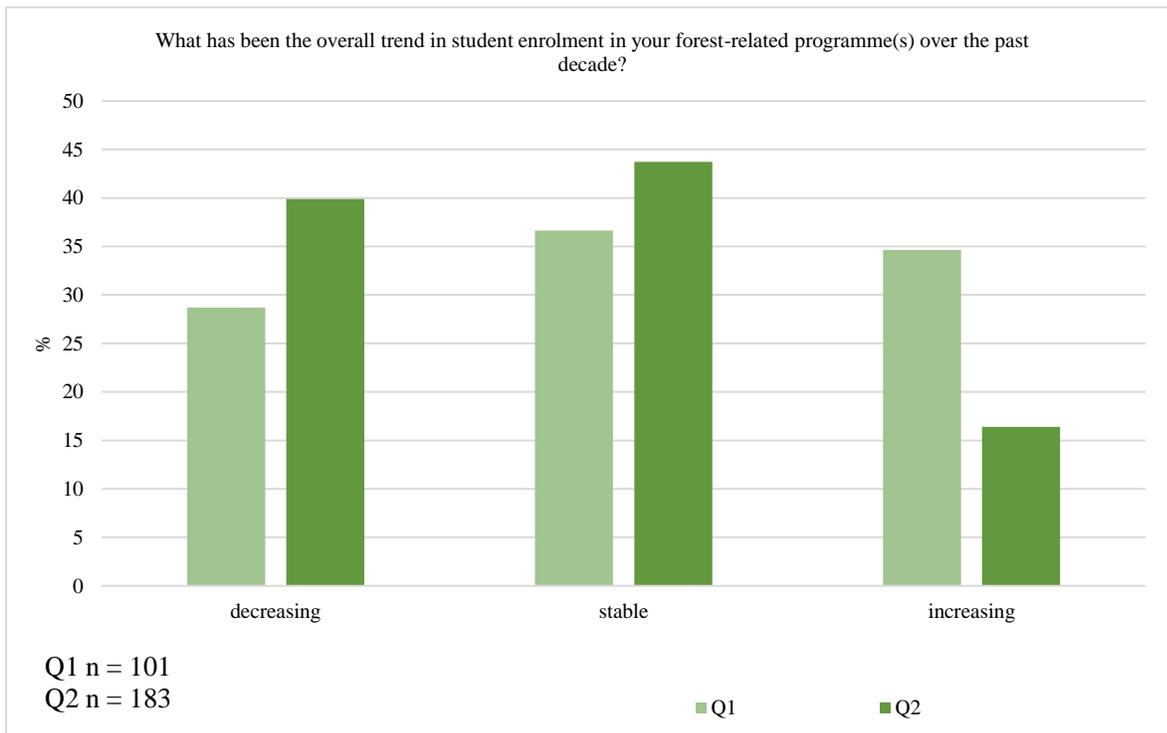
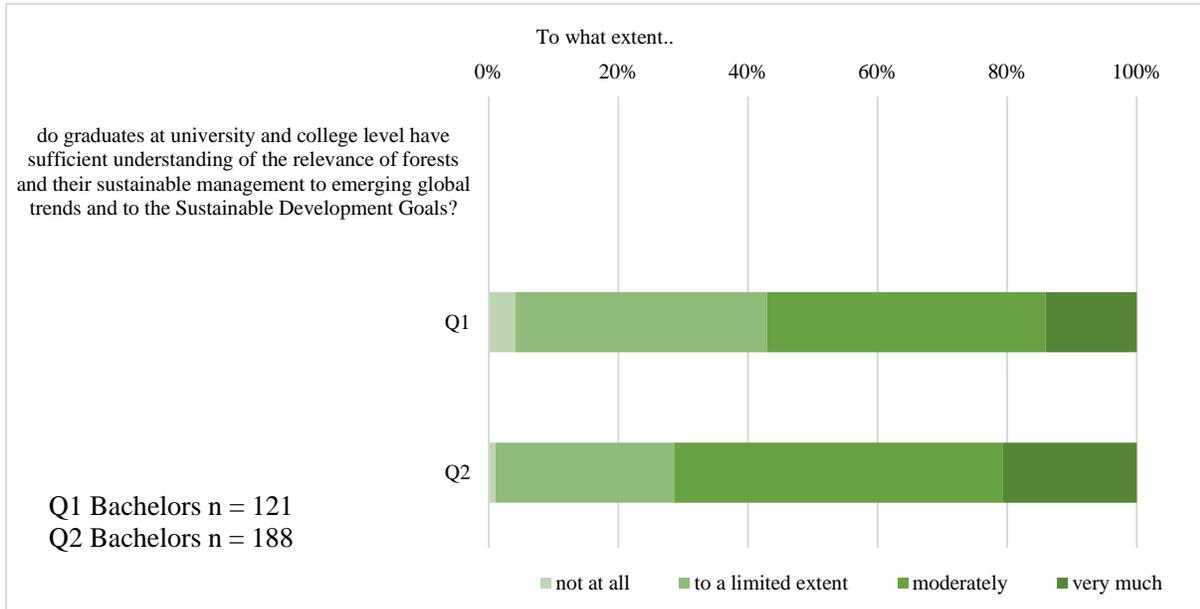
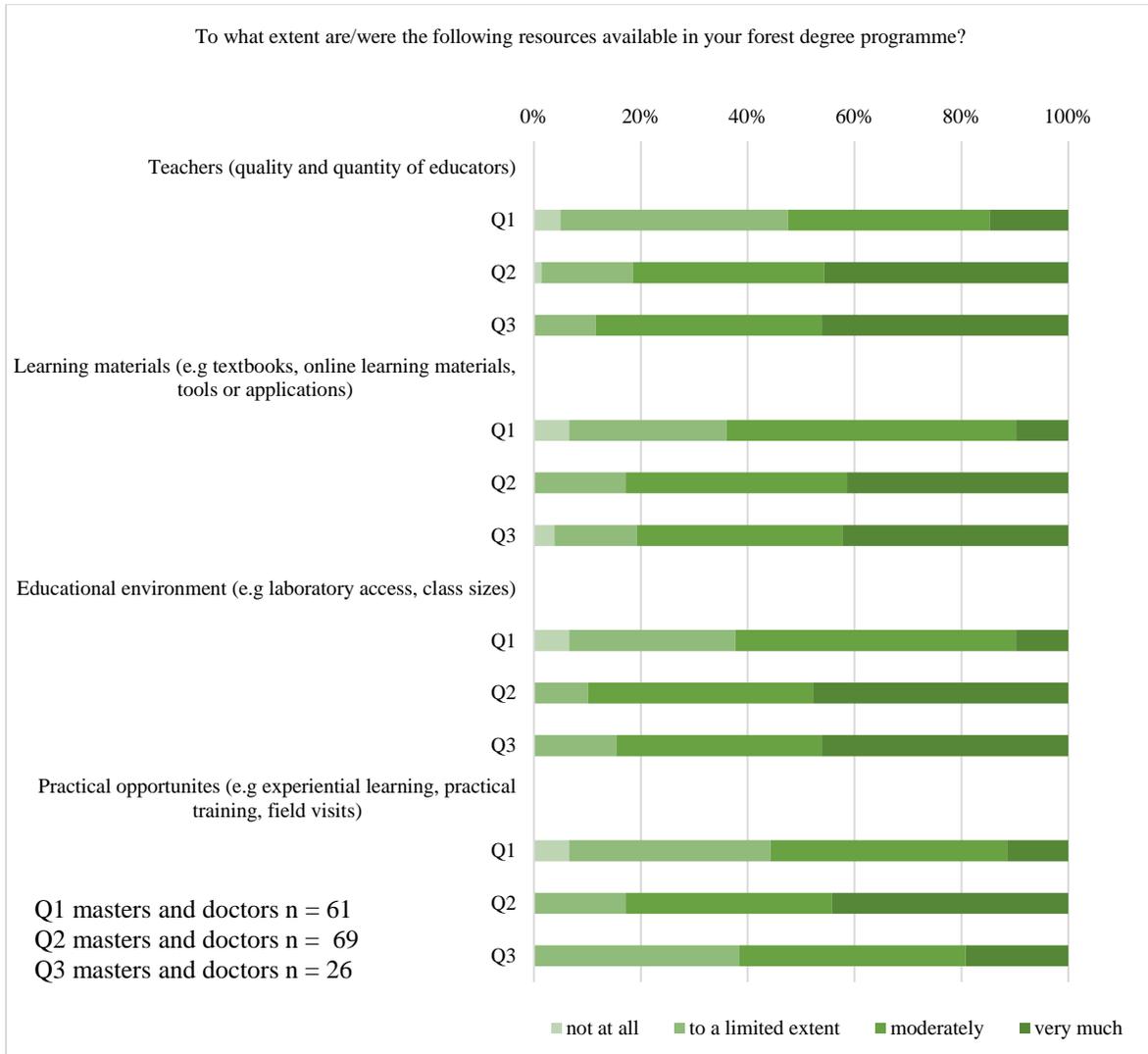


Figure A93. Graduate understanding of forests' relevance to emerging trends and SDGs (Bachelors)



## Master's and doctoral degree programme level

Figure A38. Availability of resources in forest degree programme (Masters & Doctoral programmes)



A40. Policies or strategies leading to improved forest-related education at the university and college level (Masters & Doctoral programmes)

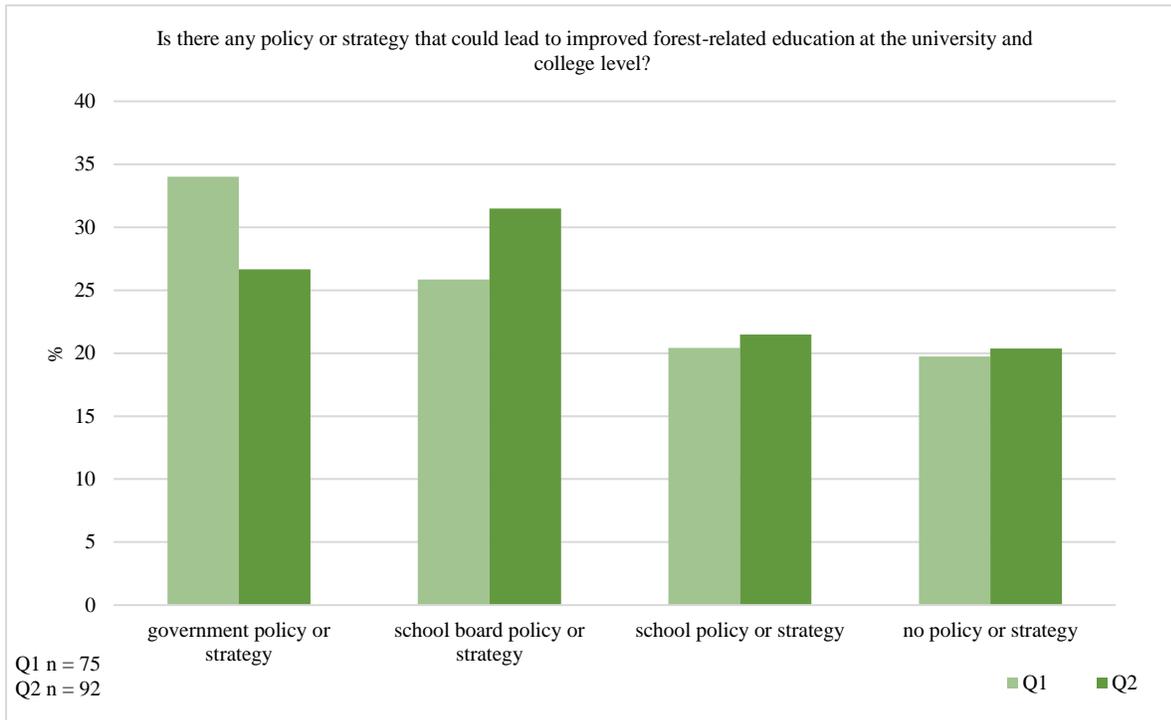


Figure A42. Student engagement in forest-related out-of-school activities (Masters & Doctoral programmes)

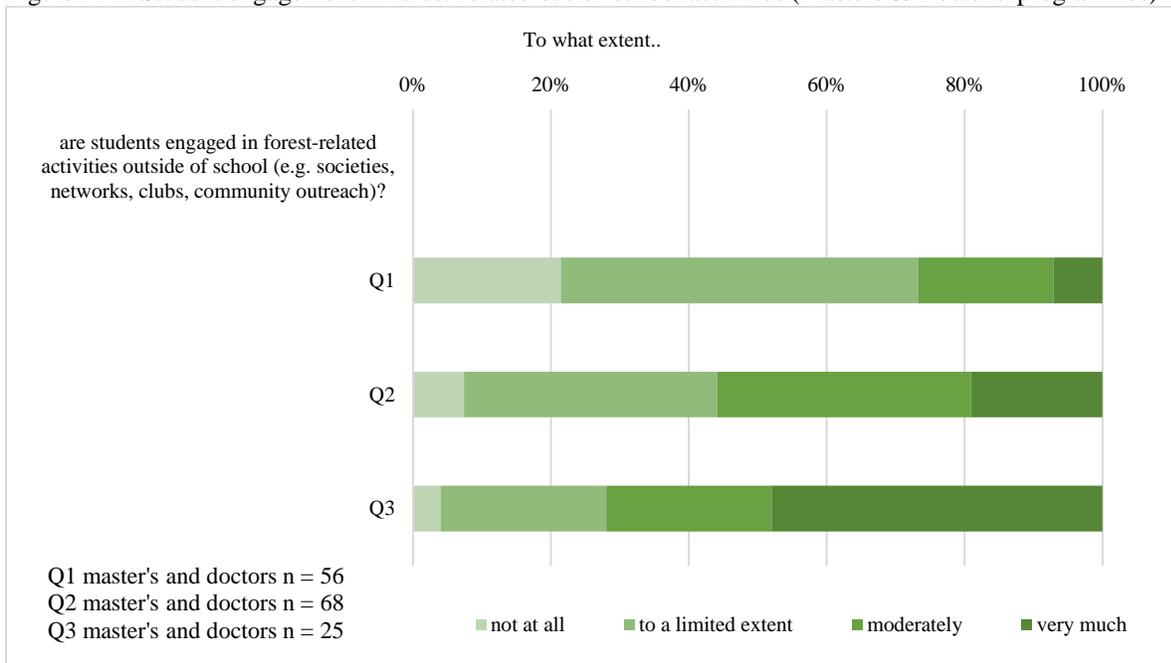


Figure A45. Use of digital learning tools at the university and college level (Masters & Doctoral programmes)

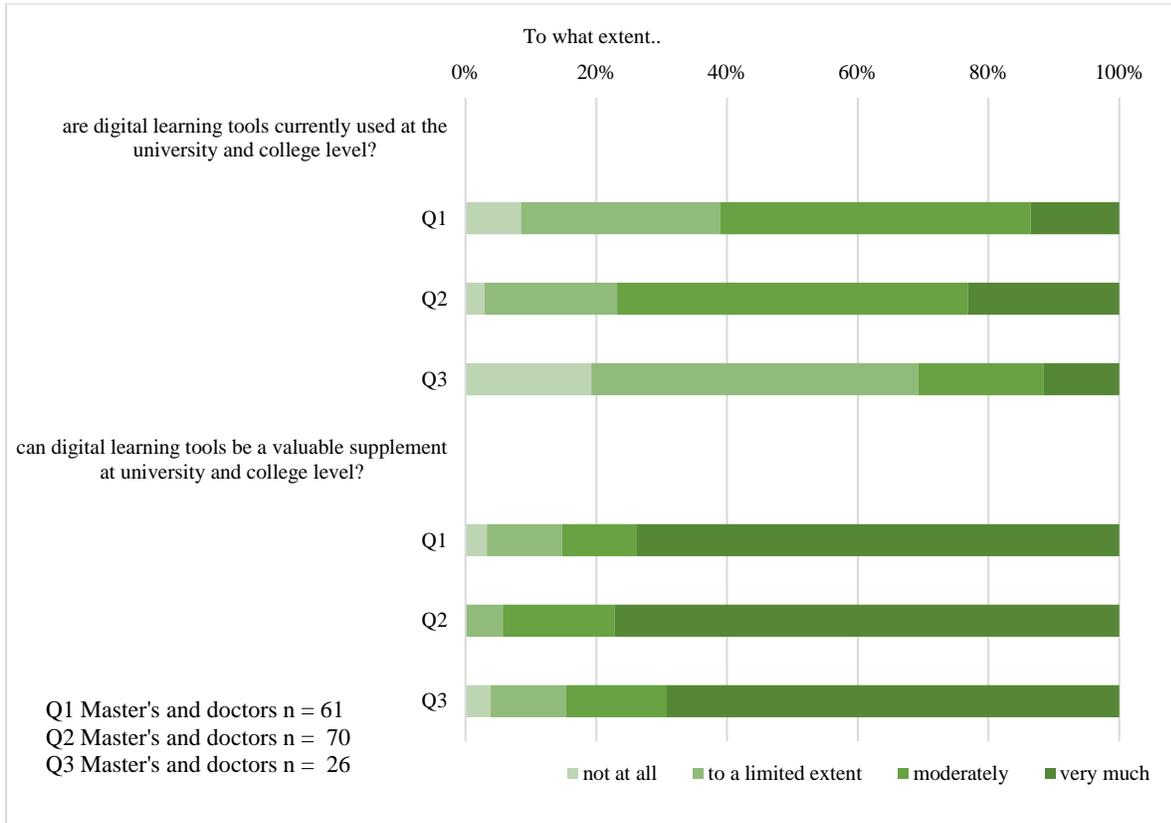


Figure A48. Use of digital learning tools in degree programme (Masters & Doctoral programmes)

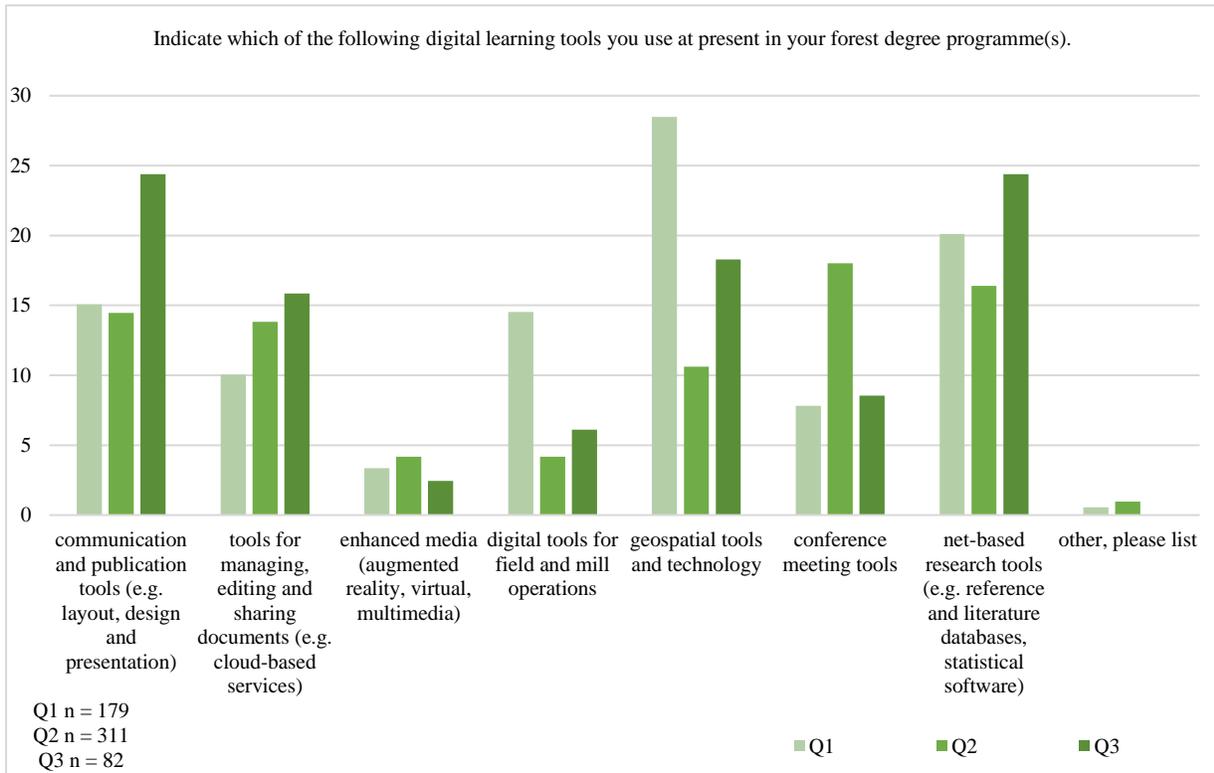


Figure A51. Desired digital learning tools for use in degree programme (Masters & Doctoral programmes)

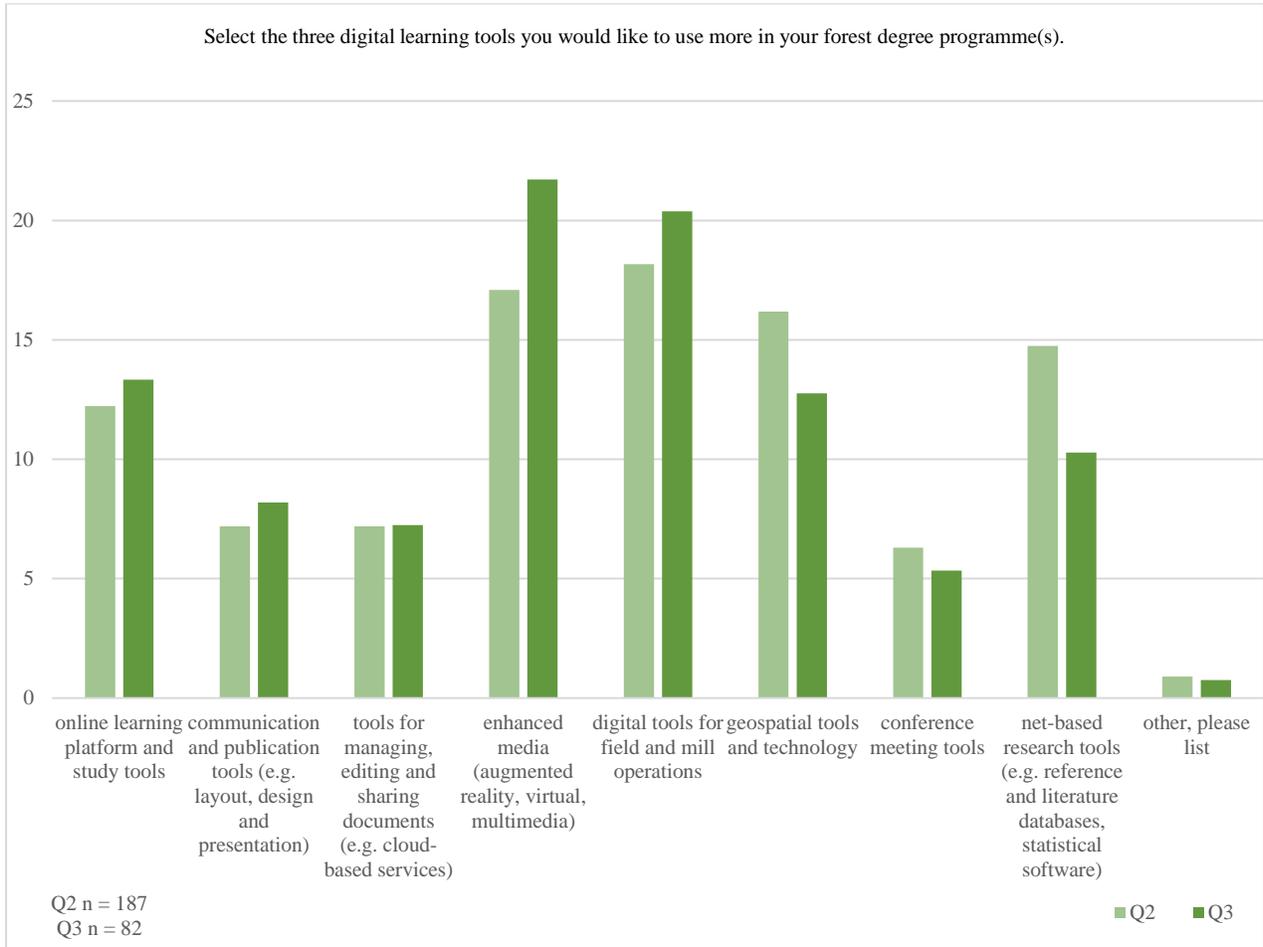


Figure A53. Familiarity with digital learning environments (Masters & Doctoral programmes)

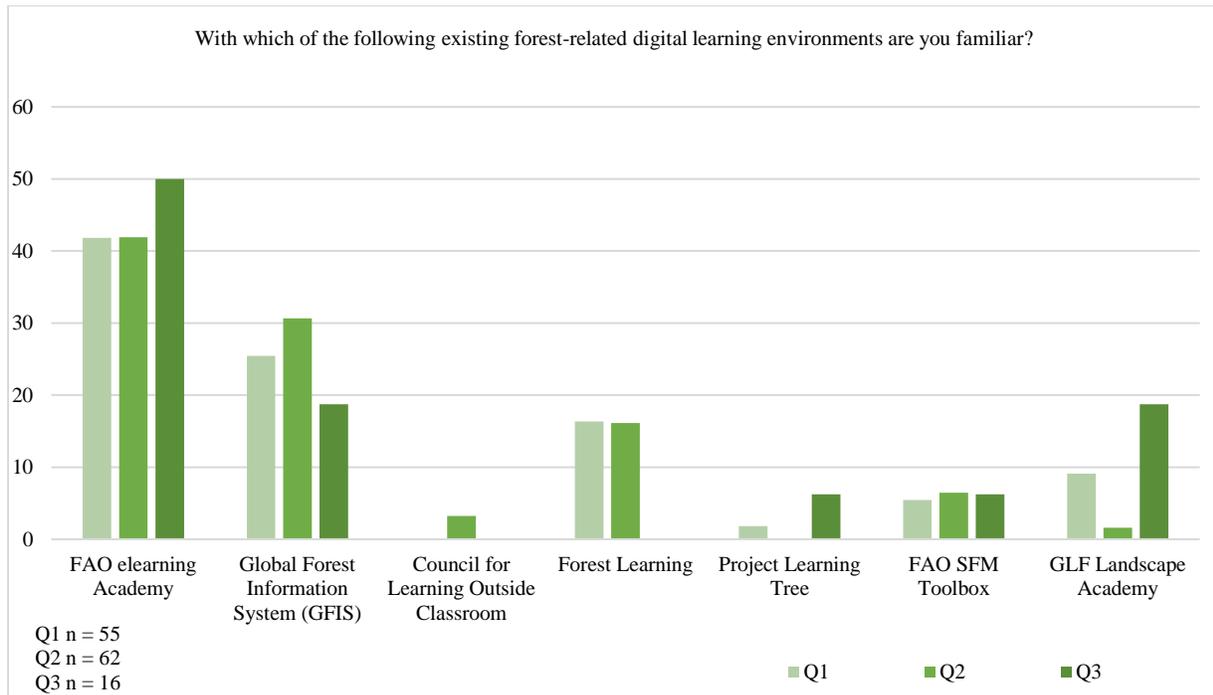


Figure A56. Coverage of forest-related topics in degree programme (Masters & Doctoral programmes)

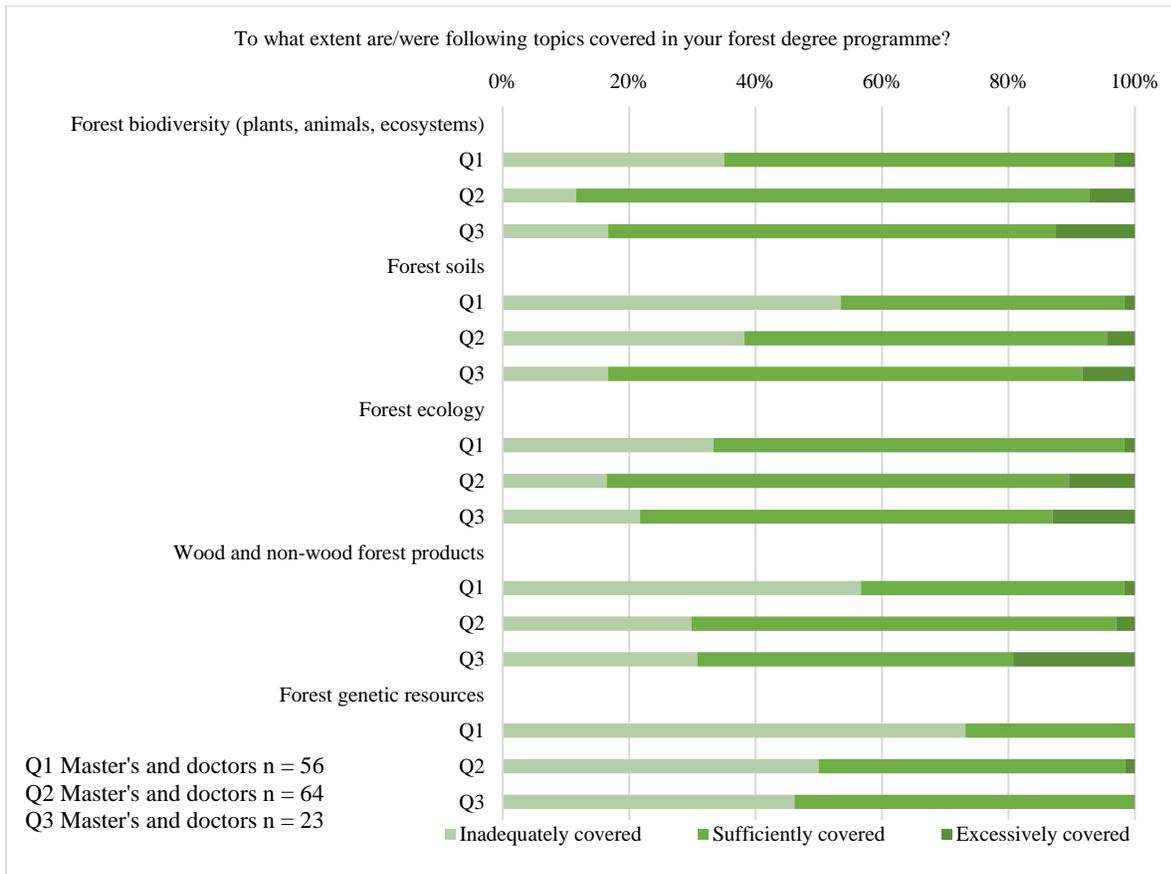


Figure A59. Coverage of forest-related topics in degree programme (Masters & Doctoral programmes)

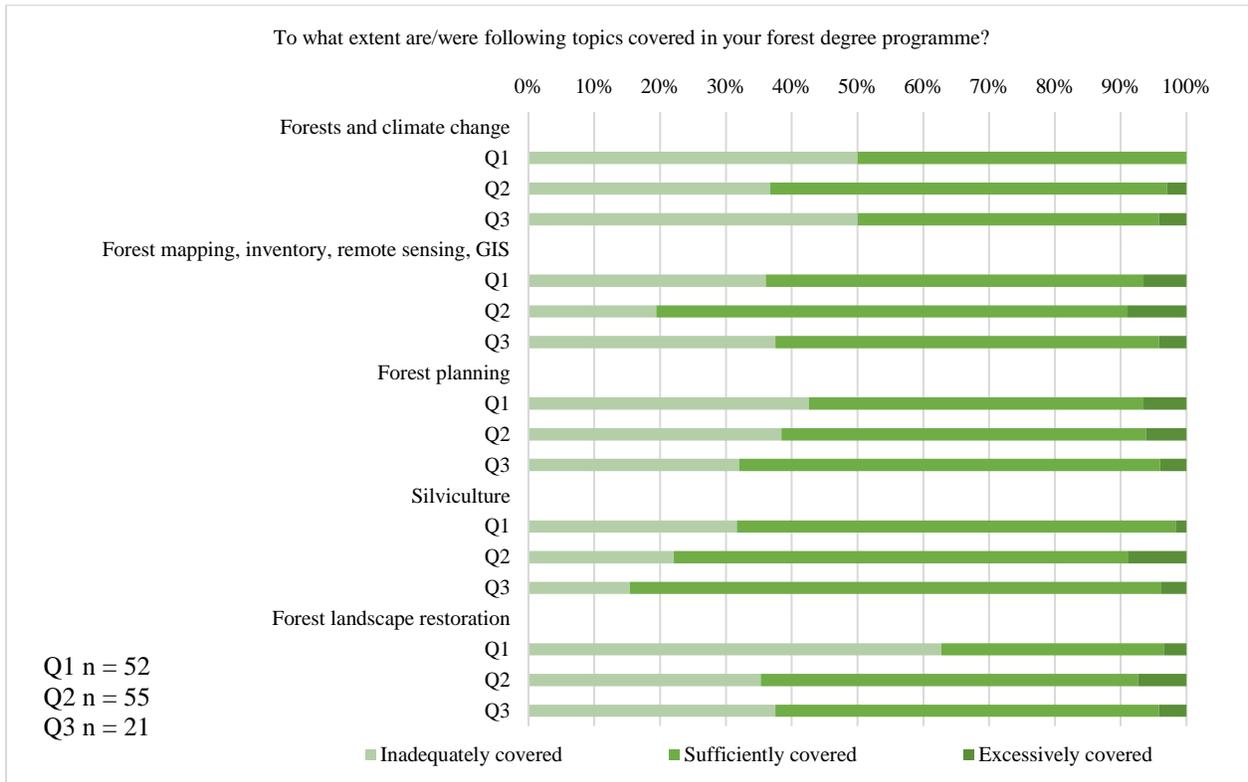


Figure A62. Coverage of forest-related topics in degree programme (Masters & Doctoral programmes)

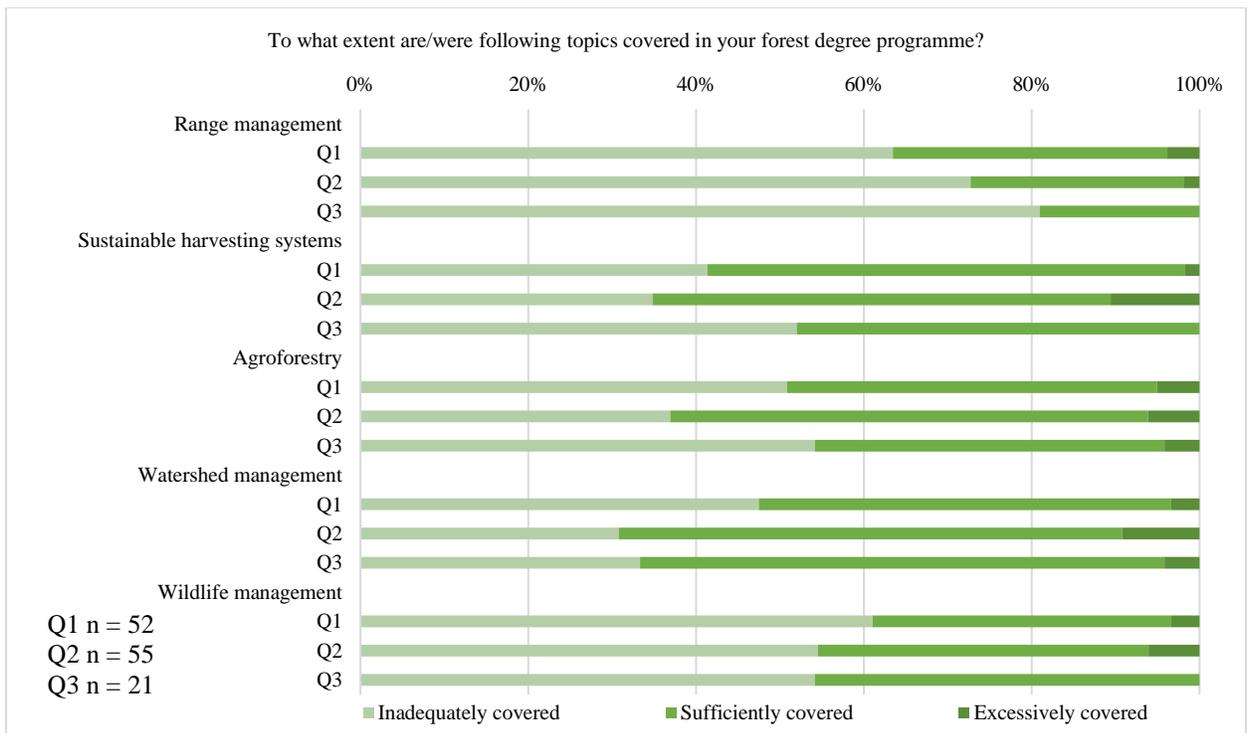


Figure A64. Coverage of forest-related topics in degree programme (Masters & Doctoral programmes)

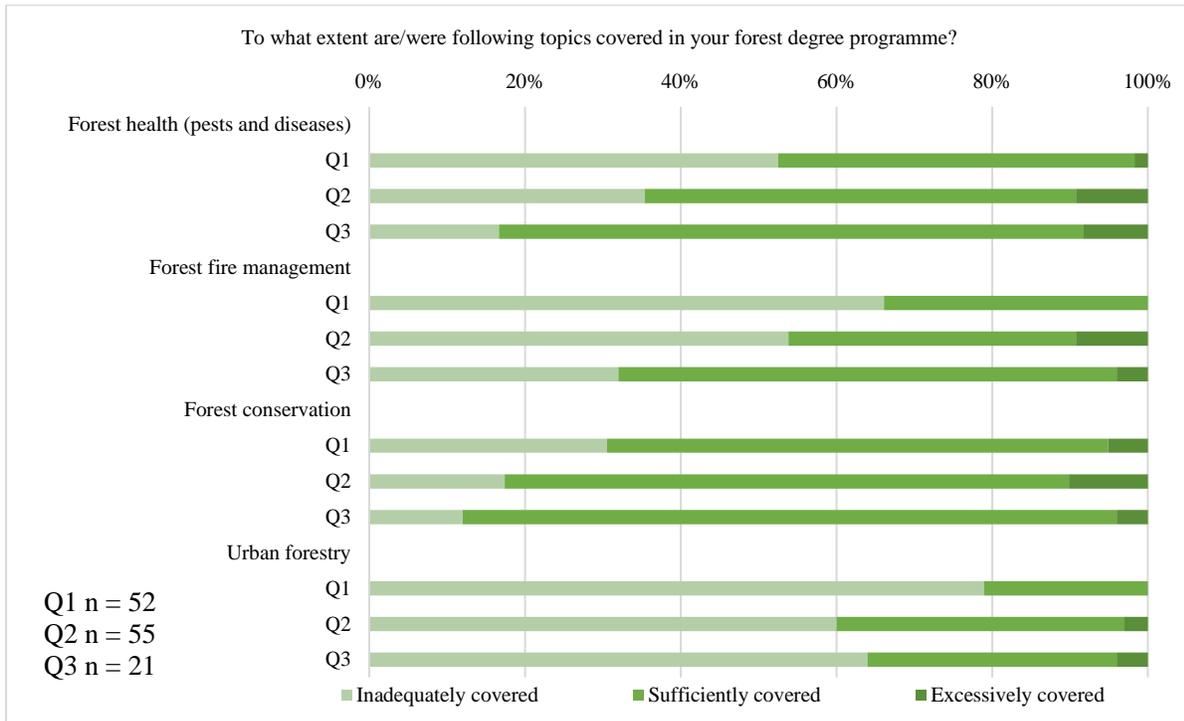


Figure A66. Coverage of forest-related topics in degree programme (Masters & Doctoral programmes)

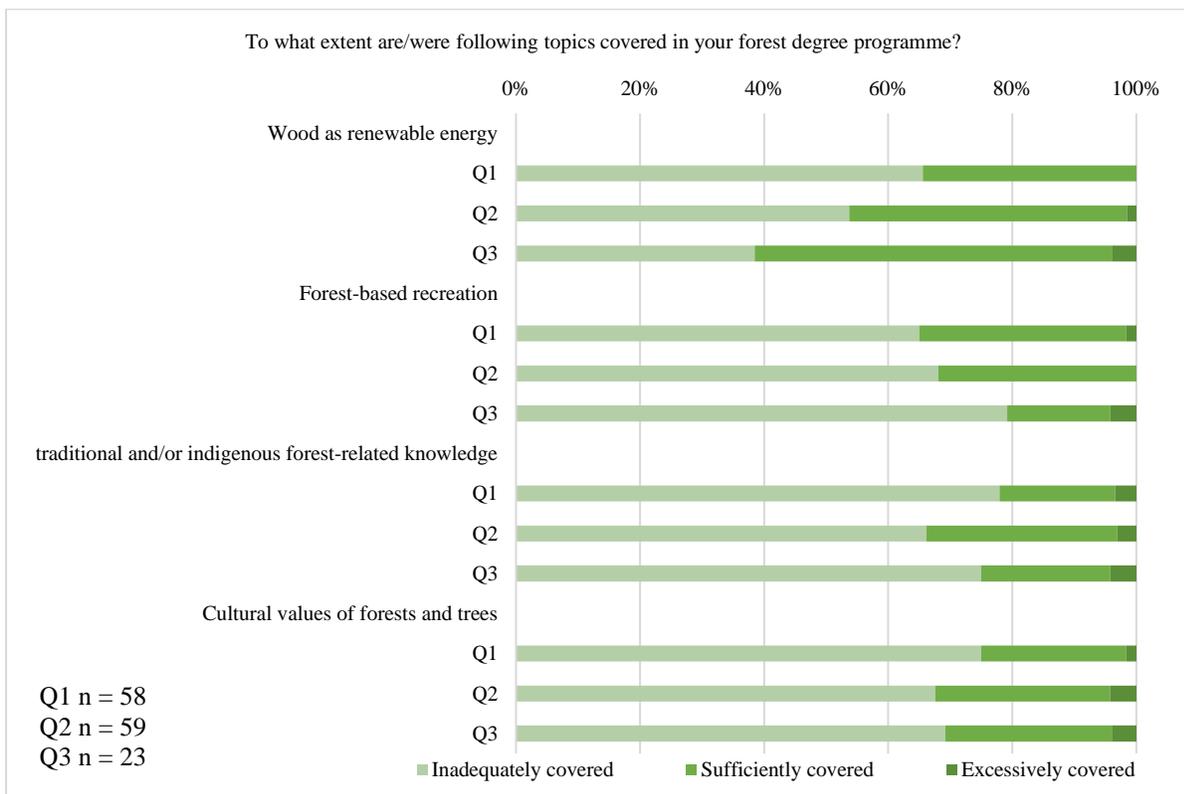


Figure A69. Coverage of forest-related topics in degree programme (Masters & Doctoral programmes)

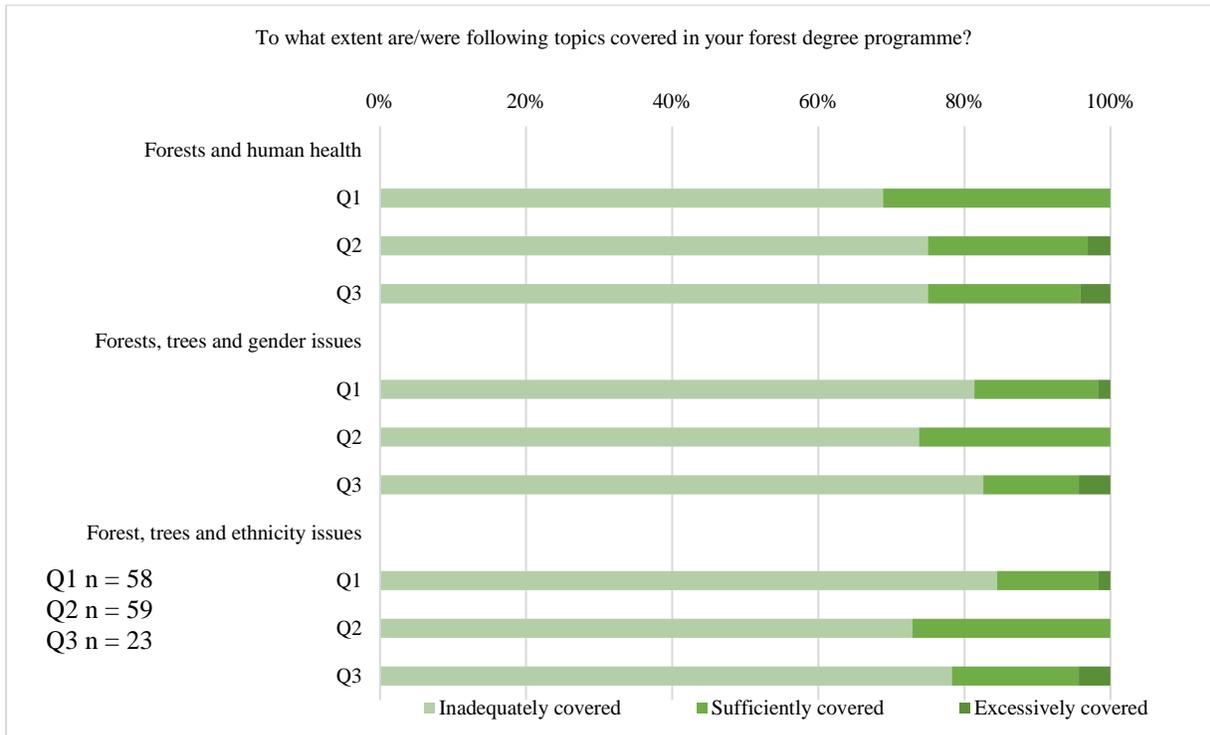


Figure A71. Coverage of forest-related topics in degree programme (Masters & Doctoral programmes)

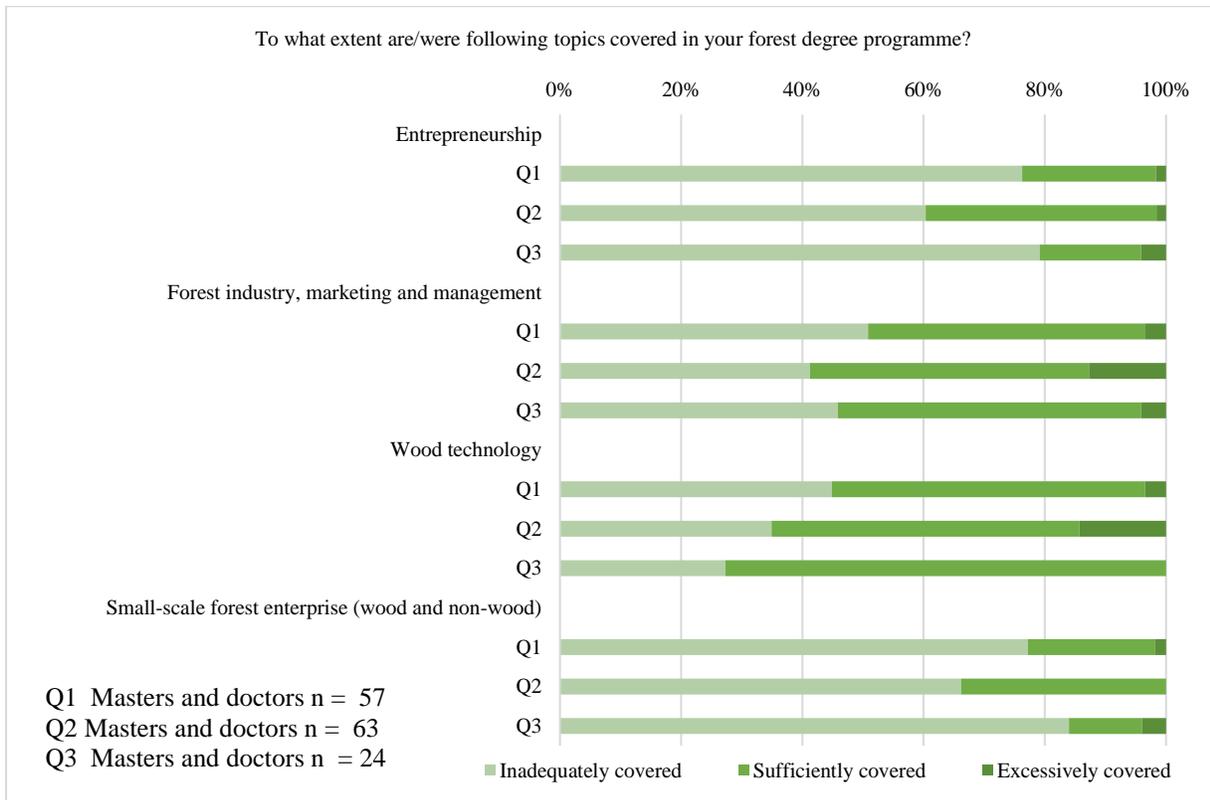


Figure A74. Coverage of forest-related topics in degree programme (Masters & Doctoral programmes)

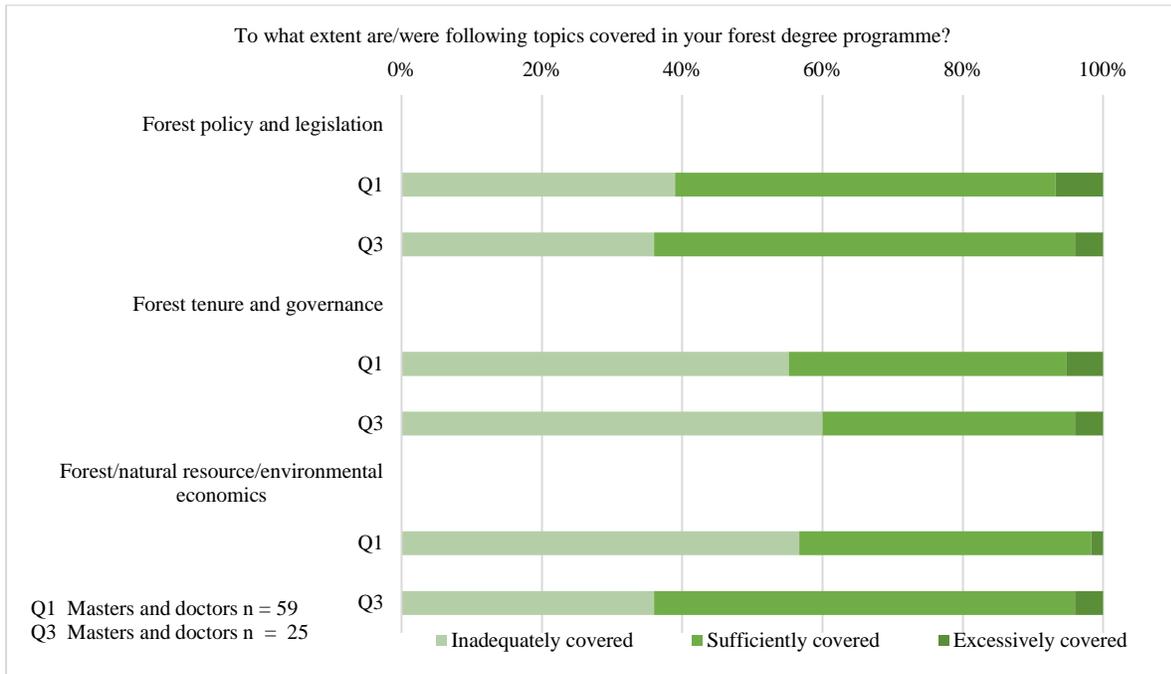


Figure A77. Availability of forest-related internships or part-time employment and effect on learning (Masters & Doctoral programmes)

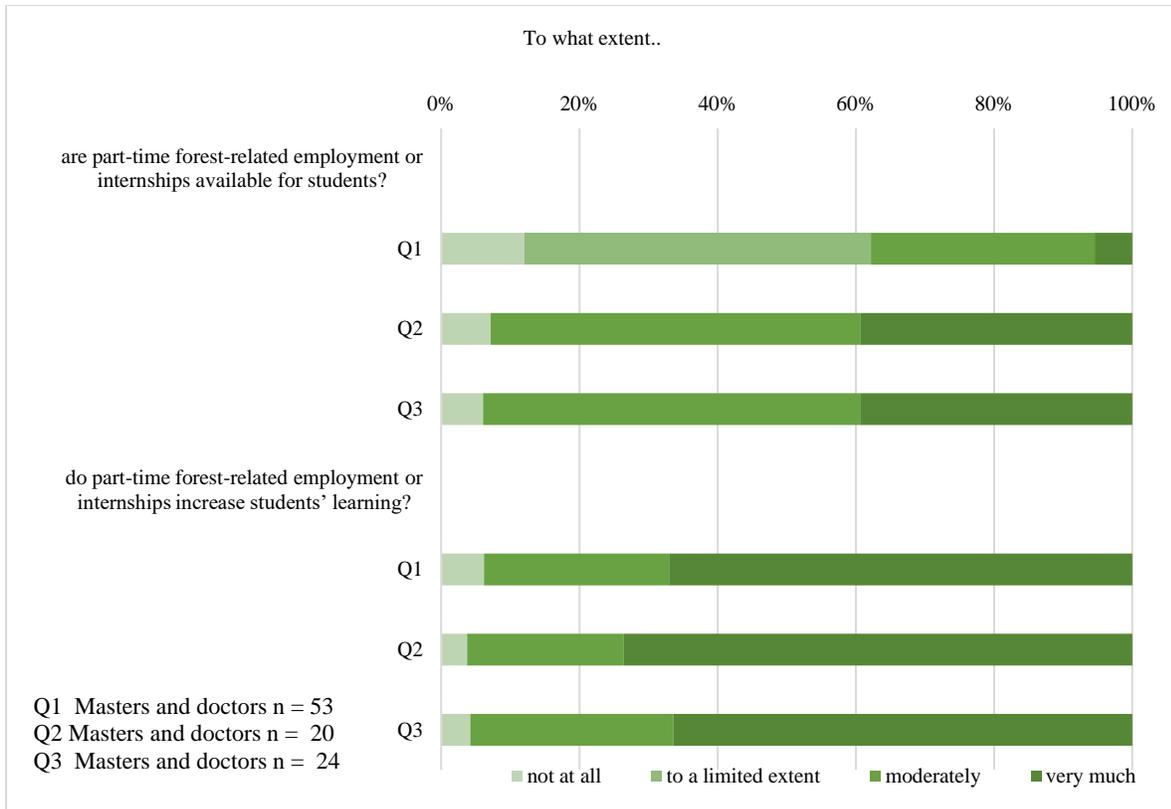


Figure A79. Workforce readiness within degree programme (Masters & Doctoral programmes)

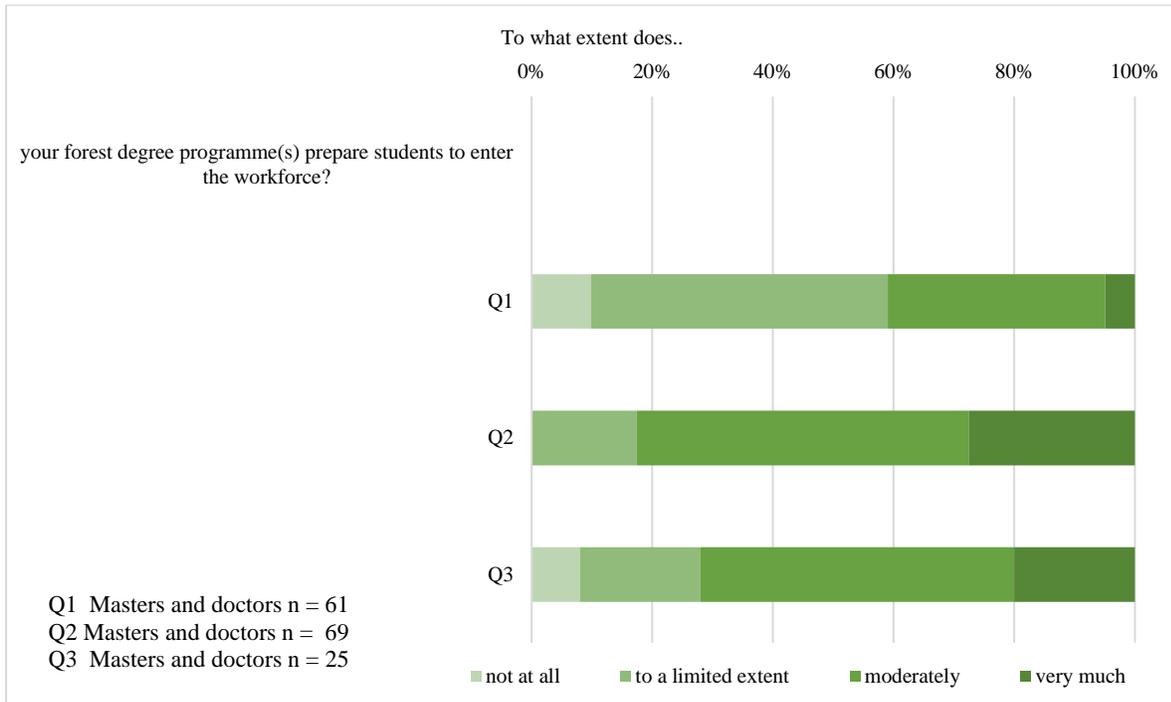


Figure A82. Gender as a factor and influence in forest-related employment (Masters & Doctoral programmes)

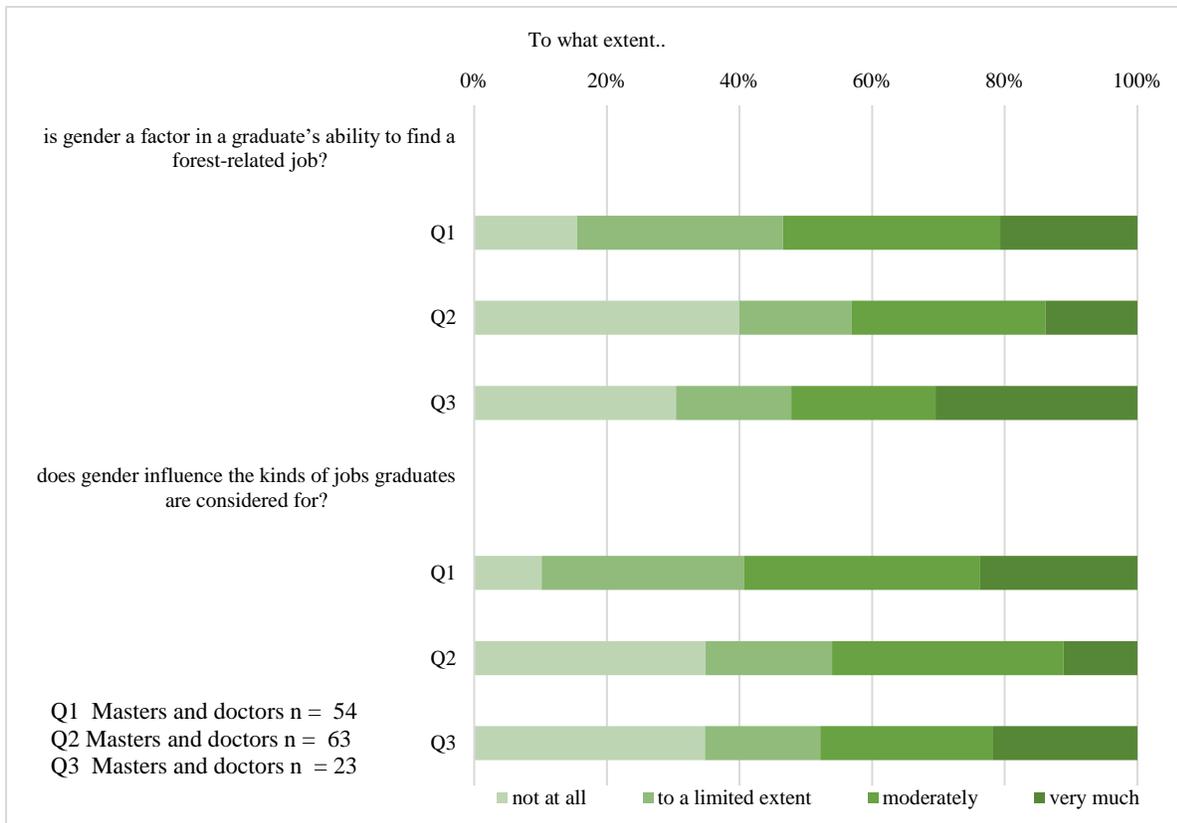


Figure A85. Race or ethnicity as a factor and influence in forest-related employment (Masters & Doctoral programmes)

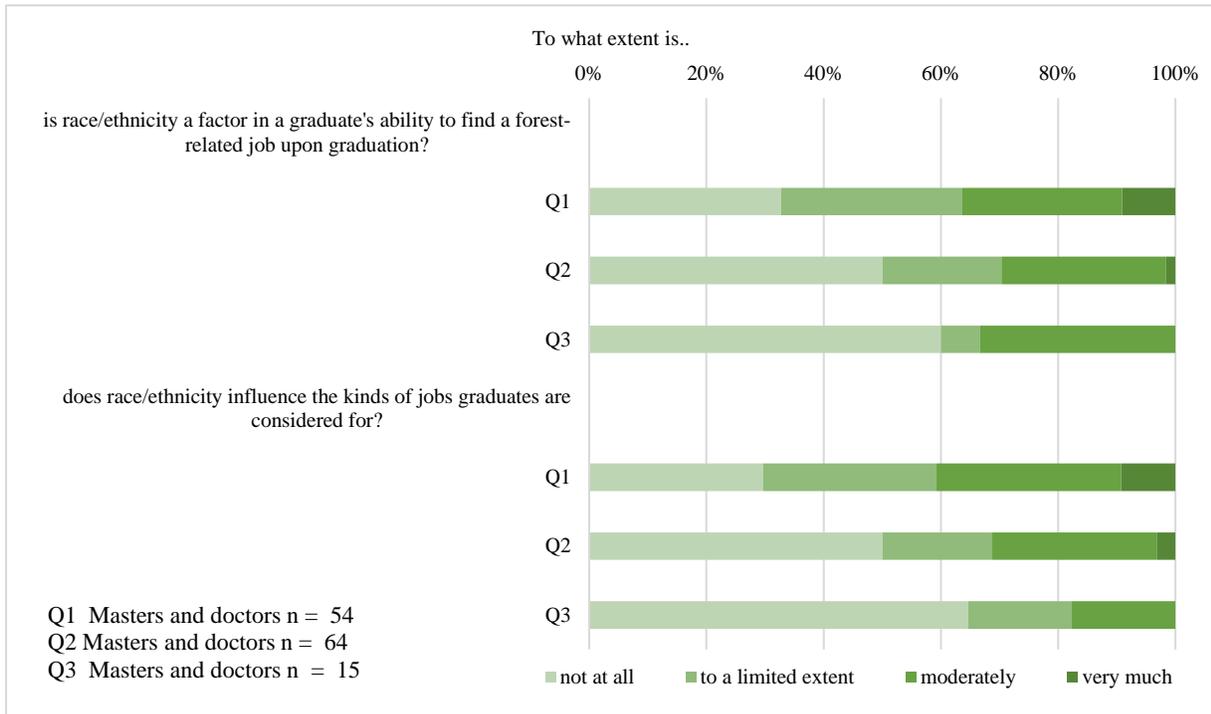


Figure A88. Availability of affordable continuing non-formal forest education

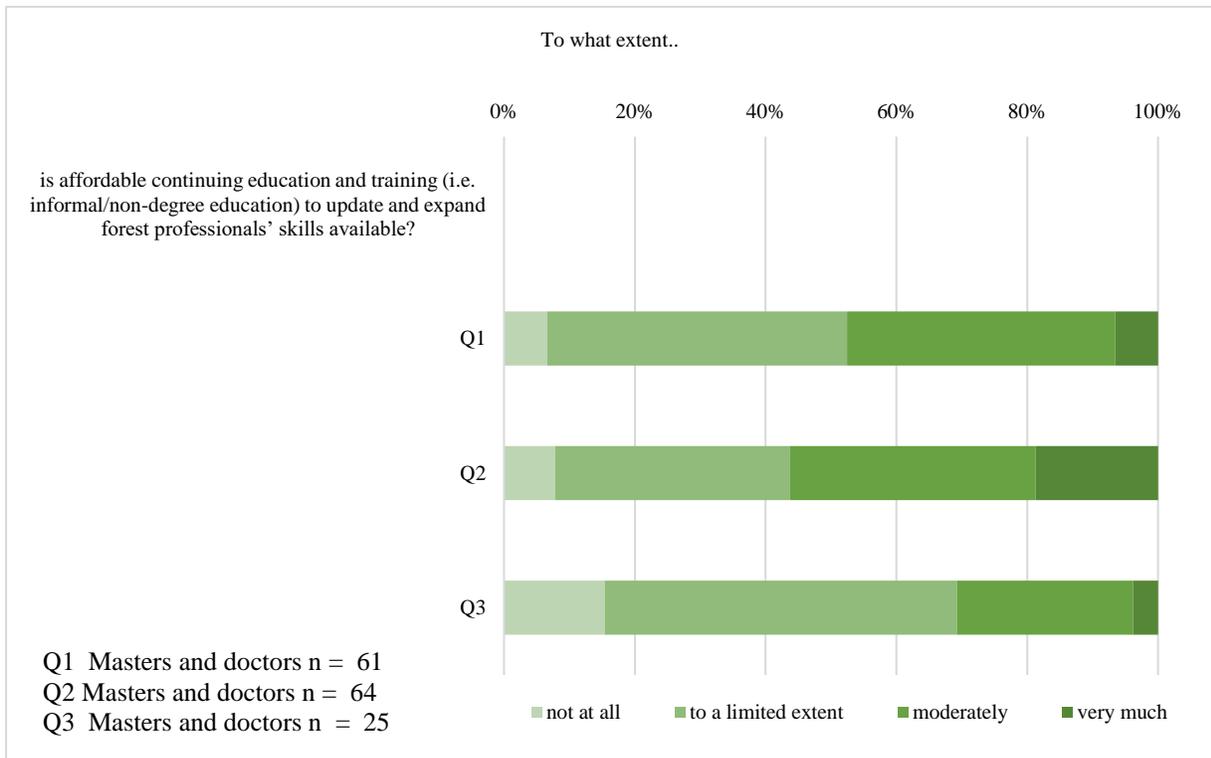


Figure A91. Overall trend in student enrolment in forest-related programmes (10-year period) (Masters & Doctoral programmes)

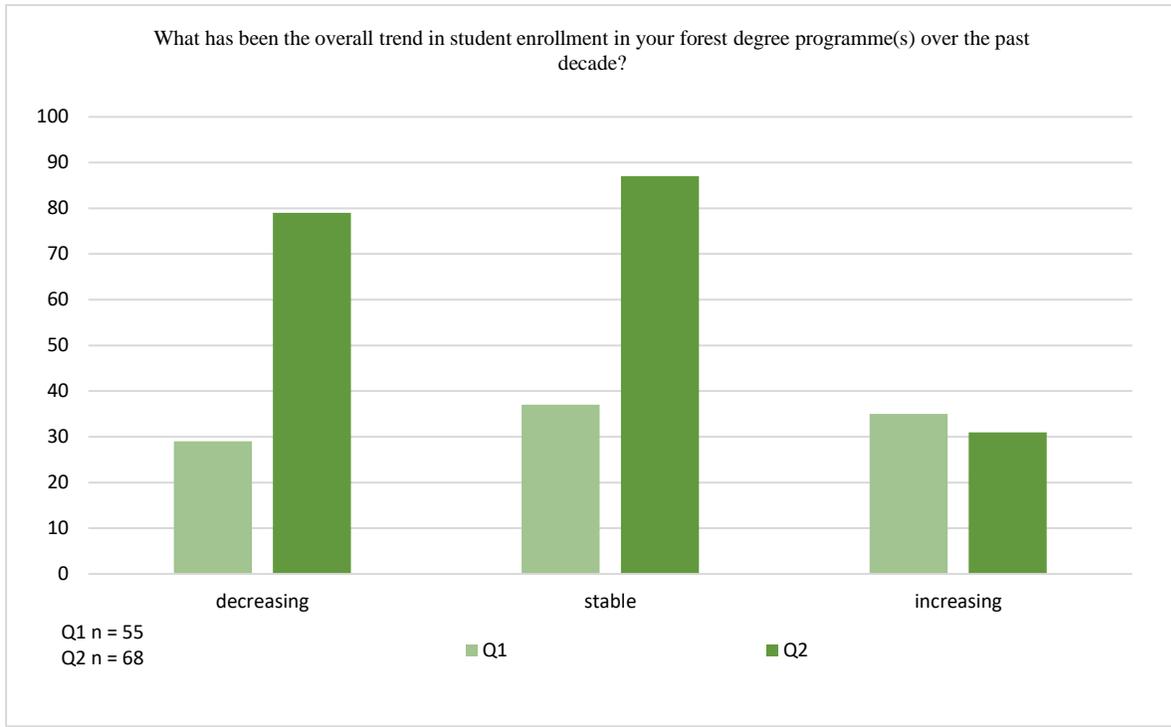
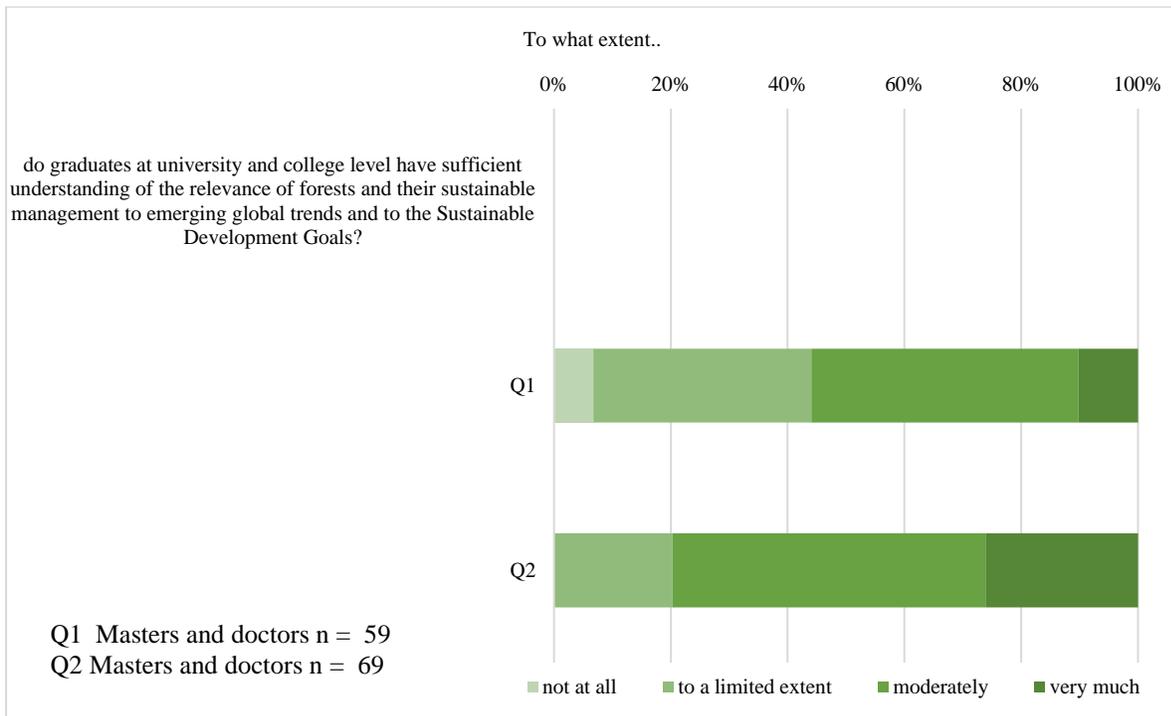


Figure A94. Graduates' understanding of forests' relevance to emerging trends and SDGs (Masters & Doctoral programmes)



## All levels, Bachelors, Masters and Doctoral degrees (aggregated)

Figure A39. Availability of resources in forest degree programme (All levels)

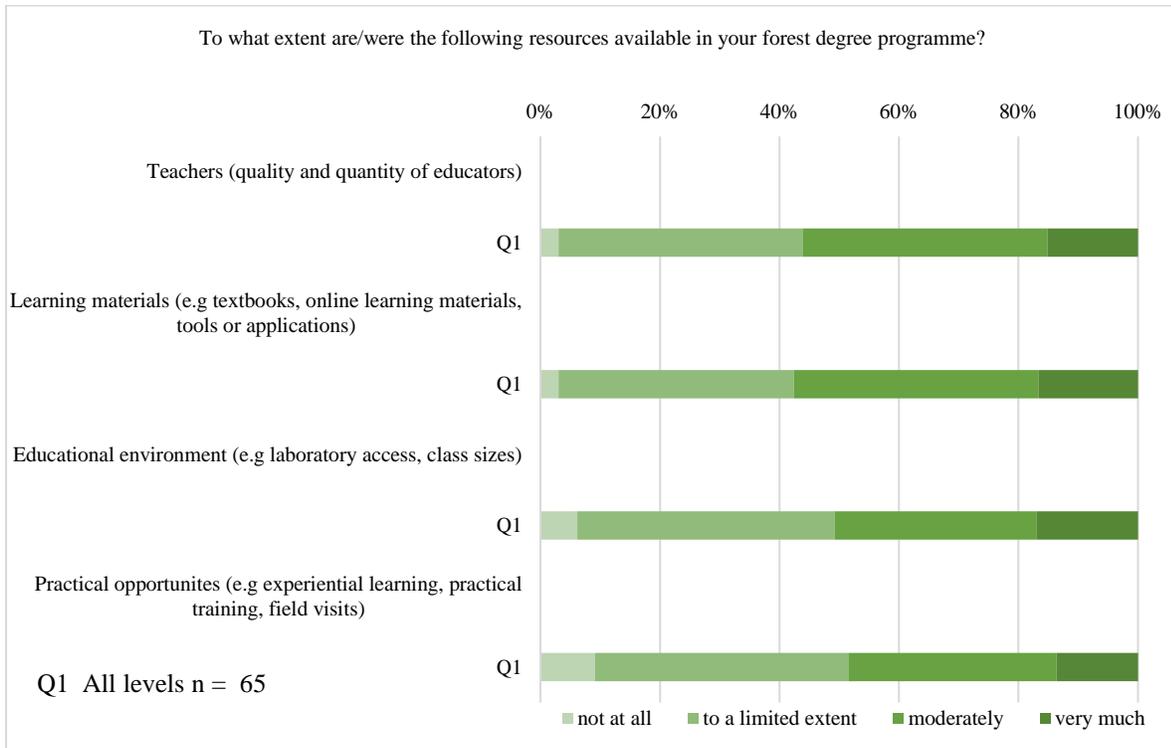


Figure A40.2. Policies or strategies leading to improved forest-related education at university and college level (All levels)

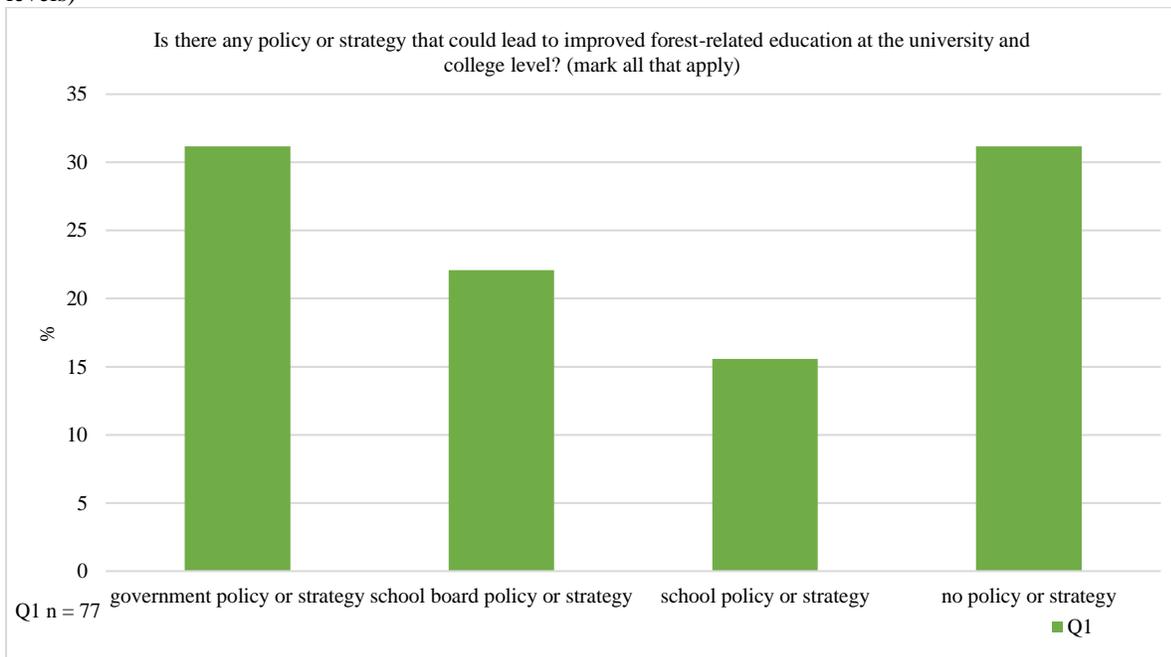


Figure A43. Student engagement in forest-related out-of-school activities (All levels)

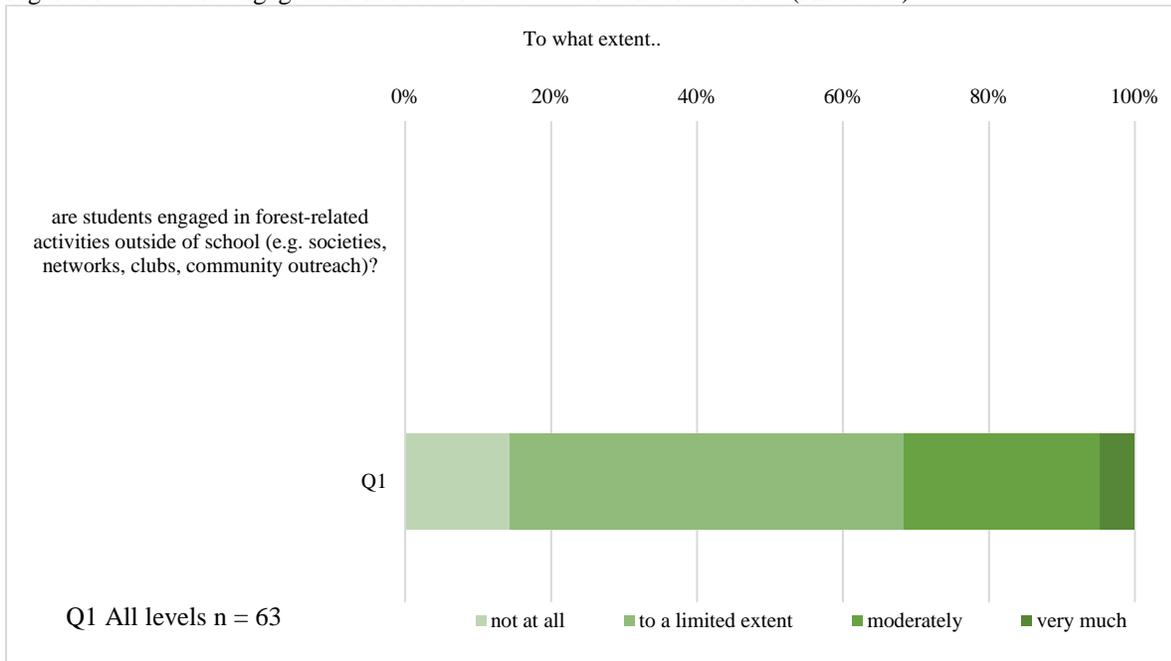


Figure A46. Use of digital learning tools at University and College level (All levels)

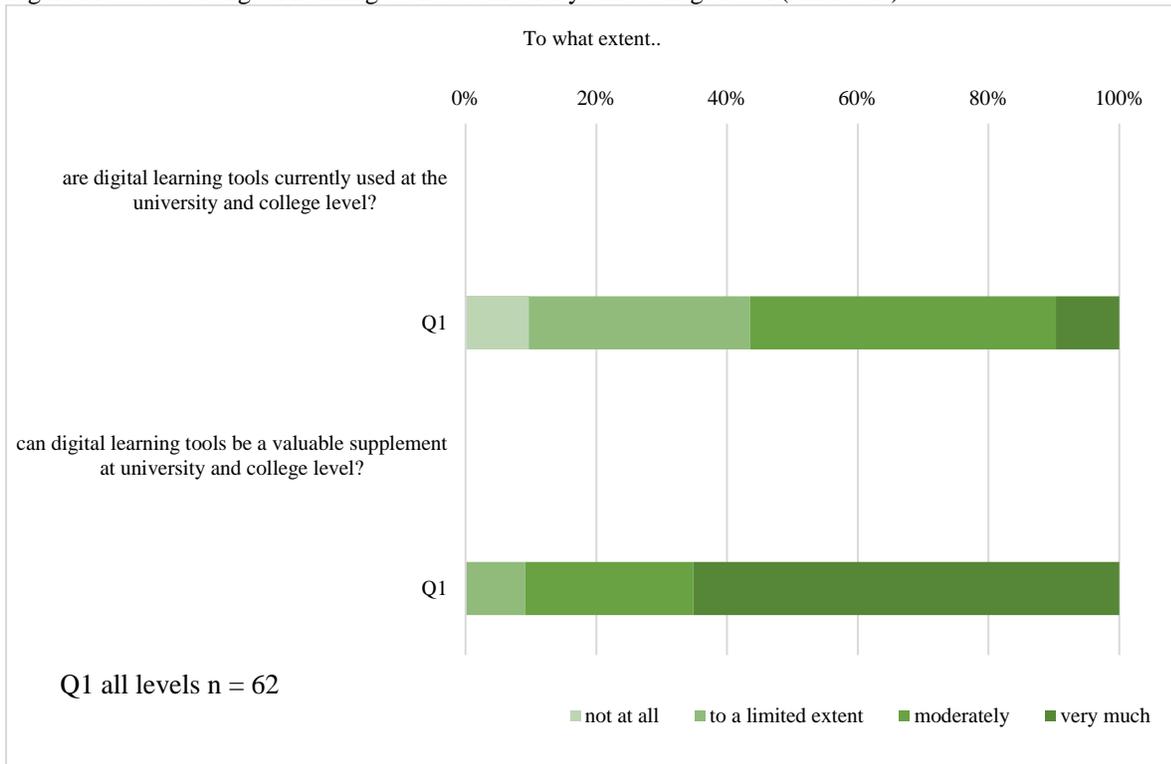


Figure A49. Use of digital learning tools in degree programme (All levels)

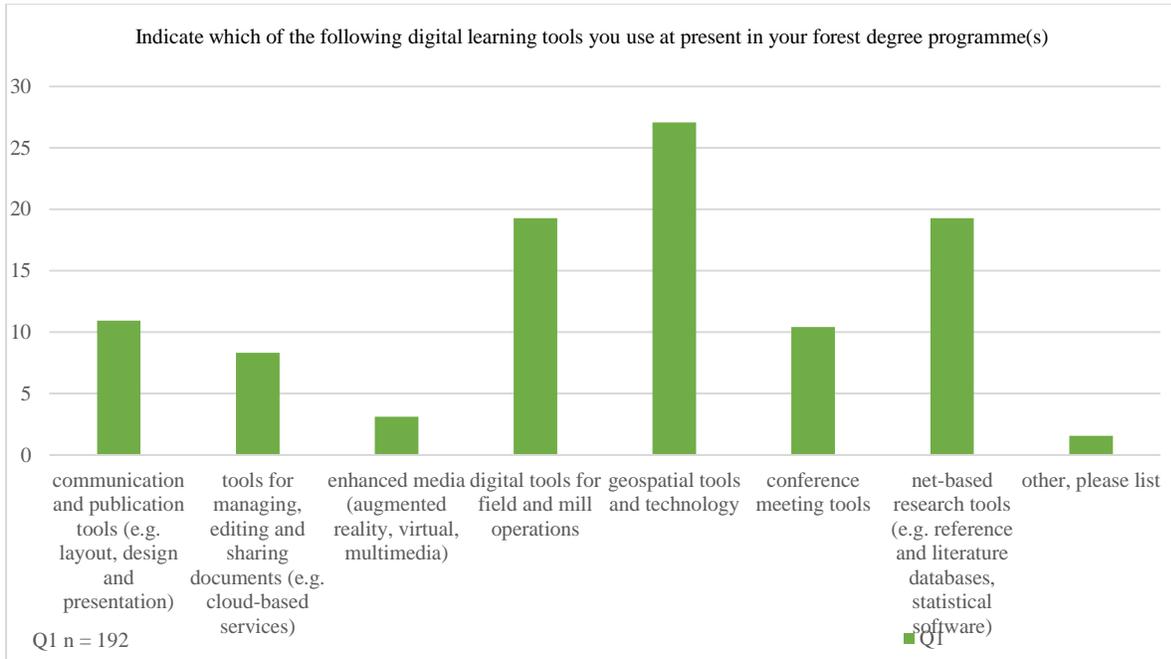


Figure A54. Familiarity with digital learning environments (All levels)

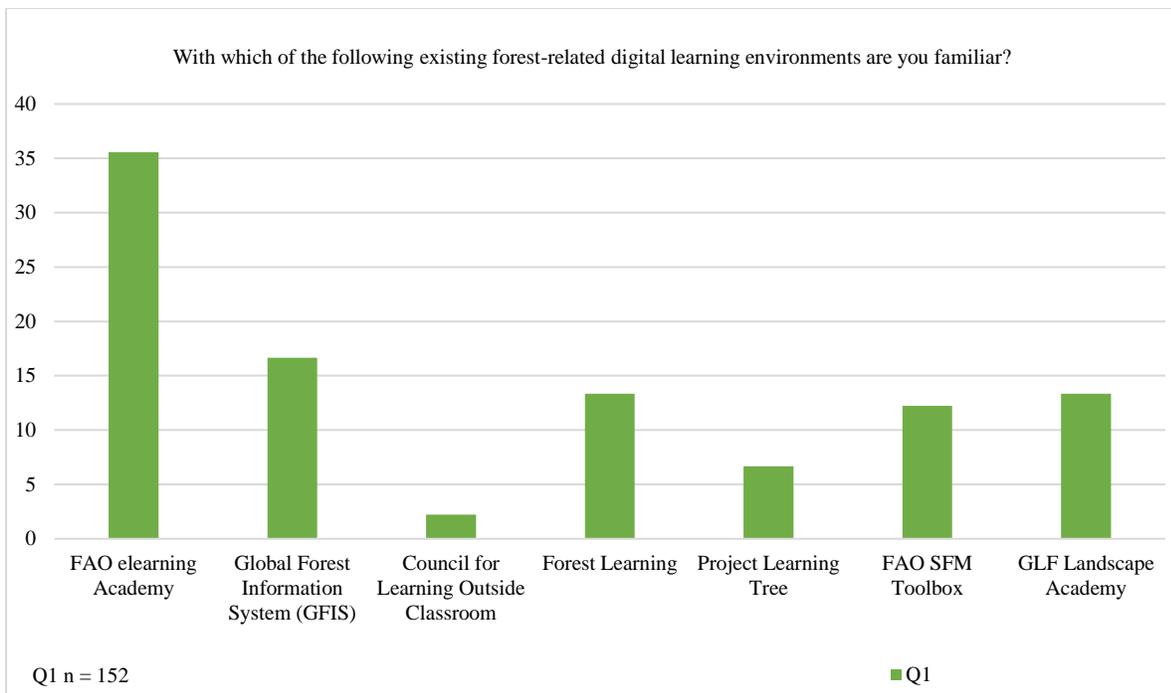


Figure A57. Coverage of forest-related topics in degree programme (All levels)

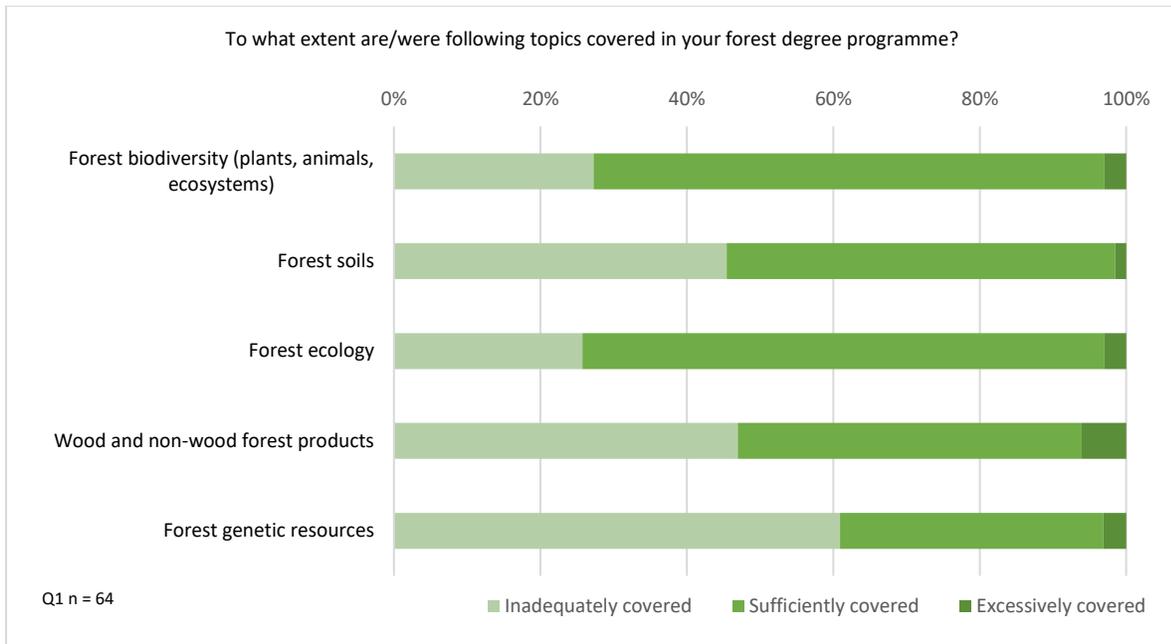


Figure A60. Coverage of forest-related topics in degree programme (All levels)

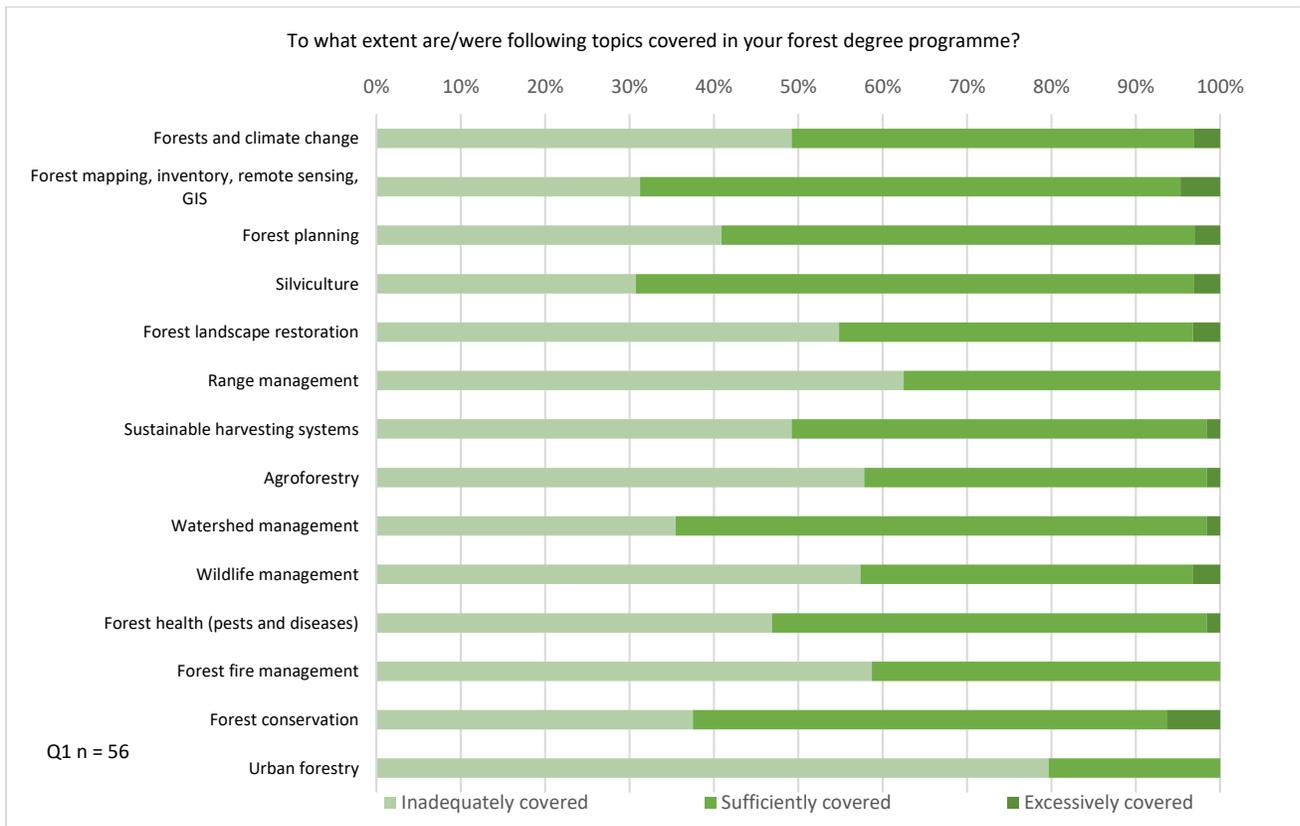


Figure A67. Coverage of forest-related topics in degree programme (All levels)

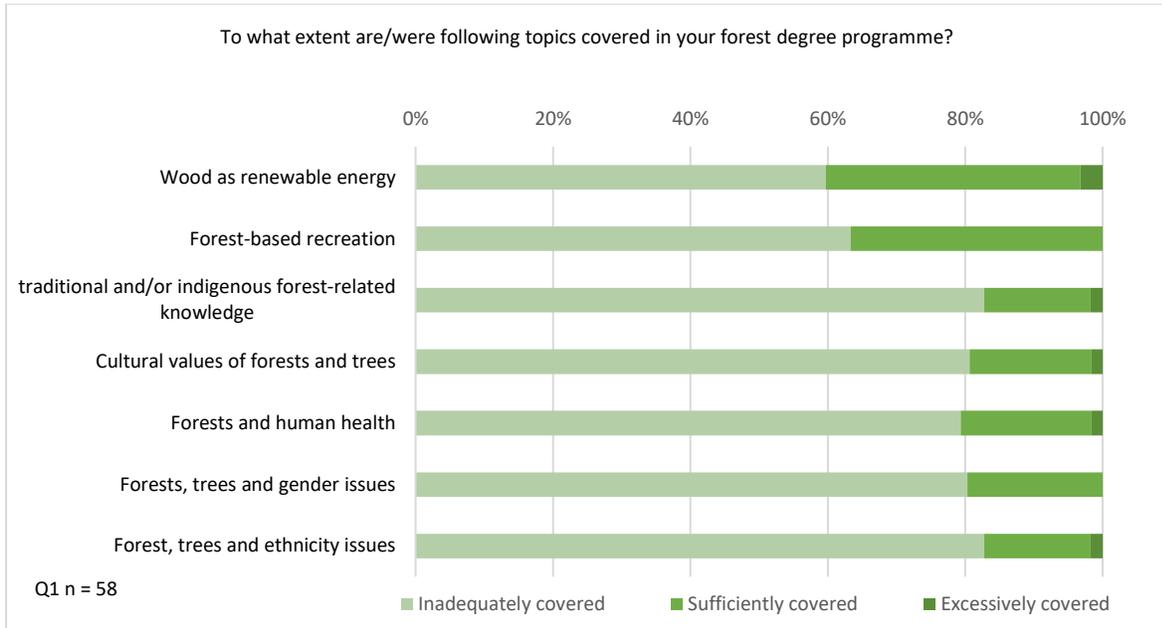


Figure A72. Coverage of forest-related topics in degree programme (All levels)

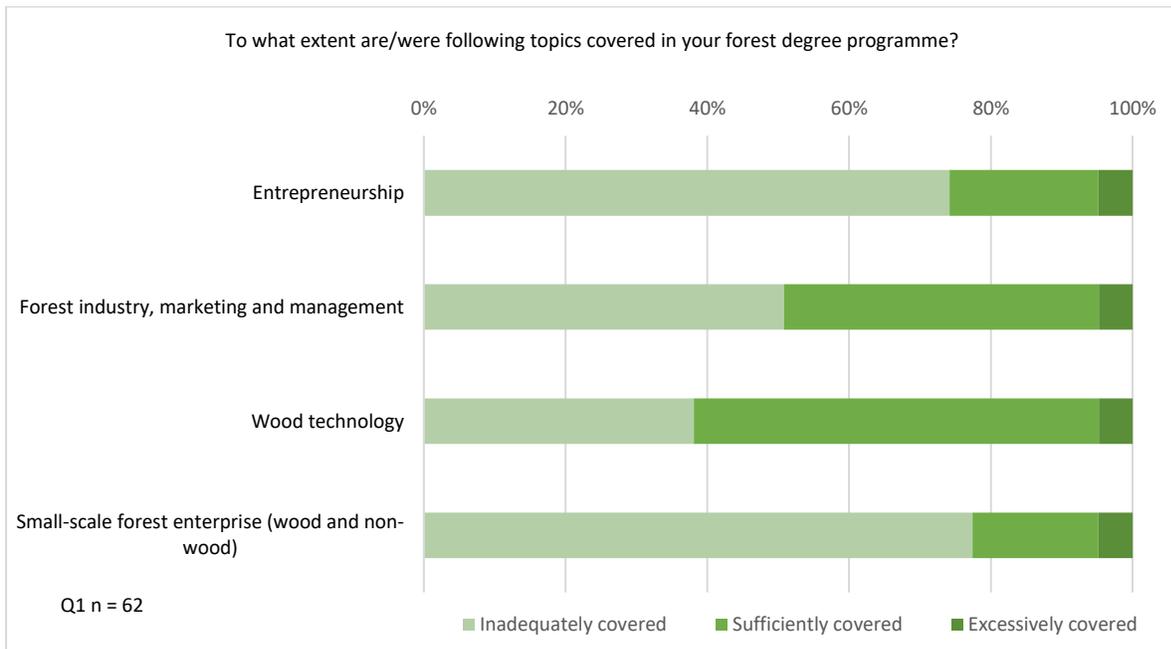


Figure A75. Coverage of forest-related topics in degree programme (All levels)

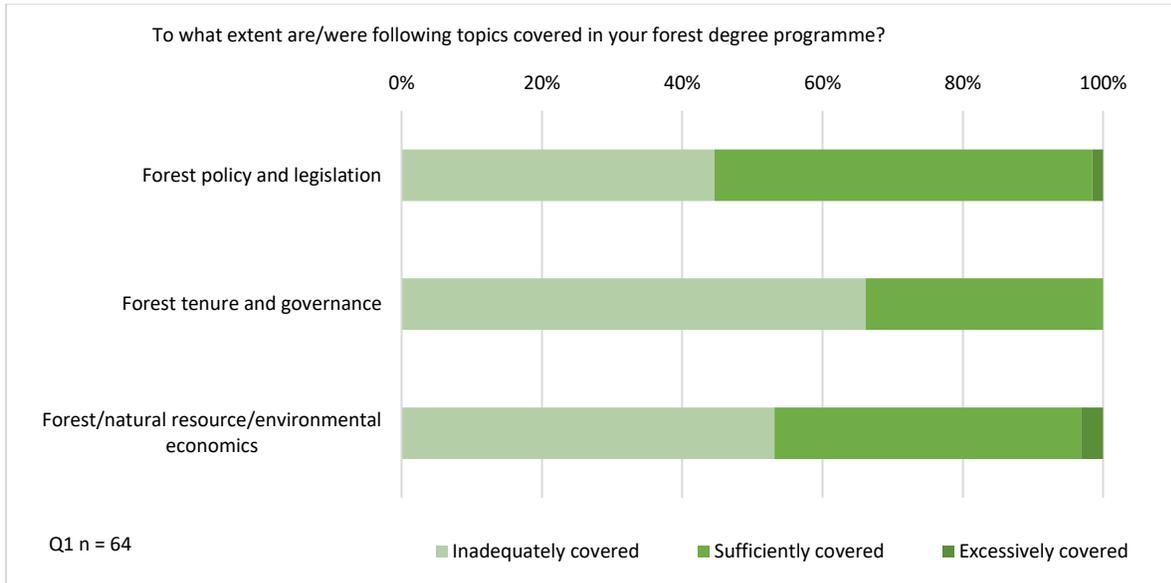


Figure A80. Workforce readiness within university and college programme (All levels)

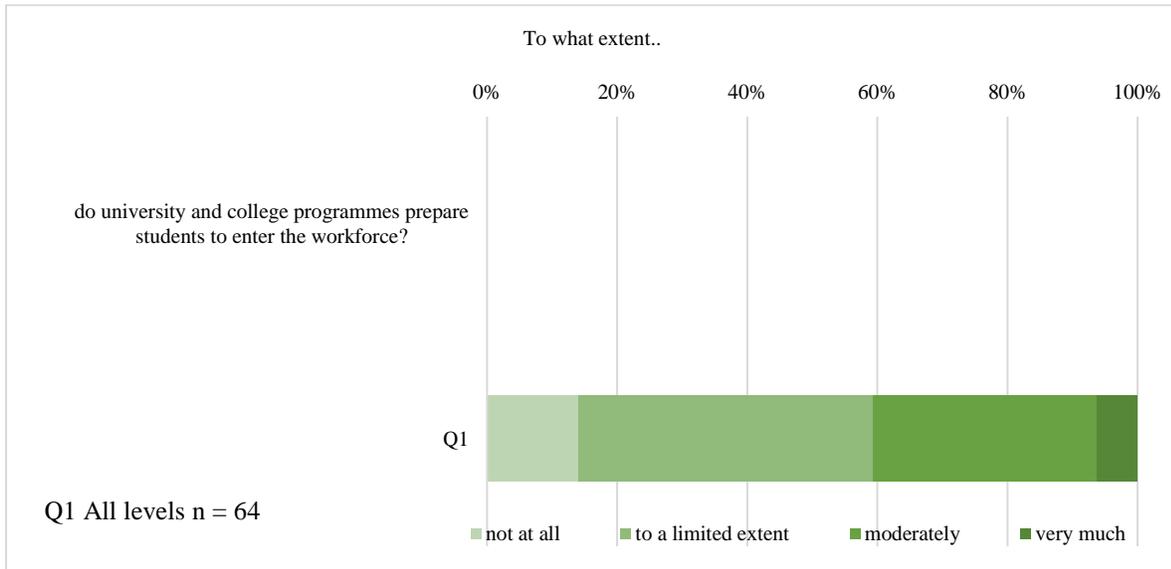


Figure A83. Gender as a factor and influence in forest-related employment (All levels)

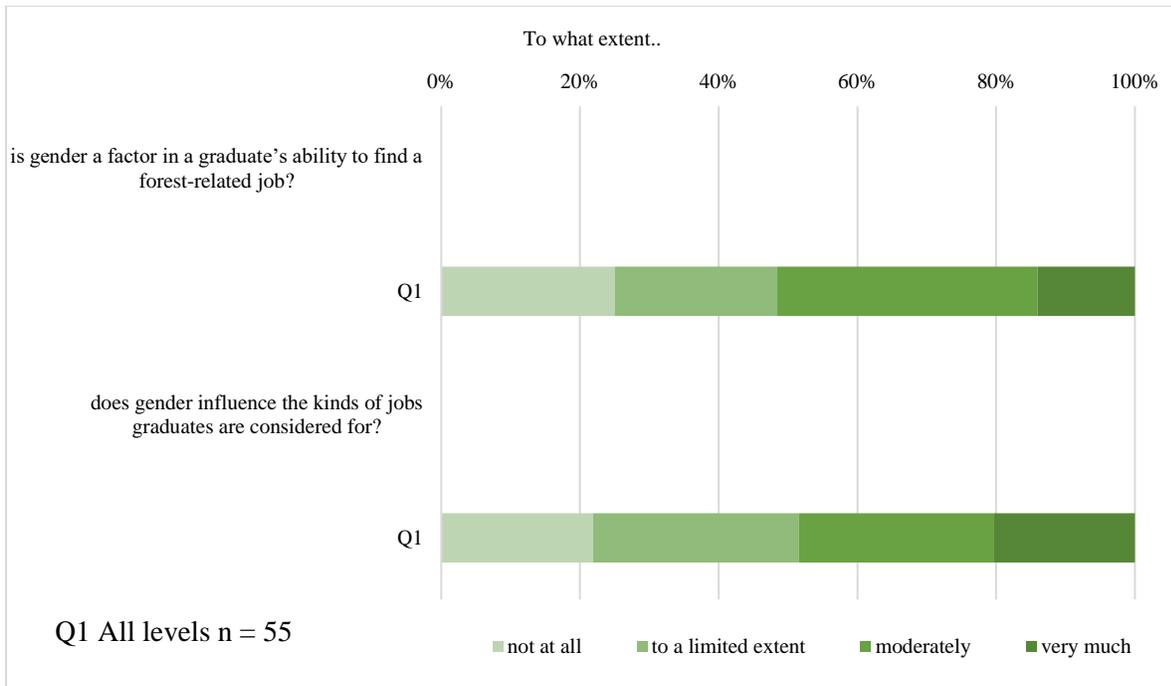


Figure A86. Race or ethnicity as a factor and influence in forest-related employment (All levels)

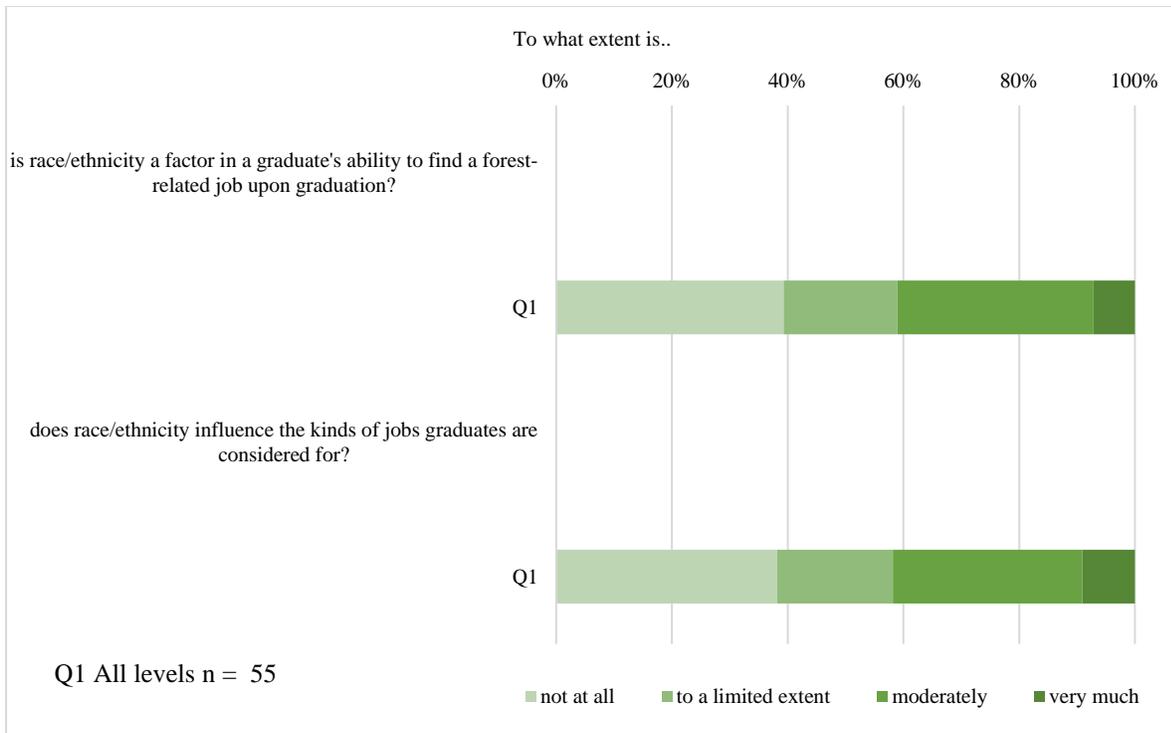


Figure A89. Availability of affordable continuing non-formal forest education (All levels)

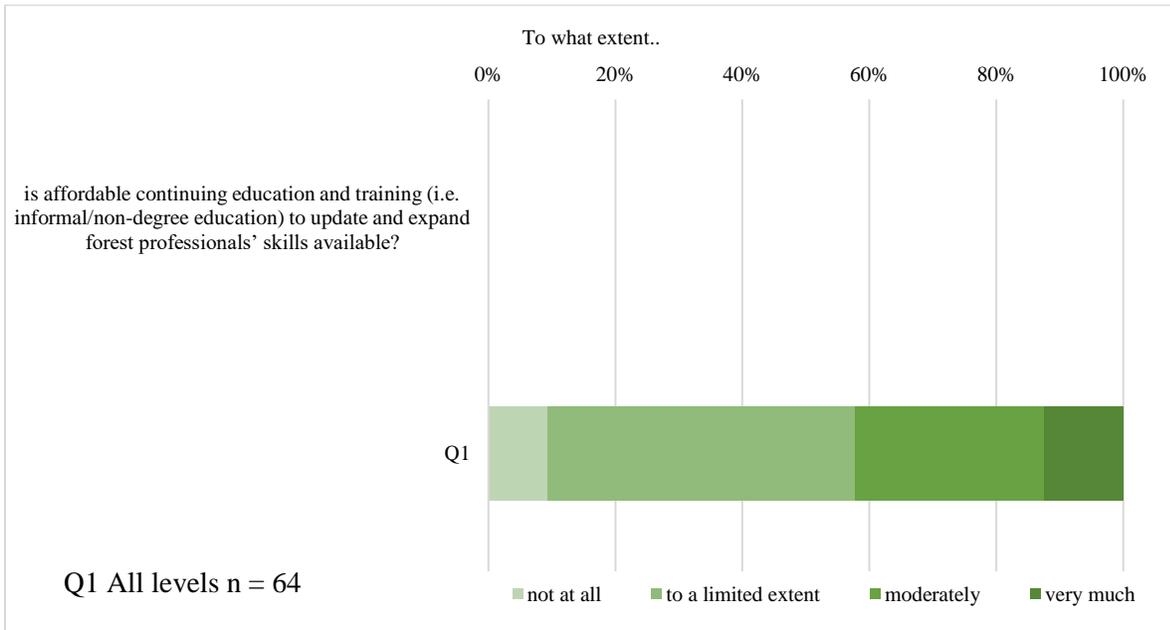


Figure A92. Overall trend in student enrollment in forest-related programme (10-year period) (All levels)

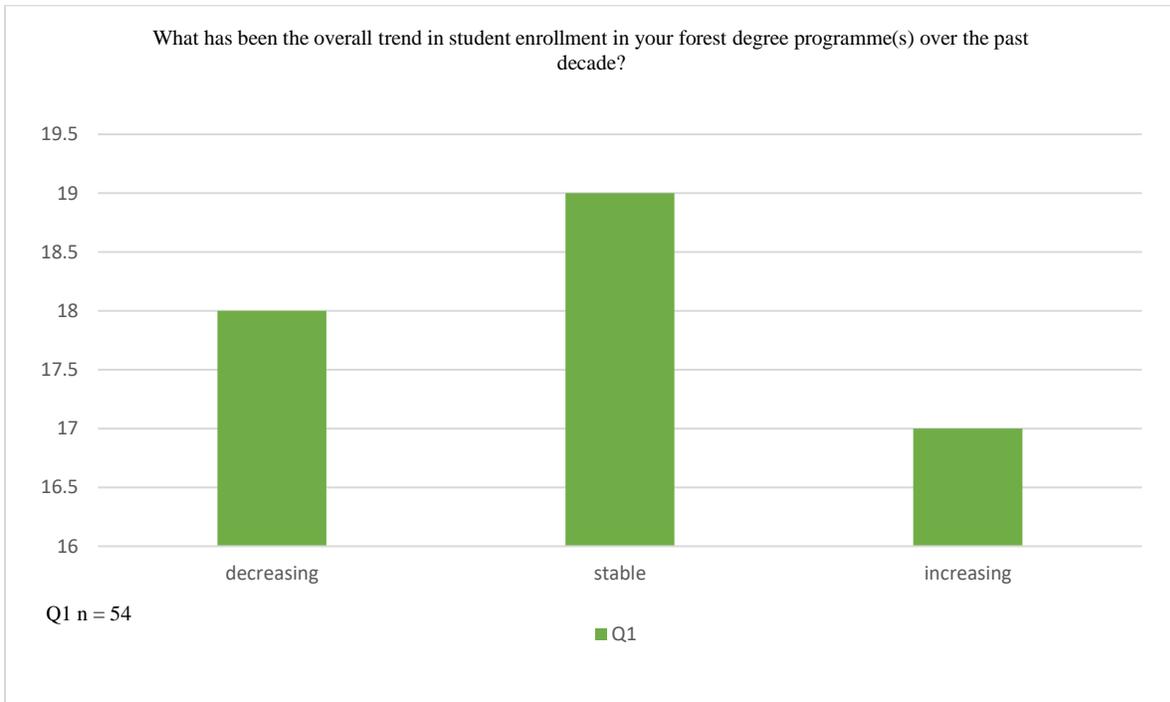
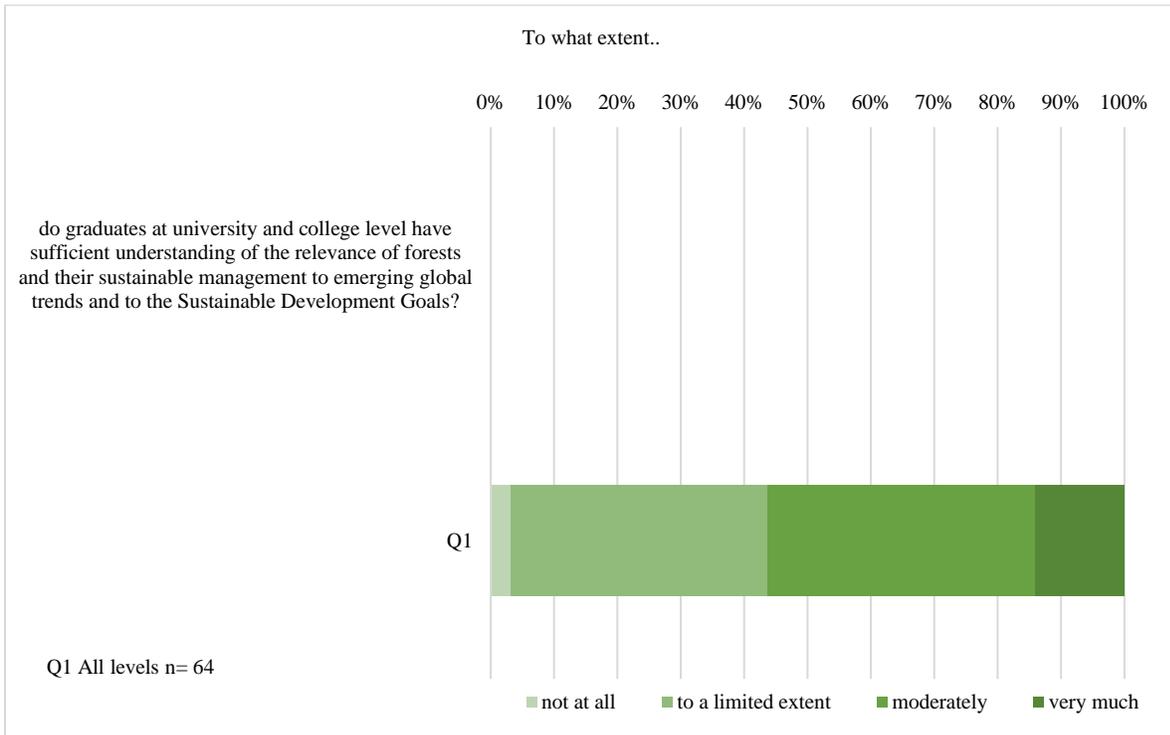


Figure A95. Graduates' understanding of forests' relevance to emerging trends and SDGs (All levels)



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