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## D 5.3 DEVELOPMENT OF EXPERIMENTS/SIMULATIONS AND TRAINING MATERIAL WP5 - DEVELOPMENT OF INFRASTRUCTURES



## Deliverable 5.3. Development of experiments/simulations and training material

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## EXECUTIVE SUMMARY

Educational material that supports the laboratory, software-based exercises and projects designed for the students of the MSc STEPS programme at the Partner Countries HEIs has been developed. The material provides learning outcomes at experiment/simulation level, detailed description of experiments/simulations, guidance and description of STEPS, i.e., measurement protocols, tutorials, sample reports and scenarios for additional exercises and further research activities. For each of the experiments and simulations from the MSc STEPS syllabus, training material was developed by scientific staff involved in the development of the two laboratories, “*Food Quality Control Lab*” and “*Food Production Systems Management Lab*”. UNBI, as the lead organization of WP5, provided guidelines for the implementation of task 5.3 to all partner country HEIs. These guidelines mainly included detailed instructions related to harmonizing the development of experiments/simulations and training material with the syllabi of the MSc STEPS program and the theoretical part of the courses (task 4.2), as well as the connection with purchased STEPS equipment. UNBI also pointed out the importance of submitting all documents related to the development of experiments/simulations and training material at partner countries HEIs.

## 1 INTRODUCTION

### 1.1 *Aims and objectives of STEPS project*

The main objective of the project is the implementation of a modern MSc programme on “Sustainable food production systems”, compliant with the Bologna convention. Food culture and sociology, agriculture and rural development, food engineering, quality and safety, environmental footprints, economics, management and governance will be combined in a flexible and modular educational programme, designed and developed in the light of the European initiative for the transition to circular economy. The project supported Partner countries HEIs in order to help them provide an education aligned to the needs of the labour market and society. Laboratories were equipped with experimental devices, computers and software while scientific staff of the HEIs involved in the consortium had the opportunity to enrich their scientific background and be familiarized with modern educational methodologies and ICT tools, used for preparing educational preparing of high quality.

### 1.2 *Development and Experiments/Simulations and Training material in Partner Countries HEIs*

Scientific staff of HEIs partner countries (AUT, EUT, UHZ, UC, UNSA and UNBI) supervised and mentored by the scientific staff from the program countries (USAMVB, CULS, TEISTE and ReadLab) designed Educational material - laboratory and software-based exercises and projects, with the aim of ultimately exploiting the purchased STEPS equipment and further improving the level of knowledge and the relevance of a variety of courses.

For each of the experiments and simulations from the MSc STEPS syllabus, educational and training material was developed by scientific staff involved in the development of the two laboratory types, “*Food Quality Control Lab*” and “*Food Production Systems Management Lab*”.

Scientific and technical staff of AUT, UHZ and UNBI, mentored and supervised by scientific staff of USAMVB and ReadLab developed experiments and training material related to the exercises/projects designed for the *Food Quality Control Lab*. Scientific and technical staff of UET, UHZ, UC and UNSA, mentored and supervised by scientific staff of CULS, TEISTE and ReadLab developed simulations and training material for exercises/projects designed for the *Food Production Systems Management Lab*.

Assisted by UNSA, UNBI provided guidance to align educational material with the theoretical part of the courses (*task 4.2*). Developed training material is based on learning outcomes at the experiment/simulation level and they include detailed description of the experiments/simulations, guidance and description of steps towards the successful implementation of the activity, samples as well as samples of the results and scenarios for additional exercises and research.

#### ***Task progress monitoring***

The progress of the tasks was monitored based on the below listed indicators:

- ✓ *the number of facilities/software licenses purchased and installed,*
- ✓ *the number of laboratory experiments and software simulations designed,*
- ✓ *the number of training/manuals developed.*

For the purpose of impartial collection and satisfaction level data analysis regarding the STEPS equipment, UNBI designed an online survey for all HEIs partner countries ([link](#)).

The survey was conducted by scientific staff of Partner Countries HEIs and MSc students/attendees during the implementation of the MSc programme. In the surveys, the participants were inquired about the level of satisfaction regarding the equipment installed, its number and the level at which the equipment supports the courses, its relevance with respect to modern approaches and applications, as well as the level at which they provide significant benefits compared to the previously existing laboratory equipment. Also, they were also asked if the equipment can simulate industrial applications or can be directly used by private companies during common projects and research activities. The data, collected via surveys, were analyzed and presented separately for each Partner Country HEI in in the chapters below.

## **2 DEVELOPMENT OF EXPERIMENTS/SIMULATIONS AND TRAINING MATERIAL IN ALBANIA**

### **2.1 *Development of experiments/simulations and training material at Agricultural University of Tirana (AUT-P1)***

Under the task WP5 and the activities 5.3 Development of experiment /simulation and training material that focus on the practical part of the syllabus, all the academic staff involved in the Master of Science prepared material in written and demonstrative form. All the material is available in the LMS platform under each module, in order to be used for experiments and simulations that support specific exercises, in accordance to the syllabus of courses presented in D4.3. The curricula of the MSc program “Sustainable Food Production System “(STEPS), has been prepared by both the Albanian Universities as well as by the HEIs participating in the Consortium, in order to support the Joint Master Thesis. During the project lifetime, training for the laboratory devices has been organized and helped the academic and technical staff, to create and to produce better written and demonstrative material. The following courses include laboratory exercises and simulations in the Joint MSc programme implemented in Albania, supported by equipment funded by the STEPS project.

**i) Advanced Food Science and Technology**, 1st semester compulsory course. In the practical part, the student will have the possibility to design new technology in the production of the products based on the sustainable technology, e.g., apples drying using different technologies, oil extraction, grain milling etc. In this course 12 laboratory exercises are prepared related to hurdle technology applications, new emerging preservation technologies; main characteristics and importance of the use of new technologies in the food industry, storing food quality with a low-cost processing, and studying trends in food processing are topic which will be concretised in the practice with ideas of food design using an integrated approach comprising hurdle technology, applications for food preservation. To evaluate the effectiveness of the process, analyses will be done as the determination of protein with the Kjeldahl, the determination of moisture with the Moisture analyser, and the determination of the pH with the ph meter or the crude oil with the Soxhlet equipment. All these devises were purchased with the STEPS project.

**ii) Development of new products**, 3rd semester, elective course. This course will help the students with some great practical ideas in order to produce new product that will have nutritional value added and accepted by the consumer. They will also help reduce waste in the food industry, using some of their waste in the production of new products. An example would be the production of bread or biscuits with pomegranate skin flour, etc. In this course 10 laboratory exercise and practical material are being prepared. To evaluate the new products, some analyses will be done

to determine some nutritional value that are added to the new products for example: the determination of protein with the Kjeldahl, the determination of moisture with the Moisture analyser, and the determination of the pH with the ph meter or the crude oil determination with the Soxhlet equipment, determination of the colour of the new products if it is acceptable for the consumers with the colorimeter. All these devises were purchased with the STEPS project.

**iii) Development and management of quality systems and evaluation of shelf life of food products**, 2nd semester, compulsory course. In this course, the professors are preparing some experimental material, where with the determination of some chemical, physical and sensorial properties, the evaluation of the shelf life for the food production will take place. To see the differences that will take place or the change in the food products from the shelf life some analyses will be done as: the determination of protein with the Kjeldahl, the determination of moisture with the Moisture analyser, and the determination of the pH with the ph meter or the crude oil determination with the Soxhlet equipment, determination of the colour of the products with the colorimeter etc. All these devises were purchased with the STEPS project.

**iv) Traceability Systems of Food products**: Elective course, planned for the first year, second semester. In the last decades the safety and quality of food has become a very important issue because the number of diseases originating from food, food allergies and the production of genetically modified products has increased significantly. Therefore, in order to protect the health of the consumer and also to meet the demands for trade between countries, it is important to implement a traceability system throughout the food chain or the so-called "From farm to fork". The course "Traceability systems of Food products" is design for students of the Scientific Master "Sustainable food production Systems". The first part of the module introduces students to the concept of traceability, objectives and relevant legislation and regulations in Albania and EU countries. The second part of the module gives the student information about new techniques based on DNA molecule, immunological technique (ELISA) etc. and their application in different food products to realize the traceability and authentication of these products. The third part of the module analyse the use of analytic technique such as ICP-MC in food traceability. The theoretical script was prepared from the responsible lecture of the module. In accordance with the theoretical part of this course, a detailed description of the experiment/simulation is prepared e.g., using ELISA technique (ELISA reader was purchased with the STEPS project budget) for the identification of allergen in food, PCR technique for the determination of bacterial pathogens in food etc.

**v) Environmental chemistry**. Elective course, planned for the first year, second semester. This course aims to acquaint students with the risk assessment of pollutants in the chain of food production, main properties and characteristics of chemical and biological pollutants, techniques chemical and biological methods used to investigate and prevent these pollutants. Particular attention will be paid to general scientific principles and methods as well as special professional knowledge needed to understand the potential sources of these pollutants within the food production chain as well as on the ways of their management. This course will also cover aspects on environmental chemistry and environmental pollution, assessment the risk of contaminants and food waste, organic pollutants, agricultural waste, heavy metals and metalloids, microbiological pollutants, mycotoxins, phytotoxins and pollutants of plant origin, some of them with experimental evaluation, in a qualitative and quantitative method.

Google Drive Link: <https://drive.google.com/drive/folders/1PLiMLgAJnBv2Y3DfHeK7jSTgDzZNzSli>



### 2.1.1. Progress of the task

The Faculty of Biotechnology and Food at the Agricultural University of Tirana, where the Master of Science "STEPS" is implemented, has some scientific laboratories where academics, technical staff and PhD students work within the framework of the research development process. The equipment purchased in the frame of the STEPS project is an added value for the HEI because it will help the interested parties (academics, technical staff and PhD students) to continue and improve their research.

All the equipment purchased in the framework of the STEPS project has been installed. Laboratory manuals have been created for them, explaining the way of working and the types of analyses that can be performed. So far, a total of 12 short manuals have been created. These manuals will be used by the students of the Master of Science STESP course to prepare and conduct the analyses. During the seminars and laboratory demonstrations, they will receive training. Each year, more than 60 individual laboratory exercises will be carried out using equipment obtained through STEPS projects.

### 2.1.2. Collected data on the level of satisfaction regarding the STEPS equipment

After the beginning of the STEPS program in the AUT, and giving time to the lectures to develop some of the lectures/seminars and laboratories, a survey was contacted to evaluate the satisfaction of the staff and technical staff with laboratory equipment

([https://drive.google.com/drive/u/0/folders/1NCrCVqZpeJgE\\_RScthcGmqrwqHgyCV5h](https://drive.google.com/drive/u/0/folders/1NCrCVqZpeJgE_RScthcGmqrwqHgyCV5h)).

The target group were the academic staff that is developing the program of the first semester and also the academic staff that will be part of the other semester. They are known for the laboratory equipment bought from the STEPS projects from the information taken by the STEPS TEAM. For this purpose, all the academic and technical staff have been able to work with the equipment to develop the experiment or layout new experiment methodic. Also in the target group were the technical staff that will work with the equipment. All the results are presented below:

Have you been able to work with the new STEPS equipment?

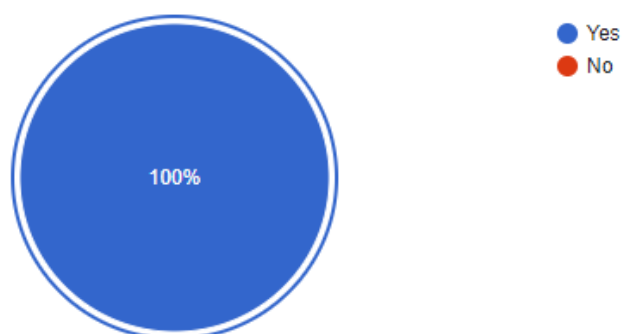


Figure 1. Result from the staff's questionnaire regarding the question: "Have you been able to work with the new STEPS equipment?"

Are you satisfied with the new installed equipment purchased under the STEPS project?

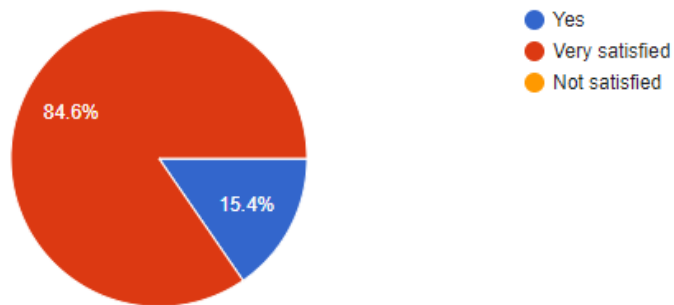


Figure 2. Result from the staff's questionnaire regarding the question: "Are you satisfied with the installed equipment purchased under the STEPS project.?"

In the second question, the staff was asked regarding their satisfaction with the newly installed equipment purchased under the STEPS project and 84.6 % of them said that they were very satisfied because most of the devices are new for the faculty so they are very valuable.

Does the new "STEPS" equipment support the syllabus of the Master study program "SUSTAINABLE FOOD PRODUCTION SYSTEMS"?\*

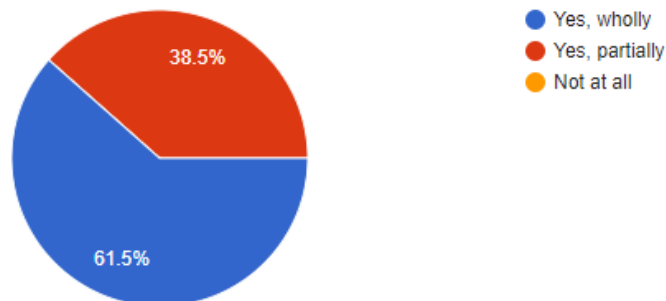


Figure 3. Result from the staff's questionnaire regarding the question: "Does the new "STEPS" equipment support the syllabus of STEPS MSc programme?".

Regarding the third question on the support of the equipment for the syllabus, 61.5% said that the laboratory devices are totally supporting what they need in their syllabus and 38.5 % fulfill the request partially.

Will the new STEPS equipment facilitate the introduction of new standardized methods in your laboratory?

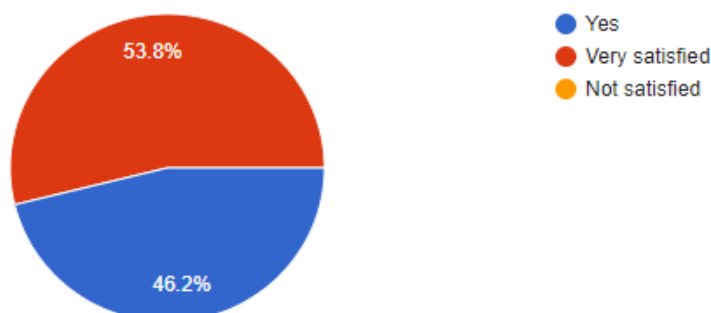


Figure 4. Result from the staff's questionnaire regarding the question: "Will the new STEPS equipment facilitate the introduction of the new standardized method in your laboratory?"

Does the new STEPS equipment provide modern access to modern instrumental methods and applications?

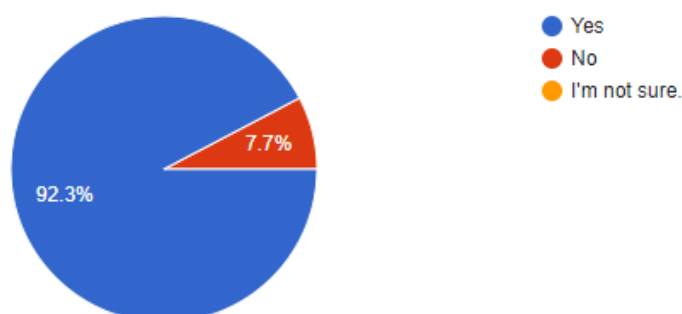


Figure 5. Result from the staff's questionnaire regarding the question: "Does the new STEPS equipment provide modern access to modern instrumental method and application?"

Figure 5 indicates that 92.3 % of the persons involved in the survey answered that the STEPS equipment provides modern access to modern instrumental method and application.

For the question "What are the advantages of the newly installed STEPS equipment compared to the existing laboratory equipment in your laboratory?", some of the most often answers include:

- With the new equipment (ELISA reader) purchased with the STEPS project, we can detect in a short period allergen in food, the presence of bacteria or viruses.
- Are new equipment and very helpful
- Modern instrumental compared to the other one
- Research work,
- Are more sustainable with the environment as the Kjeldahl equipment
- Yes, they help to give fast and exact results.
- Fast and accurate data. Sustainable with the environment.
- Yes, some of them are very efficient.

Does the new STEPS equipment provide optimal conditions for scientific research and development projects?

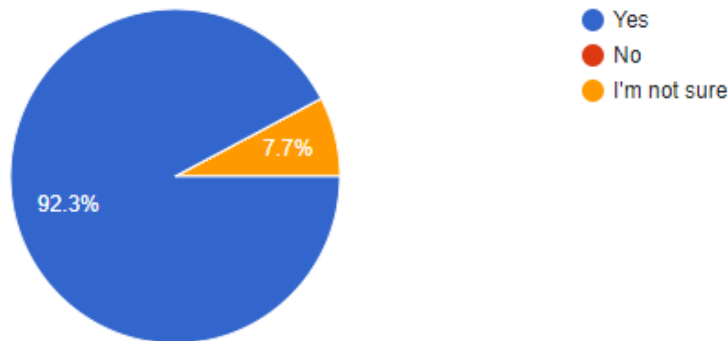


Figure 6. Result from the staff's questionnaire regarding the question: "Does the new STEPS equipment provide optimal condition for scientific research and development projects?"

As some of the STEPS laboratory devices are new for the academic and technical staff, they will provide optimal conditions for scientific research and the development of research projects. The academic and technical staff are very optimistic about the new device and have done all the training necessary to use the equipment correctly. Only 7.7 % of the persons that took part in the survey responded that they are not sure if the device will provide them with optimal condition for scientific research and development projects. This 7.7 % is because their field of research is not related with this type of equipment but as they are part of this study program, they will use the equipment and will be part of the other 92.3 % of the academic and technical staff who think that this equipment will provide condition for scientific research and will help to develop research projects.

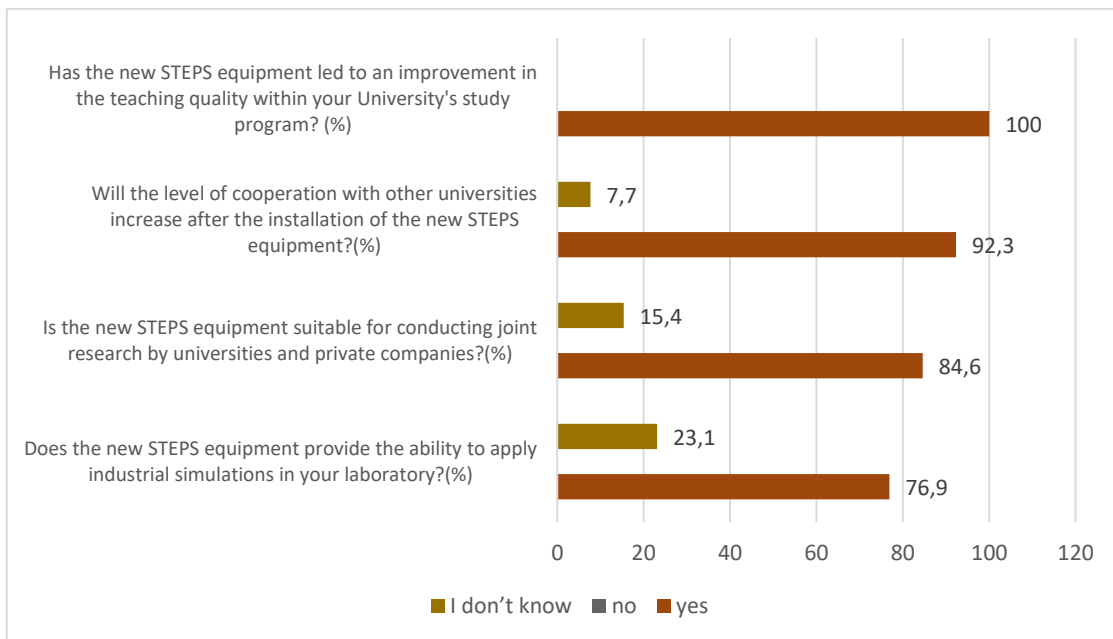


Figure 7. Results from the staff's questionnaire (grouped questions).

As is seen from figure 7 above, have and will lead to improving the teaching quality at the Faculty of Food and Biotechnology, the Agricultural University of Tirana where this Master's will be developed because some of the devices were new for the faculty and will help to improve not only the teaching but also the research field.

Most of the staff, 84.6 % of them, think that the new device will increase cooperation and collaboration with other universities in Albania and abroad, and also for the private sector. Regarding the question, of whether the STEPS equipment will provide the ability to apply industrial simulation in the laboratory, 76.9 % of the staff answered yes and 23.1 % said that they don't know. This result happens because not all the academic and technical staff is in contact with the private sector, because of their field of study and field of research and this is why they don't have the capacities to understand this process. But in the future, as they are part of this Master of Science they will be in collaboration with the other staff (76.9%) and will be able to understand better the importance of this process.

The second survey was done evolving the students of the STEPS master.

([https://drive.google.com/drive/u/0/folders/1NCrCVqZpeJgE\\_RScthcGmqrwqHqyCV5h](https://drive.google.com/drive/u/0/folders/1NCrCVqZpeJgE_RScthcGmqrwqHqyCV5h)). They have answered some questions regarding the equipment, their usage and the importance of this equipment in their research and teaching field. The survey was conducted on December 2022, because we allowed the students to work with the equipment to complete the survey correctly.

The result of the survey was collected according to the same option of the answer and are presented in the graphic below.

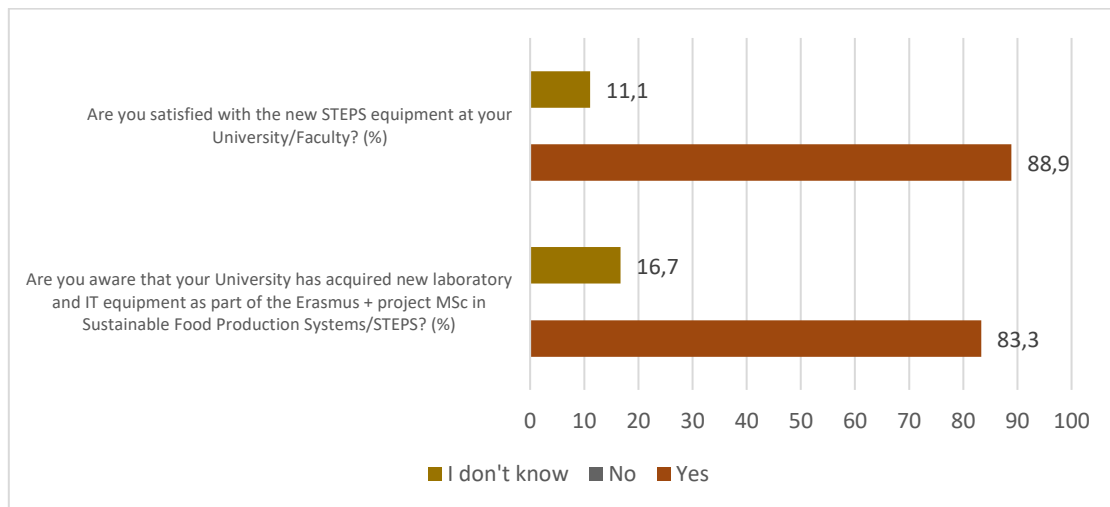


Figure 8. Results from the students' questionnaire (group 1).

The first question was for the students to let know if “they were aware that the university has acquired new laboratory and IT equipment as part of the Erasmus + project MSc in Sustainable Food Production Systems/STEPS”, and 83.3 % of the students answered yes. 16.7 % of the students answered that they don't know because they haven't been part of all the lectures and seminars due to their problems. Regarding the question, if the students “are satisfied with the new STEPS equipment at University/Faculty”, 88.9% said that they are satisfied and 11.1 % aren't sure because they answered don't know.

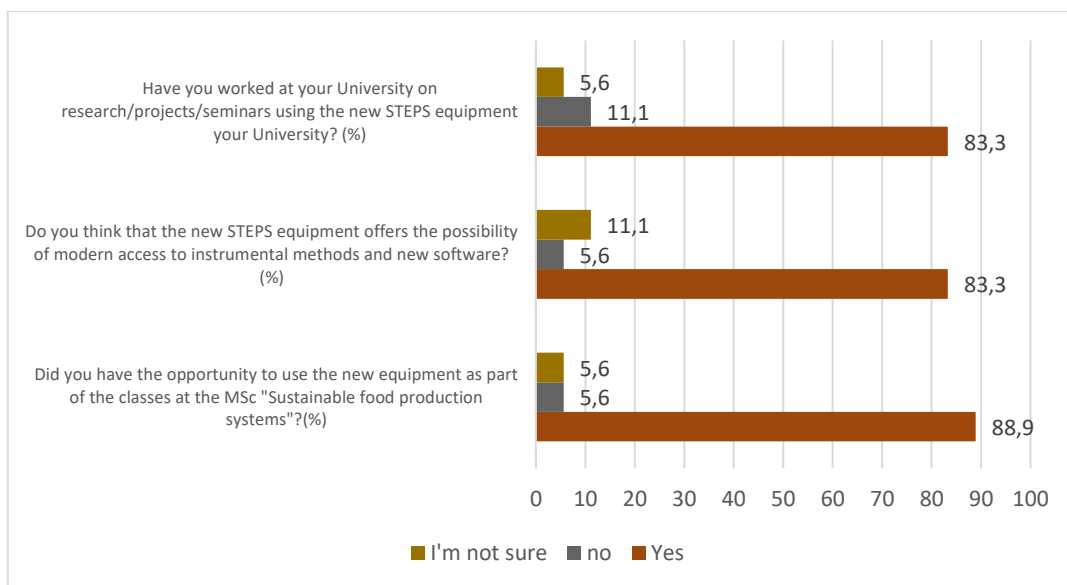


Figure 9. Results from the students' questionnaire (group 2).

Regarding the question “Did you have the opportunity to use the new equipment as part of the classes at the MSc "Sustainable food production systems"?” 88.9 % of the students have chosen positive answers and for option no and I’m not sure, the students have chosen equally 5.6 % for each option. To the question “Have you worked at your University on research/projects/seminars using the new STEPS equipment your University?”, 83.3 of the students have given positive answers, 11.1 negative answers because they have chosen option no and 5.6% of the students weren’t sure.

Regarding the question “Do you think that the new STEPS equipment offers the possibility of modern access to instrumental methods and new software?”, 83.3 % of the students have chosen the answer, yes, 11.1% of the students weren’t sure and 5.6 % gave negative answers.

**Do you think that the new STEPS equipment supports the syllabi of the Master study program "Sustainable food production systems"?**

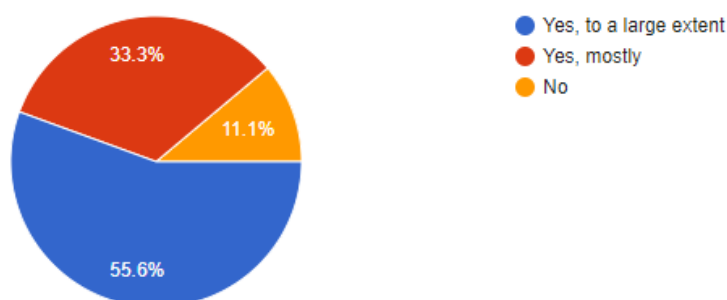


Figure 10. Result from the student's questionnaire regarding the question: “Do you think that the new STEPS equipment supports the syllabi of the STEPS Master?”

To the question of the survey, “Do you think that the new STEPS equipment supports the syllabi of the Master study program STEPS, 55.6% of the students have chosen the answer yes, to a large extent, 33.3% yes, mostly and 11.1% have given negative answers.

**Did this new STEPS equipment help you expand your knowledge in the field of food quality control and management in food production systems?**

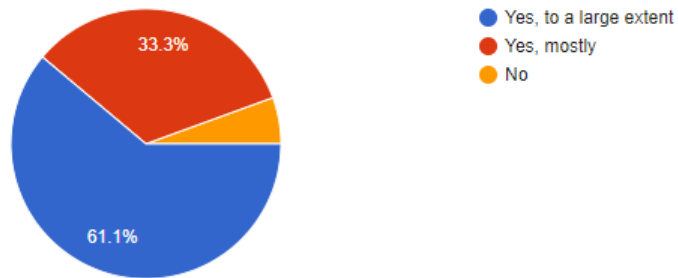


Figure 11. Result from the student’s questionnaire regarding the question: *Did this new STEPS equipment help to expand the knowledge in the field of food quality control and management in food production system*

For the question “Did this new STEPS equipment help to expand the knowledge in the field of food quality control and management in food production system” 61.1% of the students were sure that this equipment bought with the STEPS project will help to a large extent the knowledge in the field of food quality control and management in the food production system. 33.3% of the students have chosen the option yes mostly and only 5.6 % have chosen the negative answer.

**Did you use new STEPS equipment when writing your master thesis?**



Figure 11. Result from the student’s questionnaire regarding the question: *Did you use new STEPS equipment when writing your master thesis*

For the question regarding the usage of the STEPS equipment when writing the master thesis, most of the students have chosen the option that they are not at the phase of the Master Thesis preparation because the Master of Sustainability In food Production, is at the first semester and the Master Thesis will be prepared in the second semester of the second year. Only 11.1 % have chosen the option yes because these students have good knowledge of the food production system and want to expand their knowledge in sustainability. They have chosen their subject for the thesis and have started their first experiments with the STEPS equipment.

**Do you think the new STEPS equipment is applicable for industrial simulations and project implementation together with the private sector?**

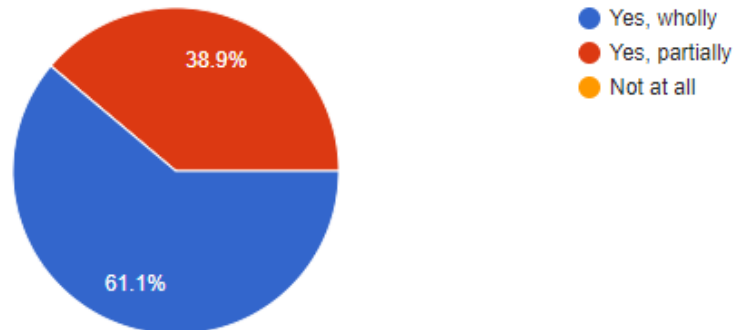


Figure 12. Result from the student's questionnaire regarding the question: Do you think the new STEPS equipment is applicable for the industrial simulation and project implementation together with the private sector?

For the last question regarding if the new STEPS equipment is applicable for industrial simulation in the private sector, 61.1% of the students were wholly sure and 38.9 were partly sure.

### Conclusions

After analyzing the result given by the academic and technical staff in the first survey and from the students in the second survey, we can summarize that the new Equipment that was purchased and installed from the STEPS projects have contributed to increase the quality of teaching and researching in the Faculty of Food and Biotechnology, Agricultural University of Tirana. The students of the Master of Science STEPS, and not only, have the possibility to develop their knowledge in the laboratory analyses and evaluating the quality of food products using this equipment. In conclusion, the laboratory equipment provided at the University of Tirana from the STEPS projects, has increased the research ability of the academic staff and also to the students. Also, it will increase the collaboration with the private sector by providing scientific expertise and laboratory simulation as one of the goals of the STEPS projects.

### **2.2 Development of experiments/simulations and training material at European University of Tirana (EUT-P2)**

European University of Tirana designed and developed experiments/simulations for the following courses/modules:

- i) Quality Management in the Agro-Food Sector:** In the topic Techniques and Methods of MCT - students will develop a practical project for a certain quality problem in a business company. They will use some of the techniques and methods of MCT, including the Pareto diagram, cause-effect diagram, etc. to identify the main causes and to build procedures for their solution. In the topic Tracking and Hygiene Systems - students will work in groups of practical tasks related to the ISO 22000 Standard, focusing mainly on the general requirements that must be met by the Food Safety Management System of an agro-food business, risk control through pre-programs, HACCP plan and continuous improvement.



**ii) Marketing of Sustainable Agro-Food Products:** Topic 9 addresses the various objectives of pricing, and then proceeds with the theory of pricing. It goes further with the factors that influence the setting of prices, as well as with the methods that are mostly used in setting prices. It also shows the different strategies used by companies, using pricing as a basis. Pricing methods are based on three main factors which are Demand, Cost, and Competition. Here, all three methods will use analytical techniques, and mathematical equations to find the right price for food companies. At the same time, it is foreseen to have guests in the auditorium, from a food company in our country, and a site visit to such a company as well.

**iii) Innovation and Entrepreneurship for Sustainable Food Production:** elective course in the 3ed semester. The practical part of the course refers to developing a business plan where the students will outline management and organization, provide logistics and operations actions, staffing, taxes, and government regulations (all necessary for protecting their businesses). Students then will move into marketing, investigating how to persuade others to buy their products and services and learning how to manage an existing business.

**iv) Data Analysis and Decision-Making:** **a)** Based on historical data on the production performance of one of the business products over the years, evaluate the central trend with statistical methods for time series analysis. **b)** Referring to a product (milk, cheese, etc) for a period of three years, evaluate the seasonal ingredients according to statistical analysis. In the role of decision maker define the business perspective.

**v) Sustainable Management of Supply Chain:** For selected business from students, define the supply chain referring to the modelling, design, execution, control, and monitoring of the respective activities with the aim of establishing the successful supply chain. Calculate the respective cost of the chain.

**vi) Sustainable Management of Value Chain of Food:** For a specific business, define: supply and value chain, determine the impact of the present competition, determine the impact of potential competition, what are the possibilities of your indication as a manager to minimize impact and competition, make an assessment of your decision-making.

### **2.2.1. Progress of the task**

EUT has upgraded and fully equipped ICT Centre and Laboratory with PC's, hardware tools, server and security system. This Centre is utilized by lecturers and students for learning and teaching purposes for the STEPS Master programme. In addition, it can be utilised in cooperation with interested stakeholders in food production system in order to develop experiments and practical exercises. This ensures a practical and learning based approach and links to the labour market. These upgraded facilities will support the installation of analytical software's and the Learning Management System (LMS). Due to the nature of the courses offered by EUT (related to the Sustainable Food Production Systems profile of the master study programme), the development of experiments/simulations and training material at European University of Tirana, is related to some specific courses, as illustrated in the section 2.2 above. Currently, training materials for six courses have been prepared by academic staff, with the support of administrative staff (IT experts).

During the implementation of the study programme, the prepared training/laboratory materials for the six courses will be delivered to the students. These manuals are focused mainly on: Techniques and Methods of MCT; analytical techniques, and mathematical equations for pricing; developing of a business plan; statistical analysis based on historical data; calculation of the respective cost of the sustainable management of value chain of food. The ICT Centre and Laboratory infrastructure will be used for research, master thesis preparation

and joint activities between academic staff, students and labour market representatives. Based on the syllabus and academic plan, a total of 18 exercises/ simulations will be organized, with the participation of the lecturer and the students enrolled in the course.

### **2.2.2. Collected data on the level of satisfaction regarding the STEPS equipment**

With the aim to assess the level of satisfaction regarding the STEPS equipment, EUT conducted an additional survey in order to assess the “Level of satisfaction with the new equipment purchased within the Erasmus+ STEPS project” ([https://docs.google.com/forms/d/e/1FAIpQLSfmyPM6X49RD7P2oY3GCLng4HWPlmEF0CY9pbCmbqaV\\_Zk86g/viewform?vc=0&c=0&w=1&flr=0](https://docs.google.com/forms/d/e/1FAIpQLSfmyPM6X49RD7P2oY3GCLng4HWPlmEF0CY9pbCmbqaV_Zk86g/viewform?vc=0&c=0&w=1&flr=0)).

The target groups was Scientific/Teaching/Technical staff of EUT. Results of the survey are summarized in the following:

- The results of the first question: "Have you been able to work with the new STEPS equipment?" showed that all respondents have used the new STEPS equipment.
- Regarding the question: “Are you satisfied with the new installed equipment purchased under the STEPS project”, the majority of the respondents (83.3%) declared that they are satisfied, and others (16.7%) declares that are very satisfied.
- All the respondents agree that the new STEPS equipment support the syllabus of the Master study program ‘Sustainable Food Production Systems’.
- All the respondents agree that the new STEPS equipment led to an improvement in the teaching quality. With the new equipment, EUT has improved its infrastructure capabilities, which will impact the quality of teaching, will give opportunities for students to test and implement their theoretical knowledge in practical assignments
- All respondents declared that the new STEPS equipment provide modern access to modern instrumental methods and application. It is expected that the newly installed equipment has a direct impact in increasing infrastructural capacities of EUT, which will contribute to the teaching quality of the study program.
- All the respondents agree that the new STEPS equipment provide optimal conditions for scientific research and development projects.
- The majority of the respondents (66.7%) declare that the new STEPS equipment provides the ability to apply industrial simulations in the laboratory, and the others (33.3%) declare that they don’t know. This aspect must be investigated again during the delivery of the study program, in order to understand if the ability (or not) of the equipment to apply industrial simulations is related to the nature of the course (in some courses, which are more theoretical, it is not mandatory or necessary for industrial simulations) or the purchased equipment are not adequate for the specifics of the course.
- All respondents declared that the new STEPS equipment is suitable for conducting joint research by universities and private companies.
- All respondents declared that the new STEPS equipment will facilitate the introduction of new standardized methods in your laboratory (83.3% yes and 16.7% very satisfied).
- Regarding the answer for the question “Will the level of cooperation with other universities increase after the installation of the new STEPS equipment?”, the majority of the respondents declare yes (83.35%) while the remaining percentage declare that they don’t know (16.7%). Increasing the infrastructural capacities will have a direct impact on the level of cooperation with other universities, because HEI’s will have the opportunity not only to exchange knowledge, but also, they can work on joint activities, supported by an improved infrastructure.

### 3 DEVELOPMENT OF EXPERIMENTS/SIMULATIONS AND TRAINING MATERIAL IN KOSOVO

#### 3.1 *Development of experiments/simulations and training material at University Haxhi Zeka (UHZ-P3)*

Considering the activities related to WP5 (Development of experiments/simulations and training material) UHZ teaching and research staff has developed teaching material and instruction materials for laboratory classes as well as software stimulations. All these activities were prepared immediately after accreditation of the study program MSc Sustainable Food Production Systems/STEPS. Training, open lectures and seminars organized as foreseen in WP3 (D3.2.) have a great impact on the development of material and practical work of the students. The UHZ staff attended seminars and HEIs staff from the program countries (USAMVB, ReadLab, CULS, TEISTE/AUA) conducted lectures on different subjects. The experience and know-how gained from these lectures as well as from open lectures trainings presented in Peja, Sarajevo and Bihac were very useful for UHZ staff in improving teaching techniques and laboratory exercises. Experiments/simulations and training material were designed before the beginning of the teaching process, and are completely in accordance with the compulsory and elective subjects in the syllabi. The material was developed for those subjects that have a practical part in their teaching content-syllabus, including practical, computational or laboratory exercises in the field of Food Quality Control Lab as well as software simulations in the field of Food Production Systems and Management Lab. Students use laboratory equipment and computers, which UHZ benefited from the STEPS project. Apart from teaching and laboratory activities, since October 2021, the teaching staff emphasized very much in developing and implementation of the practical part of the syllabi especially for those subjects where practical classes in laboratory and production facilities are necessary. Staff responsible for both compulsory and elective courses organized collaboration through working visits to specific public and private institutions in the 1st and 2nd semesters.

MSc students from UHZ attending the study program “Sustainable food production systems” are already using experiments/simulations and training material for the following compulsory and elective courses in the 1<sup>st</sup> and 2<sup>nd</sup> semesters, as follows:

- i) Fundamentals of Sustainable Agri-Food Systems – 1st-semester compulsory subject:** Based on the theoretical part of this course educational material was created which includes a detailed description of the experiment/simulation guidance for successful implementation of exercises and research related to Life-cycle Assessment. This material includes also information about collecting, analysing and monitoring the sustainability efficiency data of the company’s products and services, decision-making, changing products’ life cycles for the better, and improving the company's positive impact.
- ii) Agricultural and Food Industry Waste Management - 1st - semester compulsory course:** Training material in the form of an authorized script for laboratory exercises entitled Waste Management in Agriculture and Food Industry was prepared. Apart from general guidelines, this material includes detailed laboratory exercises in to be used by students during practical work.
- iii) Advanced Food Science and Technology - 1st - semester compulsory course:** A script entitled “Achievements in Food Science and Technology” was developed based on the syllabi of this course. This script includes 20 detailed laboratory exercises for practical training of students and also a guidelines in the field of food legislation and the latest information related to modern instrumental methods in this field.
- iv) Research methodologies and tools compulsory -1st semester compulsory course:** A script entitled “Research methodology” was developed based on the syllabi of this course. This script

includes information for master students related to the application and access to different databases such as Web of Sciences, Scopus, PubMed, EBSCO, etc. The computers donated by the STEPS project have made it easier access to the field of scientific research and have enabled students' access to areas of various research and the application of technology. The script is designed to help students of the master's level realize the practical aspects of this course such as the design of project proposals, preparation of how to write a scientific paper, preparation of postcards for participation in conferences, seminars, etc.

**v) Traceability systems of food products:** This is a second-semester elective course. Apart from the theoretical part a training material was developed, which in addition to basic traceability information contains also practical exercises related to monitoring and control of traceability implementation for food products.

Development of experiments/simulations and training material at UHZ for the needs of MSc STEPS students is a continuous process in designing materials for all courses of the program. <https://mooc.steps-project.eu/> It is a dynamic process, which considers the development of new materials but also updating existing materials following trends, new achievements, and new equipment, and specific areas within sustainable food production systems.

<https://doc-0s-3c-docs.googleusercontent.com/docs/securesc/dq37m61hukdiik7ase88t1qkiuoh0ivl/s5sbaledkhgjp2daenvlb45id0t6vkag/1674086175000/14677447921890206094/01795125092839946684/1Pdbdqgaeh2ZXWk7IT8aKMeAw5cjwhGb?e=download&authuser=0>

**Note:** The process of developing the further experiments/simulations and training material at UHZ is continuing. MSc students use the currently developed material.

<https://drive.google.com/drive/folders/1OyyKNRm8n2fBTwhdYt5c3wiCBkYCjhgG>

Some records of practical implementation of certain courses are presented through photos and videos.

[https://drive.google.com/file/d/1TU2zXm5q5\\_OdgVVJ-0F1G7dNv3LDQbJF/view?usp=drive\\_web](https://drive.google.com/file/d/1TU2zXm5q5_OdgVVJ-0F1G7dNv3LDQbJF/view?usp=drive_web)

[https://mail.google.com/mail/u/0?ui=2&ik=27fbb23461&attid=0.4&permmsgid=msg-a:r-3953561842435899011&th=18527794a204d962&view=att&disp=safe&realattid=f\\_lbtywkgug3](https://mail.google.com/mail/u/0?ui=2&ik=27fbb23461&attid=0.4&permmsgid=msg-a:r-3953561842435899011&th=18527794a204d962&view=att&disp=safe&realattid=f_lbtywkgug3)

<https://doc-0k-cc-docs.googleusercontent.com/docs/securesc/dq37m61hukdiik7ase88t1qkiuoh0ivl/6941lrb9jahqdbjng9sjie9erkd0jpn5/1674085050000/06189243714447959775/01795125092839946684/18oKleIFza9EpM96PfMB8epiVxFlyQ649?e=download&authuser=0>

### 3.1.1 Progress of the tasks

The UHZ & UC curriculum meets the recommendations on ECTS course crediting and the jointly agreed structure of compulsory first semester courses. There is a certain imbalance between MFPS and FEQS courses. Namely, the general input recommendation was to try to maintain approximately equal ratio of these two types of courses in the STEPS study program. Overall, the UHZ & UC STEPS study program contains 60% FEQS and 40% MFPS courses. This relationship was primarily influenced by the predominantly biotechnical academic-personal profile of the UHZ.

All the equipment purchased in the framework of the STEPS project has been installed with guidelines and information for students. SimaPro LCA software license (Faculty license; Release SMU, SEMS) are used for the training of MSc STEPS UNSA students in the field of Food Quality Control Lab. Accompanying material include design and development of a number of scripts and unauthorized (usually PPT) materials. A total of 77 short manuals have been developed, which included over 55 individual laboratory exercises from different areas, and a large number of chapters of instructions. Each year, more than 85 individual laboratory exercises will be carried out using equipment obtained through STEPS projects, including detailed software simulations - scenarios, and LCA software - based exercises.

### ***3.1.2. Collected data on the level of satisfaction regarding the STEPS equipment***

For collection and analysis of data on the level of satisfaction with STEPS equipment, UHZ is in the process of implementing of online surveys, which consist of two parts. The first part is related to the level of satisfaction with the new equipment purchased within the Erasmus+ STEPS project (Scientific/Teaching/Technical staff), while the second part is related to the level of satisfaction with the new equipment purchased within the Erasmus+ STEPS project (students). Since this questionnaire was carried out together with UC, it will be presented in section 3.2.2.

## ***3.2 Development of experiments/simulations and training material at Universum College (UC-P4)***

Taking into account the activities related to WP5 (Development of experiments/simulations and training material) the teaching and research staff of Universum College have developed teaching materials and instructional materials for the program's managerial subjects. The academic staff of Universum College was involved in the Accreditation process of the MSc Sustainable Food Production Systems/STEPS study program together with the academic staff of UHZ. Immediately, after the accreditation of the program, the academic staff is included in the development of the course with managerial content which will be read by the academic staff of the Universum College as part of the curriculum of the Master's program which is a Joint Degree. Trainings, open lectures and seminars have been organized as foreseen in WP3 (D3.2.) which have had a great impact on the development of students' material work on sustainability. UC staff attended workshops and HEI staff from program sites (USAMVB, ReadLab, CULS, TEISTE/AUA) delivered lectures on various topics. The experience and knowledge gained from these lectures as well as from the open lecture trainings presented in Peja, Sarajevo, Bihac and Pristina were very useful for the Universum College staff in improving teaching techniques and practical laboratory exercises. Experiments/simulations and training material are designed before the start of the learning process, and are fully compatible with the compulsory and elective subjects in the curricula. The material was developed for those subjects that have a theoretical part and a practical part of their teaching seminars, including practical exercises and real case studies on Food Production and Management Systems. All the computer and technological equipment benefited from the STEPS project are used by the students of Universum College. Universum College has developed all teaching materials for the courses that will be offered as follows:

- i) Marketing of Sustainable Agro-Food Products:** The course aims at providing students the tools useful for managing the food market. The main marketing research strategies will be applied to this market and a marketing mix program will be implemented. By the end of the course students will be able to analyze the challenging aspects of this market, to develop a strategic analysis of the market, and to allocate resources among marketing mix variables. The course will begin with the analysis of the peculiarities of agro food products and markets, with respect to marketing and

management. Secondly, the development of the connection between agriculture/industry/retailing will be examined, with a specific focus on the definition of wholesale and retail structures both at national and international levels, taking into consideration the new regulatory approaches. After will continue with the marketing theory, with a particular focus on the marketing management process that leads to the marketing strategy, the definition of the marketing mix and the need of control and planning. The analysis will then go into the possible segmentation criteria of agro food markets, the related products positioning and the product life cycle management, taking into particular consideration the possibilities offered nowadays by the information technology to reinforce and develop the relationship with the customers. Then will follow with the most significant and widespread applications in the agro food products operations management, with a particular emphasis on the connection between agriculture, industry and retailing. The examination will encompass category management, customer category management, business transactions, partnership account management and horizontal and vertical integration. A real cases of marketing strategy and management of agro food products linked to the related theoretical models will try to clarify a fallacy that depicts the agricultural sector and part of the agro food one as unable to evolve following a marketing oriented approach.

**ii) Sustainable Management of Supply Chain:** In this course we will refer to Supply Chain Sustainability from companies' efforts to consider the environmental and human impact of their products' journey through the supply chain, from the source of raw materials to production, storage, distribution and any transport links in between. The goal is to minimize environmental damage from factors such as energy use, water consumption and waste production while having a positive impact on people and communities in and around their operations.

**iii) Innovation and Entrepreneurship for Sustainable Food Production** – elective course 3<sup>rd</sup> semester: The program is designed to gradually guide students in setting up and managing a concrete project such as the creation of a product development-oriented activity. This course covers product innovation and the design of a processing unit, covering its technical, organizational and financial dimensions. Students will understand the standards of sustainable development, the diversity and wealth of agricultural raw materials and processed products. They will gain knowledge about the main sectors of agricultural processing such as the characteristics of raw materials, processing technologies and the impact of processes on quality (theoretical and practical aspects). They will understand Food Product Innovation lessons and stories from professionals about food innovation tools and practical applications, leading to the realization of a new product development project (from an idea to a product model).

**iv) Consumer Science and Sustainable Consumption:** This is an elective course offered during the 2<sup>nd</sup> year (3<sup>rd</sup> semester) to students who elect to undertake management stream. During this course students are expected to develop e thorough understand on how consumption effects the individual as well as the community. In addition to discussions that will be based on materials and videos offered/shown to students, the course will be organized using environmental calculators and scenario analysis teaching methods. More specifically, the focus will of the experiments in class will be to understand and discus patterns of consumption between different regions in Kosovo, as well as different social classes. Students will be asked to use financial tools to list the buying habits and make decision of sustainable consumption.

**v) Data Analysis and Decision Making:** This elective course provides students with a pivotal access to business activities bases on decision making. More specifically, teaching methods are designed in a format to equip students with a comprehensive approach on how quantitative techniques

guide evidence-based managerial decision-making in food production companies. In addition to lab work using statistical tools focusing on linear regression models, multiple regressions, functional form and exploiting time variation, students will also engage in problem-based learning using data to analyze decisions as well as provide their own decisions. Each student will choose a cluster of varied food productions firms and analyze their decision making. Thereafter, using statistical models learned in class, they will be asked to provide recommendation for a different decision and then test the hypothesis. The improved recommendations will be presented in front of a panel of business representatives

**vi) Sustainable Management of Value Chain of Food:** This course aims to equip designers and project managers with the concepts, principles and tools they need to utilize value chain approaches to improve nutrition through agriculture and food systems. The concept of sustainable food value chains for nutrition considers how the development of a sustainable food value chain can contribute to improving the nutrition of a target population. Students will learn about: a) Key concepts related to sustainable food value chains for nutrition, including diet and nutrition and value chains and their sustainability, b) Elements of the analytical framework, including possible strategies and entry points for intervention, c) The three impact pathways by which a sustainable food value chain can improve nutrition, d) The process of developing this type of project, including analysis and identification of goods and interventions.

**vii) Total Quality Management in the Agri-Food Sector:** This elective course from the 3<sup>rd</sup> semester is a coronation of the individual systems learned and developed by students throughout the 1<sup>st</sup> year of studies. TQM course will focus more on analyzing the implementation process of the system in different businesses in agri-food sector. Having the least experience amongst the countries involved in this project, the agri-food sector in Kosovo will need a specific guidance in understand the benefits of TQM and well as the necessity to follow systems or practices designed in Good Agricultural Practices, Good Hygiene Practices and Good Manufacturing Practices. In this course, students (groups of 3-5) will work with small family managed firms in order to guide them into developing at least a minimal TQM process that fits their needs.

### **3.2.1. Progress of the tasks**

The UHZ & UC STEPS study program is conceived as a two-year study, with four semesters. The project intention of the first semester as a semester with six common compulsory courses was respected. The second semester consists of 7 elective courses, all developed and to be implemented at UHZ. The third semester contains 12 elective courses developed by UHZ and UC. The third semester has now started and there are 6 courses selected for this semester. Apart from the compulsory courses of the first semester, all elective MFPS courses of this joint study program is available in this semester. The fourth semester of the study program is scheduled for the preparation of a master's thesis. The UHZ & UC curriculum meets the recommendations on ECTS course crediting and the jointly agreed structure of compulsory first semester courses. There is a certain imbalance between MFPS and FEQS courses. Namely, the general input recommendation was to try to maintain approximately equal ratio of these two types of courses in the STEPS study program. Overall, the UHZ & UC STEPS study program contains 60% FEQS and 40% MFPS courses. This relationship was primarily influenced by the predominantly biotechnical academic-personal profile of the UHZ.

Given that UPHZ and UC are offering Msc. in Sustainable Food Production System jointly, the equipment purchased followed the logic of the specialization offered by each institution. In UCs case, where a management specialization will be offered, an ICT laboratory was developed to support class activities,

research, coursework, master thesis preparation and demonstration, class delivery, etc. The equipment now allows for each student to have their own computer station during the lectures and exercises. The equipment purchased have been installed and integrated within the current infrastructure, **where manuals have been updated regarding their use**. Additionally, based on the syllabi developed for the management stream, **19 individual exercises have been designed and will be implemented throughout the duration of the program**.

### 3.2.2. *Collected data on the level of satisfaction regarding the STEPS equipment*

UC has not been able to collect this data yet, as the 1<sup>st</sup> year of studies was organized at our joint partner, University of Peja “Haxhi Zeka”. Collection of data regarding the satisfaction of stakeholders with STEPS equipment was done using two different questionnaires, where one of them was disbursed to the scientific, teaching and technical staff, whilst the second survey was disbursed to students who attended the masters’ programs and used the equipment purchased as part of the project. Below is a summary of the survey, whilst the full data for the 1<sup>st</sup> survey could be found here:

<https://docs.google.com/forms/d/e/1FAIpQLSdVT9nxpGatyqNAwjqCfLfaL-ciM-E5NWoHeFjrQOfFIJCPNg/viewform>.

Have you been able to work with the new STEPS equipment?

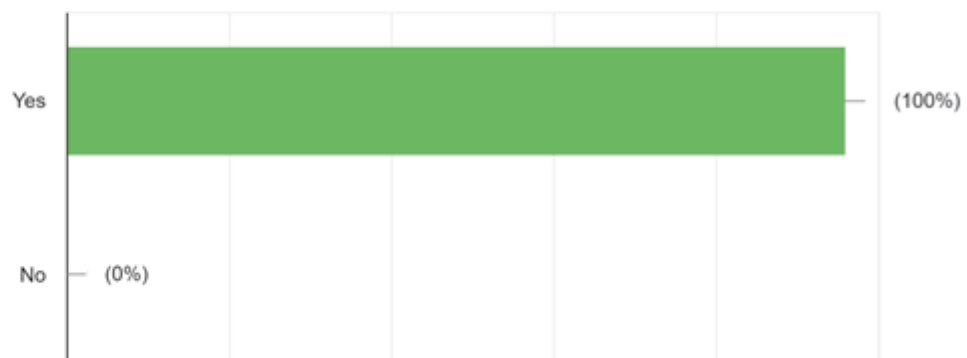


Figure 13. Result from the staff’s questionnaire regarding the question: “Have you been able to work with the new STEPS equipment?”

One of the most prolific achievements of this project is that 100% of the staff who were part of the project were able to work with the new STEPS equipment. This was an effort from both UPHZ and UC to ensure that equipment is included in the curriculum as well as daily tasks.



Are you satisfied with the new installed equipment purchased under the STEPS project?

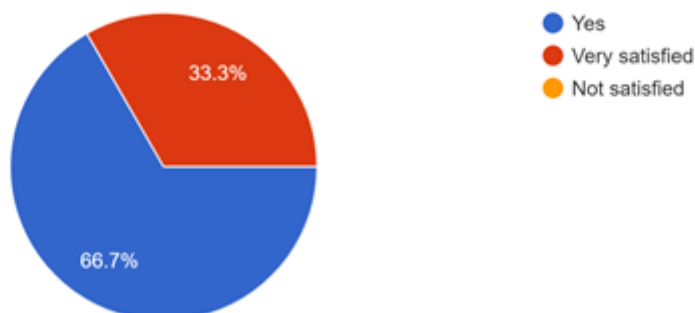


Figure 14. Result from the staff's questionnaire regarding the question: "Are you satisfied with the installed equipment purchased under the STEPS project.?"

As shown in Figure 14, the scientific, teaching and technical staff were asked regarding the satisfaction with installment of new equipment purchased under the STEPS project. In total, 100% of the respondents stated that they are either very satisfied (33.3%) or satisfied (66.7%). No staff expressed dissatisfaction with the new equipment purchased as part of the project.

Does the new "STEPS" equipment support the syllabus of the Master study program "SUSTAINABLE FOOD PRODUCTION SYSTEMS"?\*

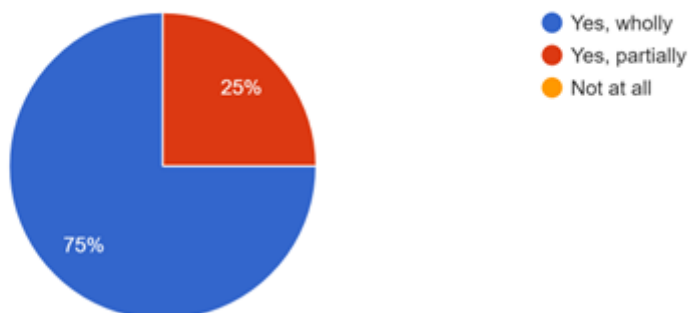


Figure 15. Result from the staff's questionnaire regarding the question: "Does the new "STEPS" equipment support the syllabus of STEPS MSc programme?".

One of the main targets when developing the syllabi for the master study program in Sustainable Food Production Systems, was create a link between theory and lab work in order to create a coherence. As shown in Figure 15, 75% of the respondents stated that the equipment fully supports the syllabus of the master study program, while 25% of the respondents stated that the equipment partially supports the syllabus of the master study program. In some cases, additional resources where need to carry-out activities that where part of the curriculum.

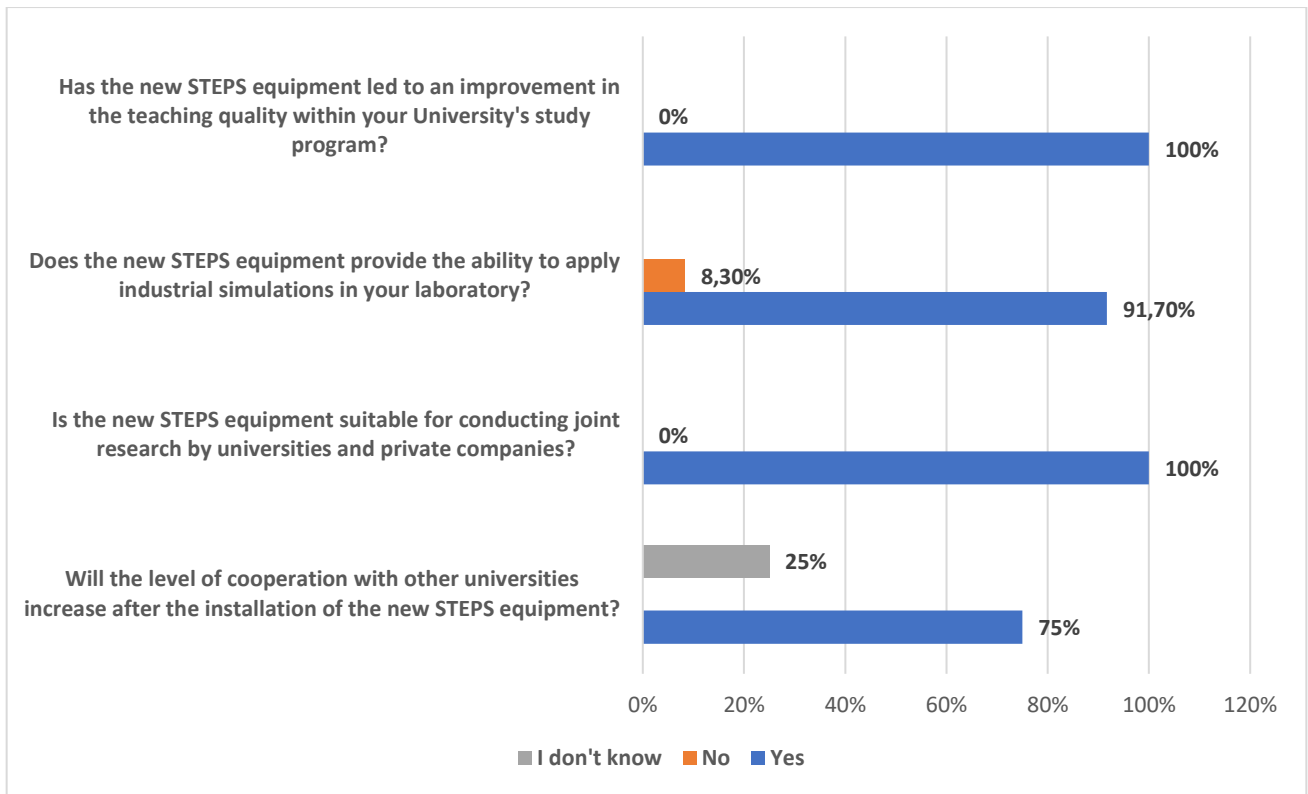


Figure 16. Result from the staff's questionnaire (group-1)

In Figure 16, answers of a series of questions regarding the usability of equipment purchased as part of the STEPS project are presented. The first question has to do with the improvement of teaching quality within the institution because of the equipment. In this case, 100% of the respondents agree that the new equipment have improved the quality of teaching in the institution. Around 91.7% of the respondents believe the new equipment allow for industry simulation within the laboratory, whilst 8.3% do not think that current equipment allow for such industry simulations. On the other hand, 100% of the scientific, teaching and technical staff believe that current equipment is suitable for conducting joint research between university and private companies. Lastly, the results regarding further cooperation between universities as a result of new equipment have been presented. 75% of the respondents think the level of collaboration between universities will increase as a result of new equipment, whilst 25% of the respondents do not know whether the collaboration will increase.

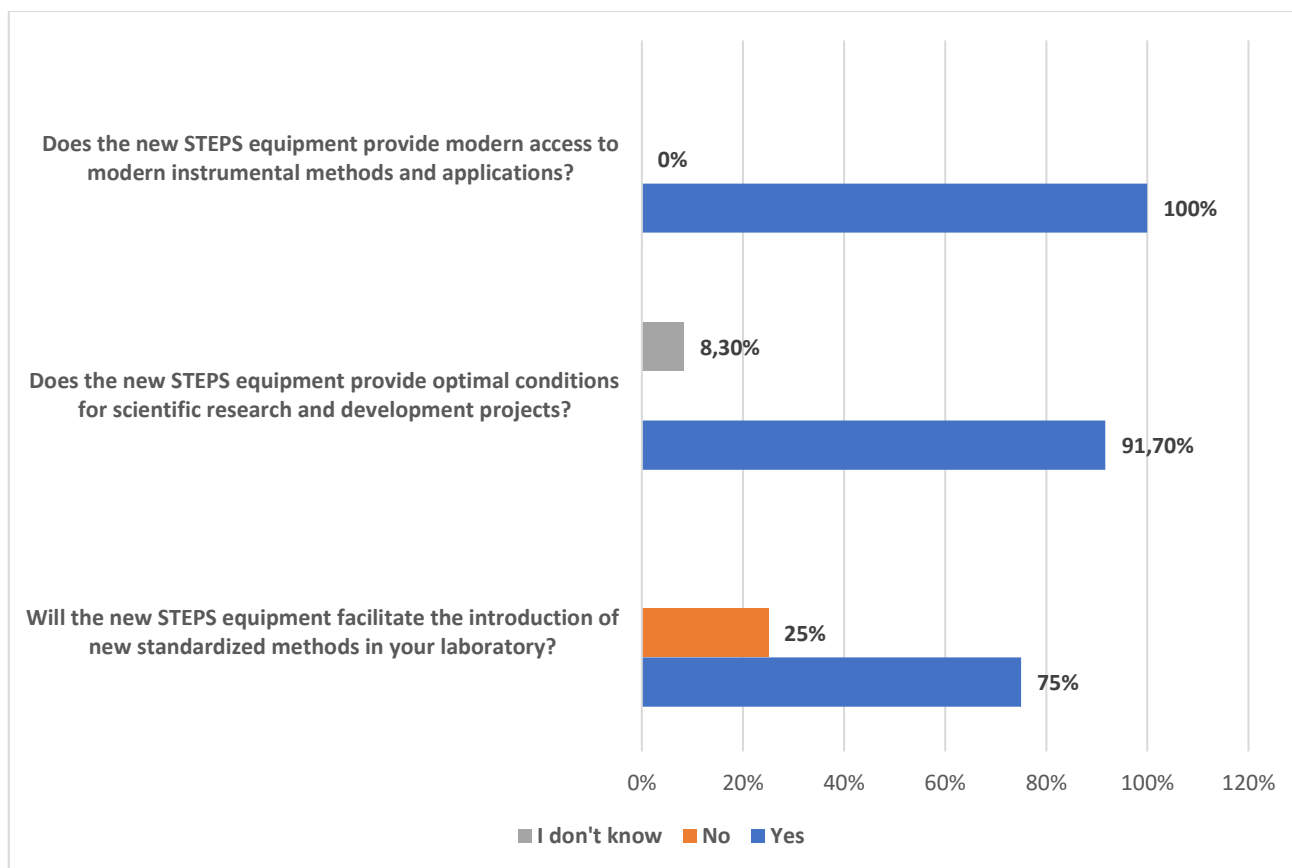


Figure 17. Result from the staff's questionnaire (group-2)

Figure 17 indicates that 100% of the respondents stated that new STEPS equipment provides modern access to modern instrumental methods and applications. Additionally, 91.7% of the respondents think the new STEPS equipment provide optimal conditions for scientific research and development of projects. Lastly, 75% of the respondents think the new STEPS equipment will facilitate the introduction of new standardized methods within institutional laboratories.

When asked “What are the advantages of the newly installed STEPS equipment compared to the existing laboratory equipment in your laboratory?”, the scientific, teaching and technical staff gave the following responses:

- Advanced technology.
- We can do more things to enhance student’s experience.
- They are a more modern version and are easier to conduct research and work
- Informing the students about the adequate equipment of the program
- New Methodology
- Simple to apply, good performance, fast in analyzing samples etc
- New methodology
- The main advantage is that the equipment’s belong to the new technology and all students have the opportunity to use them
- The main advantages are that equipment belong to the new technology and the students have possibility to use them

- Practical courses fulfill
- New advance technology comparing to our conventional
- more modern, more precisely, the data from the results obtained can be directly transferred to the computer and processed

**The second survey was conducted with students** who are attending the master study program STEPS. The survey contained 10 close-ended questions and it intended to obtain the opinion of students regarding the equipment purchased specifically for the program. the full data for the 2nd survey could be found here:

[https://docs.google.com/forms/d/1r18bqQMPeMrDI5ccHgW\\_KnbENFiN1uAR8c8VFPmIf8U/edit](https://docs.google.com/forms/d/1r18bqQMPeMrDI5ccHgW_KnbENFiN1uAR8c8VFPmIf8U/edit).

The following are the result of the survey:

Are you aware that your University has acquired new laboratory and IT equipment as part of the Erasmus + project MSc in Sustainable Food Production Systems/STEPS?

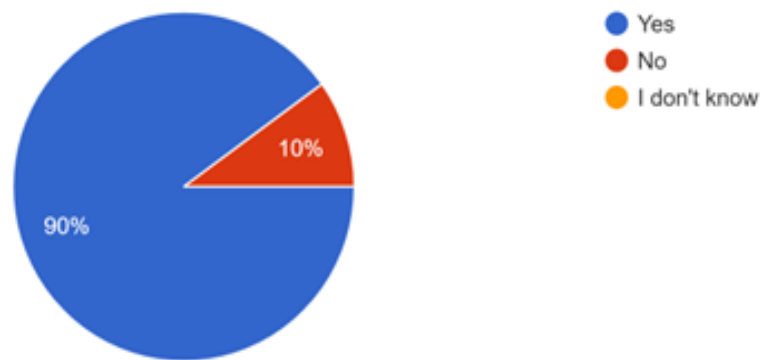


Figure 18. Result from the students' questionnaire regarding the question: "Are you aware of the STEPS equipment?"

Because of the dissemination activities conducted by representatives of UPHZ and UC, the vast majority of students are aware that the new laboratory and IT equipment were part of the Erasmus + project MSc in Sustainable Food Production Systems. Figure 18 indicates that 90% of the students stated that they are aware of the new laboratory and IT equipment. Regarding the satisfaction with the new STEPS equipment at UPHZ and UC (Figure 19), 60% of the students stated they are completely satisfied, while 30% of the students stated they are partially satisfied. Similar to the responses of the previous question, in this case also, a 10% of the students stated they are "Not at all" satisfied with the new STEPS equipment at the institutions. No further explanations were given by students regarding the fact that they were not satisfied.

### Are you satisfied with the new STEPS equipment at your University/Faculty?

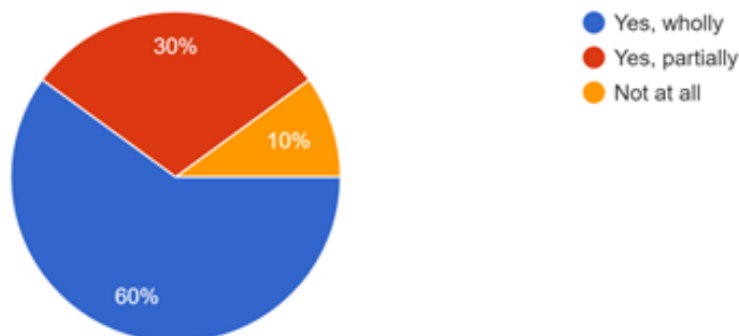


Figure 19. Result from the students' questionnaire regarding the question: "Are you satisfied with the new STEPS equipment?"

The 3<sup>rd</sup> and 4<sup>th</sup> questions posed to students had to do with their opportunity to use the new equipment as well as whether the new equipment support the syllabi of the Master study program STEPS. In total, 90% of the students stated they had an opportunity to use the new equipment, while 10% of them did not have a chance to use the new equipment (Figure 20). Given the fact that the majority of courses are conducted in the laboratory as well, the 10% of students who did not have a chance to use the new equipment might have been absent during the lab session or are not aware that equipment being used is purchased through the project. Regarding the 4th question, presented in Figure 21, 70% of the students believe the new STEPS equipment support to a large extent the syllabi of the master program, while 20% stated that the new equipment mostly supports the syllabi. On the other hand, 10% of the students stated that STEPS equipment does not support the syllabi of the master study program.

### Did you have the opportunity to use the new equipment as part of the classes at the MSc "Sustainable food production systems"?

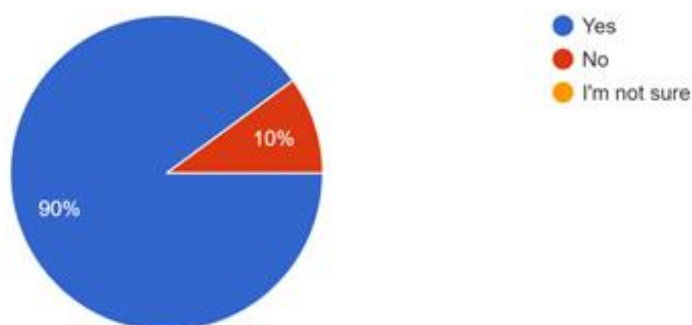


Figure 20. Result from the students' questionnaire regarding the question: "Did you have the opportunity to use the new equipment as part of the classes at the STEPS MSc programme?"

Do you think that the new STEPS equipment supports the syllabi of the Master study program "Sustainable food production systems"?

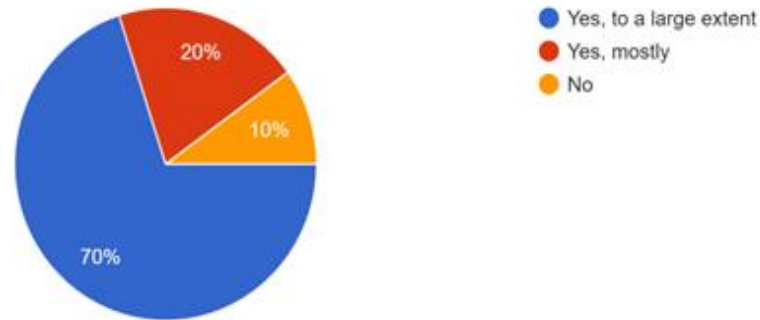


Figure 21. Result from the students' questionnaire regarding the question: "Does the new "STEPS" equipment support the syllabi of STEPS MSc programme?".

Did this new STEPS equipment help you expand your knowledge in the field of food quality control and management in food production systems?

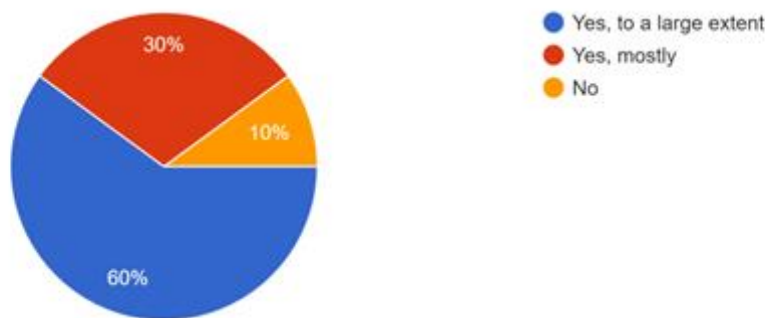


Figure 22. Result from the students' questionnaire regarding the question: "Did the STEPS equipment help you expand your knowledge in the field of food quality control and management in food production systems?".

Regarding the question related to knowledge expansion as a result of new STEPS equipment, 60% of the students stated that equipment expanded their knowledge to a large extent and 30% stated that new equipment expanded their knowledge in the field of food quality control and management in food production system to some extent. 10% of the students believe their knowledge has not expanded as a result of the new equipment.

Have you worked at your University on research/projects/seminars using the new STEPS equipment your University?

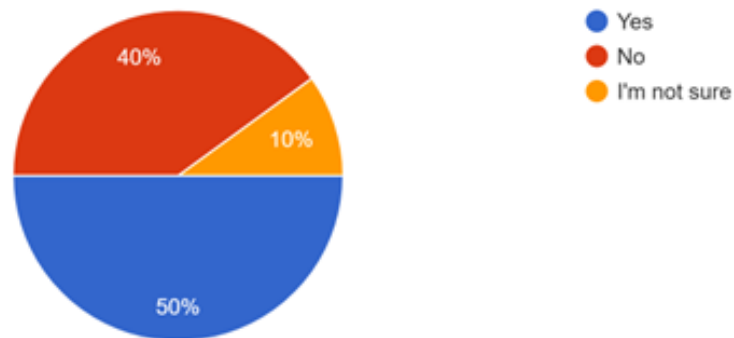


Figure 23. Result from the students' questionnaire regarding the question: "Have you worked on research/projects/seminars using the new STEPS equipment?".

Did you use new STEPS equipment when writing your master thesis?

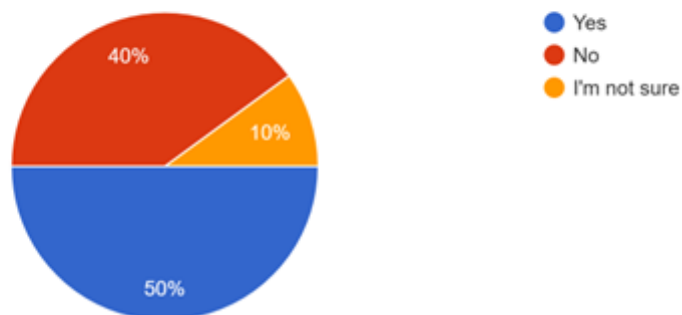


Figure 24. Result from the students' questionnaire regarding the question: "Did you use the STEPS equipment when writing your master thesis?".

The question relating STEPS equipment utilization for MSc theses is not completely applicable to students who are currently attending the joint Msc. in Sustainable Food Production Systems at UPHZ and UC because they are not currently working in their thesis. However, given the standardized questions, it was explained to students that they should answer whether the new equipment was used in written projects. On the other hand, a 50% of students stated that they have worked at the university on research/projects/seminars using the new STEPS equipment, while 40% of the students stated they have not used the equipment for research/projects/seminars. On the other hand, 10% of the students stated that they are not sure whether they have worked at the university on research/projects/seminars using the new STEPS equipment.

Do you think the new STEPS equipment is applicable for industrial simulations and project implementation together with the private sector?

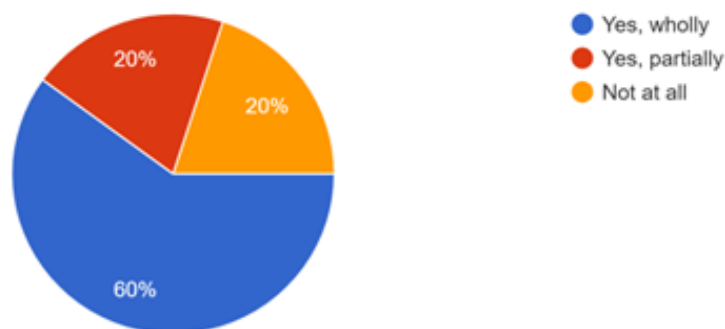


Figure 25. Result from the staff's questionnaire regarding the question: "Do you think the new STEPS equipment is applicable for industrial simulations and implementation together with the private sector?".

When asked whether the new STEPS equipment is applicable for industrial simulations and project implementation together with the private sector, 60% of the students stated that the new equipment is wholly applicable while 20% stated they are partially applicable. An additional 20% of the students stated that the equipment is not at all applicable for industrial simulations and project implementation together with the private sector.

### Conclusions

Given the results collected from both surveys, it is evident that the new equipment purchased through STEPS projects has significantly contributed toward an increase in the level of teaching and learning quality within UPHZ and UC. From the perspective of professors/researchers, the new equipment along with the designed curriculum has provided them with an opportunity to better engage students as well as create ample opportunities for knowledge expansion in the field of sustainable agriculture, food production and quality control management. For the institution, the next step is to encourage a better relationship with the industry in order to allow students to be involved in real-life activities that not only improve their knowledge and skills, but also provide them with opportunities for employment.



## 4 DEVELOPMENT OF EXPERIMENTS/SIMULATIONS AND TRAINING MATERIAL IN BOSNIA AND HERZEGOVINA

### 4.1 *Development of experiments/simulations and training material at University of Bihać (UNBI-P5)*

In accordance with the tasks within WP5 and activities 5.3 *Development of experiments/simulations and training material* which essentially include development of experiments, simulations and materials for practical - laboratory exercises and student training, UNBI teaching and research staff started designing and creating materials in a form of scripts/manuals with guidelines and instructions, as well as individual laboratory exercises and software simulations after approval and establishment of the study program [MSc Sustainable Food Production Systems/STEPS](#).

Organized trainings and D3.2 Seminars and lectures intended for HEIs partner countries teaching/scientific staff have greatly contributed to the quality preparation and development of this material. As planned by the project, these trainings, seminars and lectures were organized and conducted by HEIs staff from the program countries (USAMVB, ReadLab, CULS, TEISTE/AUA). The trainings conducted during the Peja and Sarajevo meetings were especially important for the UNBI teaching and scientific staff. However, as the development of experiments/simulations and training material is a continuous and constantly open activity combined with the later conducted online and live trainings (Bihać, Pristina and Tirana meeting), they were important for the update of the existing materials and as a preparation ground for the creation of the new training material in the future.

Experiments/simulations and training material were designed before the beginning of the teaching process, and are completely in accordance with the compulsory and elective subjects in the syllabi. It is important to point out that this material was developed for those subjects that have a practical part in their teaching content - syllabus, whether it is practical, computational or laboratory exercises in the field of *Food Quality Control Lab* or software simulations in the field of *Food Production Systems Management Lab*. Accordingly, for the purposes of training MSc STEPS students in UNBI, experiments/simulations and *training material* were developed for the following compulsory and elective courses in the 1<sup>st</sup> and 2nd semester, as follows:

**i) Fundamentals of Sustainable Agri-Food Systems** – 1st semester compulsory subject. In accordance with the theoretical part of this course, an unauthorized educational material was created - a manual for software exercises based on LCA software. This material include detailed description of the experiment/simulation LCA SimaPro project, (*SimaPro Faculty license; Release 9.1.1.1*) guidance and description (inputs and outputs) of steps towards the successful implementation of the activity, samples as well as scenarios for exercises and research of: Life-cycle Assessment (software-based exercises and projects); Life-cycle assessment (software-based exercises and projects) - collecting, analyses and monitoring the sustainability efficiency data of company's products and services; Life-cycle assessment (software-based exercises and projects) - decision-making, change products' life cycles for the better, and improve the company's positive impact. For the development of experiments/simulations and training material of this course from STEPS equipment, complete ICT equipment (Computer Configuration, Server, Printer, etc.) from the newly established *Food Production Systems Management Lab* was used. Food Production Systems Management Laboratory offer the opportunity for students to design and analyse processes and supply chains and evaluate the performance of production systems, in terms of energy consumption, environmental impact and recoup.

**ii) Agricultural and Food Industry Waste Management** - 1st semester compulsory course. Training material in the form of an authorized script for laboratory exercises entitled *Waste Management in Agriculture and Food Industry* was prepared and distributed. In addition to the introduction and general guidelines, the script included 34 individual, detailed laboratory exercises in this area intended for student training, following the syllabus of the subject. For the development of experiments/simulations and training material of this course, instruments from STEPS equipment were used: Analytical Instrument - Automated Titrators (LL-Unitrode WOC/pH electrode), IKA Laboratory mill, Moisture Analyzer and VORTEX - laboratory orbital shaker. In addition to this, in the preparation of detailed laboratory exercises, the already existing instrumental equipment of the Laboratory of the Biotechnical Faculty of UNBI was used.

**iii) Advanced Food Science and Technology** - 1st semester compulsory course. As part of this course, which anticipates student practical - laboratory training in its curriculum, an authorized script entitled *Achievements in Food Science and Technology* has been designed and written, which in addition to 20 detailed laboratory exercises for practical training of students, includes guidelines in the field of food legislation and the latest information related to modern instrumental methods in this field. For the development of experiments - simulations and training material of the course Advanced Food Science and Technology from STEPS equipment, the following instruments were used: Kjeldahl Distillation Solutions for Food and Feed – Automatic distillation unit, Analytical Instrument - Automated Titrators (LL-Unitrode WOC/pH electrode), IKA Laboratory mill, Moisture Analyzer, Color measurement instrument, pH measuring device - pH portable Food kit. In addition to this, in the preparation of training material - detailed laboratory exercises, the already existing instrumental equipment of the Laboratory of the Biotechnical Faculty of UNBI was used.

**iv) Harvesting and Post Harvesting Technologies** – 2nd semester elective course. For practical training of students in this subject, training material was prepared in the form of an unauthorized script or manual entitled *Fruit Harvesting and Fruit Manipulation after Harvest*, which follows the theoretical part of the syllabus and is fully consistent with its content related to Practical–Laboratory and calculation exercise. In addition to 7 laboratory exercises, this material also contains chapters of instructions, guidelines and information related to fruit harvesting, handling, packaging and storing. For the development of experiments - simulations and training material of the course Harvesting and Post Harvesting Technologies from STEPS equipment, the following instruments were used: Kjeldahl Distillation Solutions for Food and Feed – Automatic distillation unit, Analytical Instrument - Automated Titrators (LL-Unitrode WOC/pH electrode), IKA Laboratory mill, Moisture Analyzer, Color measurement instrument, pH measuring device - pH portable Food kit.

**v) Animal Food Technology Science, Sustainable Technology of Meat Products and Sustainable Technology of Dairy Products** - for these elective courses of the second semester, which anticipate laboratory exercises, UNBI teaching and scientific staff prepared an extensive script entitled *Quality of food of animal origin in sustainable food production systems of animal origin*, contains 29 elaborated laboratory exercises for sensory, chemical and microbiological analysis of animal origin food intended for practical education of students or as a control part in production. For the development of experiments/simulations and training material for these 3 courses from the new "STEPS" equipment, instruments were used: Kjeldahl Distillation Solutions for Food and Feed – Automatic distillation unit, Analytical Instrument - Automated Titrators (LL-Unitrode WOC/pH electrode), IKA Laboratory mill, Moisture Analyzer, Color measurement instrument, pH measuring

device - pH portable Food kit. In addition to this, in the preparation of training material - detailed laboratory exercises, the already existing instrumental equipment of the Laboratory of the Biotechnical Faculty of UNBI was used.

**vi) Sustainable Animal Production, Sustainable Plant Production and Low Input Agriculture.**

Regarding the *training material* for software simulations (*LCA - software-based exercises and projects - SimaPro Faculty license; Release 9.1.1.1*) for these second semester elective courses, unauthorized training material was designed based on learning outcomes at the level of experiment or simulation. This material in the form of a manual is harmonized with the theoretical part and syllabus outcomes of these subjects, and in addition to instructions and guidelines contains a detailed description of the experiment - *simulation LCA SimaPro projects*: guidelines and description (inputs and outputs) of steps for successful analysis, samples and exercise scenarios and life cycle assessment research, LCA project design in low-input agriculture (crop and animal production), LCA project design in the areas of sustainable plant and animal production, environmental and resource impact analysis using LCA software. For the design and development of experiments/simulations and training materials for these STEPS courses, complete ICT equipment (Computer Configuration, Server, Printer, etc.) from the newly established *Food Production Systems Management Lab* was used. Food Production Systems Management Laboratory offer the opportunity for students to design and analyse processes and supply chains and evaluate the performance of production systems, in terms of energy consumption, environmental impact and recoup.

**vii) Sustainable Land Management.** For this second semester elective course, which anticipates a practical part in the form of laboratory exercises, material was designed in a form of an authorized script called *Sustainable Land Management*, which in addition to basic land information contains 18 laboratory exercises that give students the opportunity to acquire basic knowledge of soil as well as methods of soil study through theoretical knowledge, practical work in the field and in the laboratory easier and faster. In addition to this, it was also developed *training material* for software simulations (*LCA - software-based exercises and projects - SimaPro Faculty license; Release 9.1.1.1*) for these second semester elective courses, unauthorized training material was designed based on learning outcomes at the level of experiment or simulation. This material in the form of a manual is harmonized with the theoretical part and syllabus outcomes of these subjects, and in addition to instructions and guidelines contains a detailed description of the experiment - *simulation LCA SimaPro projects*: guidelines and description (inputs and outputs) of steps for successful analysis, samples and exercise scenarios and life cycle assessment research, LCA project design in Sustainable Land Management. For the design and development of *training material - software simulations* for these STEPS courses, complete ICT equipment from the newly established Laboratory for Food Production Systems Management was used.

Finally, when it comes to the *development of experiments/simulations and training material at UNBI for the needs of MSc STEPS students*, it is important to emphasize that it is a continuous and constantly open process subject to designing new and updating existing materials following trends, new achievements and new equipment and specific areas within sustainable food production systems.

**Note:** Due to the scope and amount of the developed experiments/simulations and training material at UNBI, and due to the copyright protection of certain scripts/manuals, it has not been updated on the GD STEPS project. However, as envisaged by the project, this training material was digitized and updated (D4.3) together with D4.2 educational material on the STEPS LMS platform (<https://mooc.steps-project.eu/>). MSc STEPS UNBI courses are created and run on the STEPS LMS platform. Also, all teachers and students of MSc STEPS at UNBI registered and started to use the platform. The part of the training material that has been authorized has passed the established procedure at UNBI, and the documentation related to these procedures is available on **Google Drive** and is linked in **Chapter 7** of this report.

#### **4.1.1. Progress of the tasks**

Research Laboratories at UNBI have been developed with new equipment that will support the development and increase in quality and relevance of courses. Equipment and software are purchased and installed. The equipment will be used to improve the quality of teaching and the level of knowledge delivered, but it will also increase the potential of the scientific staff so that they are able to prepare and publish research articles in international scientific journals and conferences. For the purpose of monitoring progress according to defined indicators, we state that for the training of our MSc STEPS students in the field of Food Quality Control Lab, a total of 4 authorized and 1 unauthorized scripts were designed and written, which included more over 120 individual laboratory exercises from different fields, as well as great number of instructions, guidelines and information for students. SimaPro LCA software license (*Faculty license; Release 9.1.1.1*) has been acquired within the Food Production Systems Management Lab and will be renewed every year. Based on this software, 6 manuals in the form of *unofficial training/teaching material* were designed and created. Each of these manuals, in addition to a brief guide, contains one detailed software simulation - scenario, or *LCA software - based exercises*.

#### **4.1.2. Collected data on the level of satisfaction regarding the STEPS equipment**

For the purpose of impartial collection and analysis of data on the level of satisfaction with STEPS equipment, UNBI conducted two online surveys. **In the first survey** „[\*Level of satisfaction with the new equipment purchased within the Erasmus+ STEPS project \(Scientific/Teaching/Technical staff\)\*](#)“ the target group were teachers and scientific and technical staff of the UNBI Biotechnical Faculty who are in the process of teaching (laboratory and exercises based on software), intensively using the new ICT, laboratory and instrumental UNBI STEPS equipment. After analysis, the results of this survey are presented in graphs grouped based on the same answers offered for a more rational presentation. **Figure 26** shows the analyzed results of the first question in general *"Have you been able to work with the new STEPS equipment"*. As can be seen from the presented results, the vast majority of respondents (93.8%) responded positively to this question, while the percentage of negative responses was 6.2.

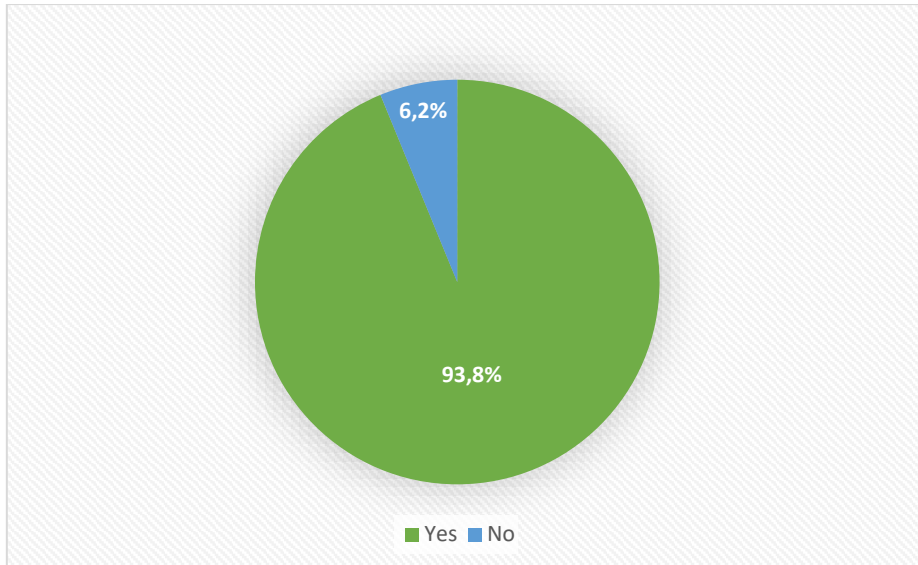


Figure 26. Answers to the question: "Have you been able to work with the new STEPS equipment?".

**Figure 27** shows the results of the answers to the question about satisfaction with the new equipment of respondents who had the opportunity to use it in the process of performing exercises and simulations in the area of Food Quality Control and Food Production Systems Management during the teaching process of the MSc STEPS study program. As can be seen from these results, respondents were satisfied (68.8%), or very satisfied (31.3%) with the newly installed STEPS equipment at UNBI.

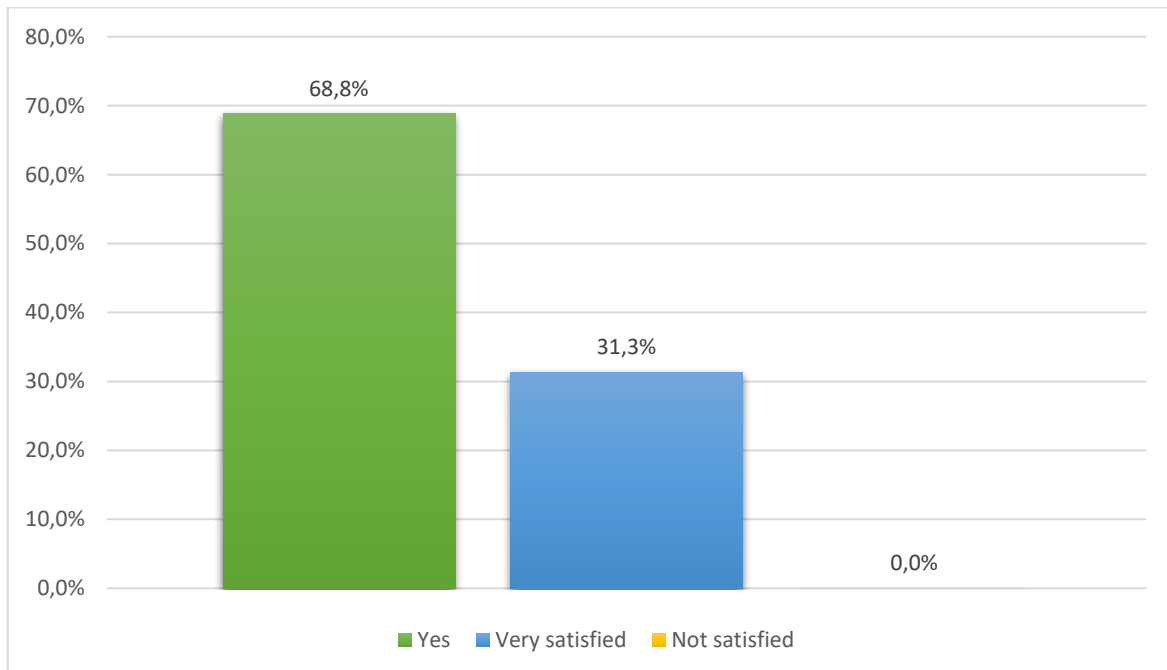


Figure 27. Answers to the question: "Are you satisfied with the new installed equipment purchased under the STEPS project?".

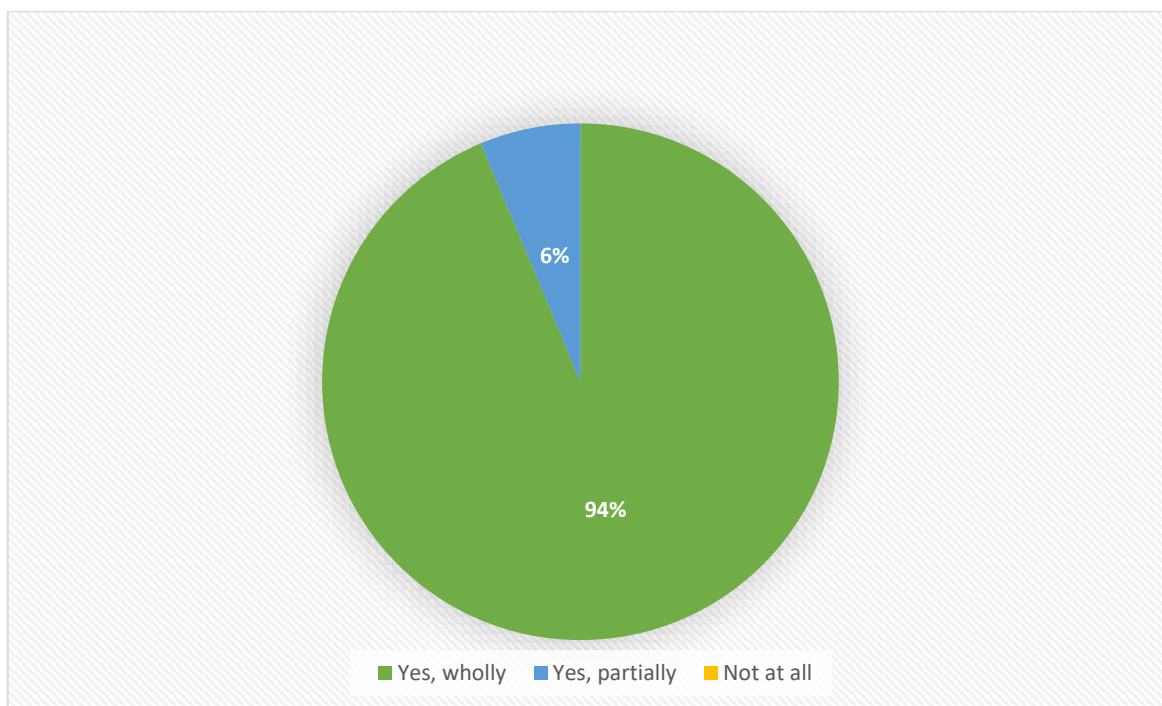


Figure 28. Answers to the question: "Does the new "STEPS" equipment support the syllabus of the MScSTEPS?".

Since the engaged teachers, assistants and laboratory assistants are the most representative in terms of providing objective and credible information regarding the representation of equipment in the syllabi of the MSc STEPS study program, the answers of the respondents to the question whether the new equipment supports the syllabuses of this study program were impressively analyzed. Namely, as can be seen from Figure 28, a large number (94%) of the staff who had the opportunity to use the new equipment responded that the STEPS equipment fully supports the syllabus of the master program of the same name, while 6% of respondents stated that this support was partial.

The results related to the potential of the newly installed STEPS equipment are shown in terms of establishing cooperation and conducting joint research and industrial simulations with other universities and private companies. When it comes to these topics, the majority of respondents believe that the new STEPS equipment at UNBI can increase the level of cooperation with other universities (87.5%), while an even higher percentage (93.3%) believes that this equipment is suitable for conducting joint research between of the University of Bihać and private companies. However, a significantly lower percentage of affirmative answers (60%) was recorded when answering on the topic of equipment support with industrial simulations compared to the previous two questions. The number of negative answers to this question was 27%, while the percentage of those who were not sure was 13%. From the above results, it could be concluded that the newly acquired and installed STEPS equipment at UNBI can only partially meet the requirements when it comes to conducting simulations from industry. However, when we look at the survey questions shown in **Figure 29**, the percentage of responses to the question "Has the new STEPS equipment led to an improvement in the teaching quality within your university's study program?" attracts the most attention. Namely, the entire surveyed staff involved in the teaching process at MSc STEPS that the new STEPS equipment is the quality of teaching at UNBI, which we consider to be extremely important.

In **Figure 30**, the presented survey questions and their answers refer to the support of the new STEPS equipment for the introduction of standards, the provision of conditions for the implementation of scientific research and development projects, and modern instrumental methods and applications in the laboratories

and IT study room of the UNBI Biotechnical Faculty. As indicative from the results shown in this graph, the majority of respondents (94%, 87,5% and 93,8%) believe that the new STEPS equipment at UNBI ensures the conditions for the above-mentioned activities. Negative answers (6,7%) from this group of questions were recorded only in the question of equipment support in the process of introducing standards.

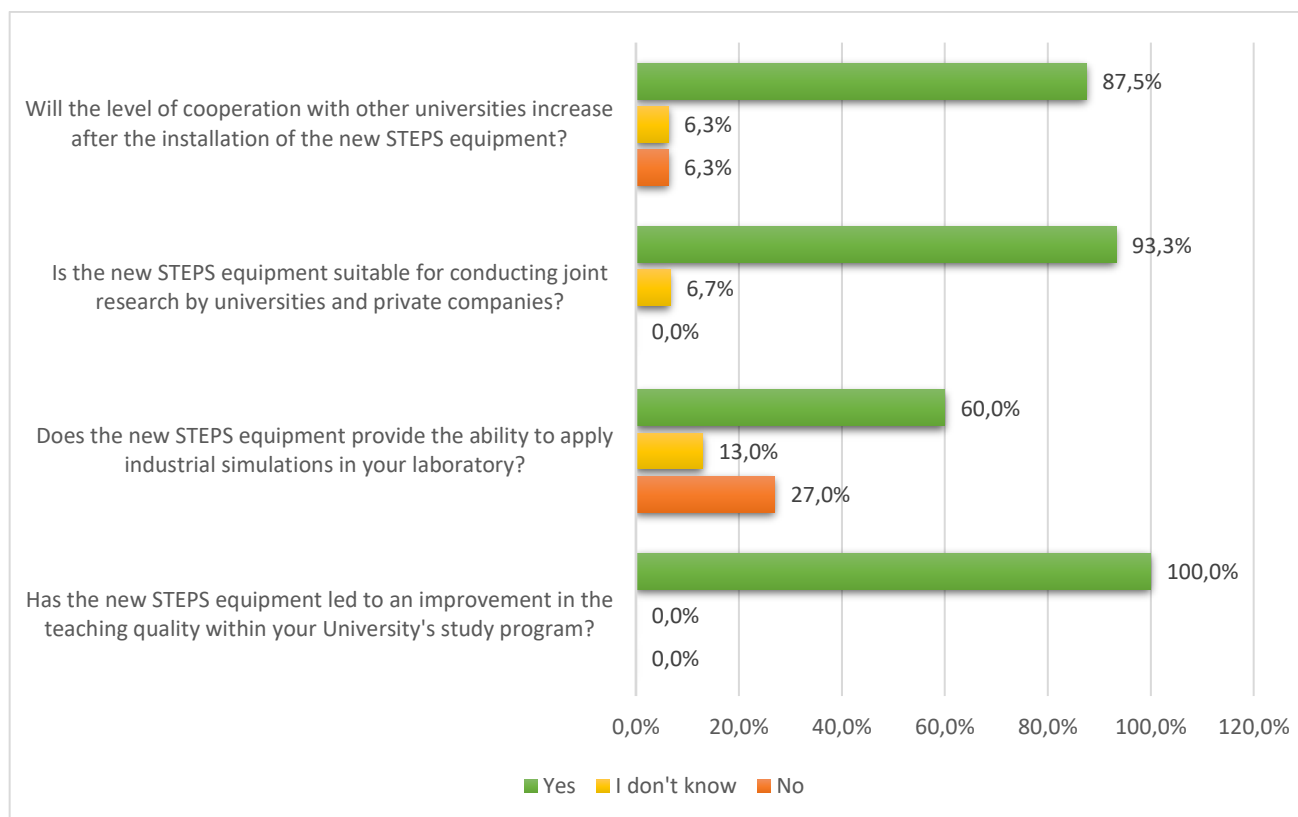


Figure 29. *Answers to questions related to research, synergies and teaching quality*

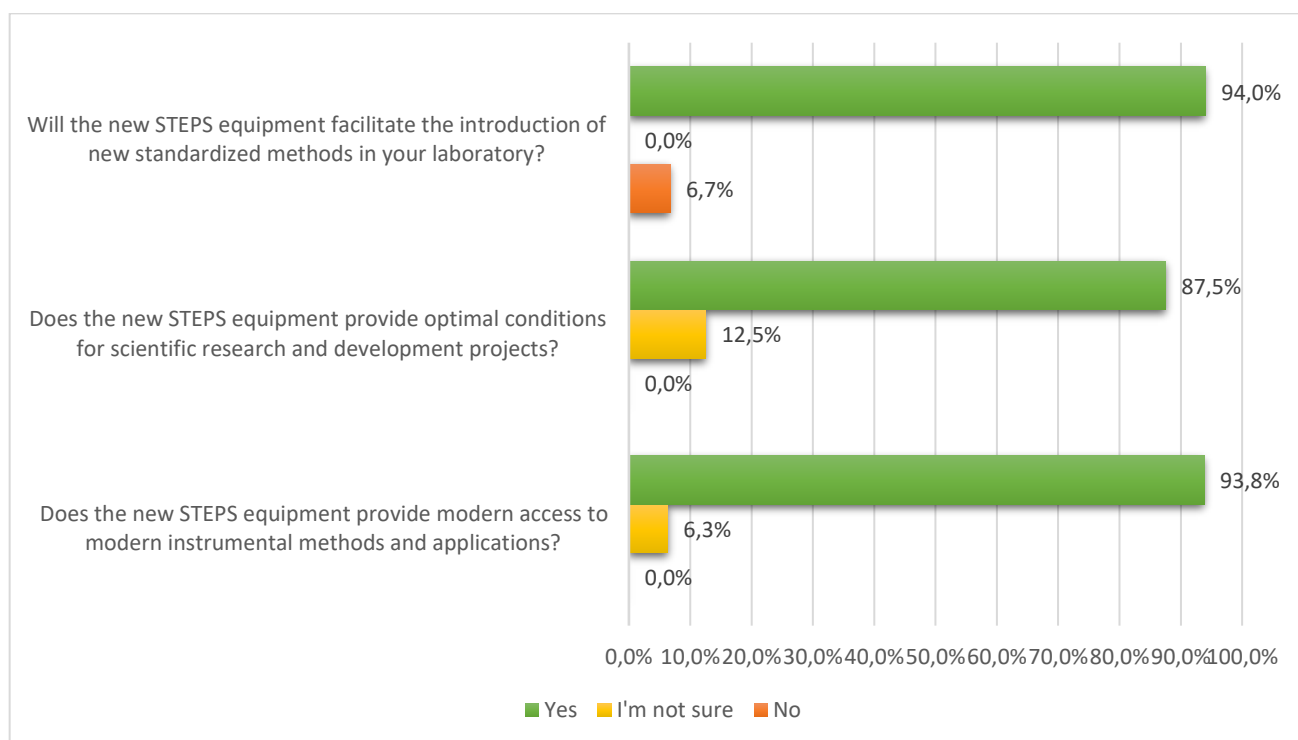


Figure 30. *Answers to questions related to research, measurement methods and standardization processes.*

After the question "What are the advantages of the newly installed STEPS equipment compared to the existing laboratory equipment in your laboratory?", the following comments were collected:

- In the segment where it covers certain analyses, it is automated and more precise
- Scientific and research work, new analyzes that we were not able to do with the existing equipment.
- Equipment of newer technology and standards compared to existing equipment
- More possibilities, more precise analyses, more reliable results.
- Is compatible with existing equipment
- Application of newer methods
- Practical, easy to use.
- More modern equipment, faster availability of results
- Faster and more accurate results
- Strengthened organizational resources
- By acquiring and installing STEPS equipment, we enriched our laboratory with new equipment that we did not have until now or we had older, obsolete equipment at our disposal. The installation of the new equipment gives us the opportunity for better scientific and research work, as well as work with students.

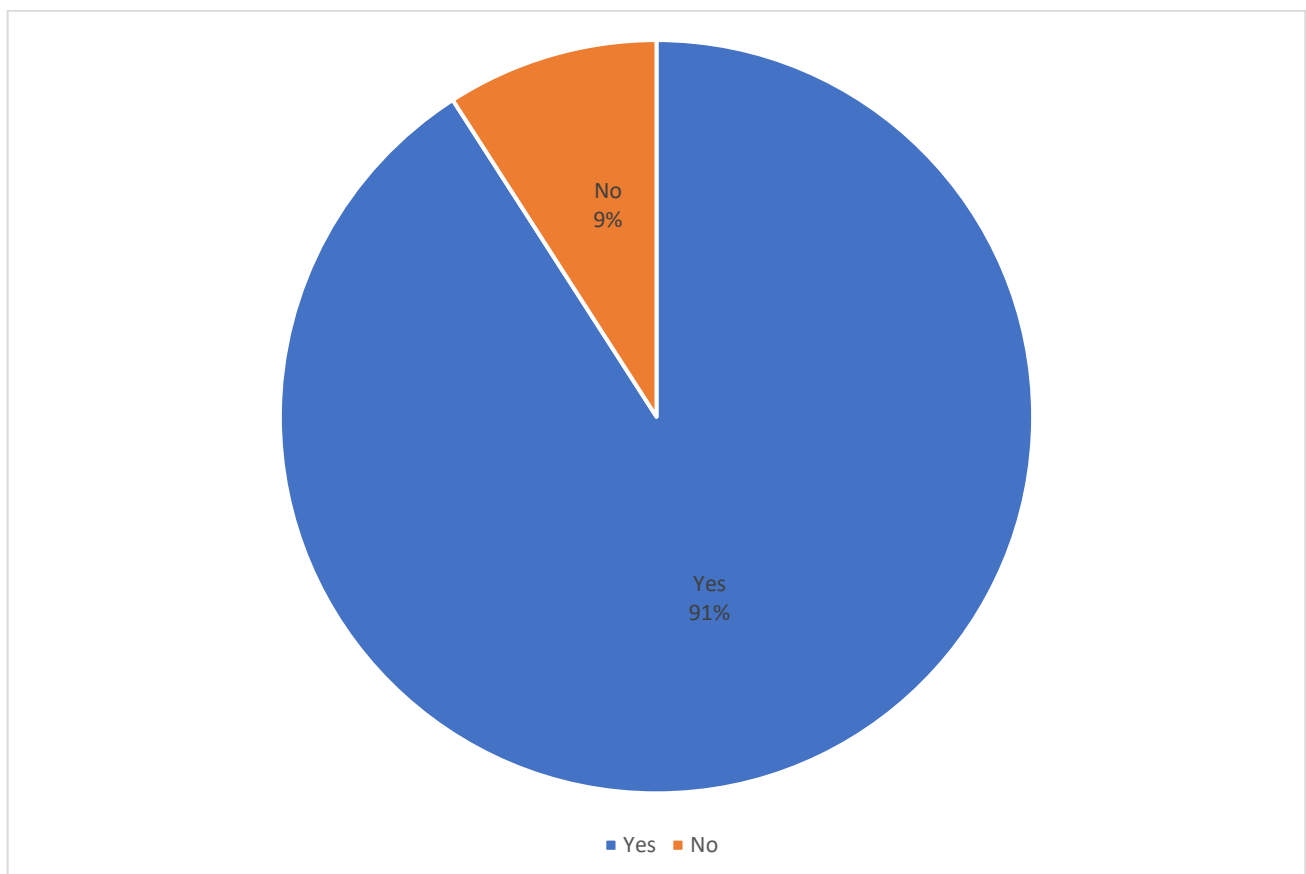


Figure 31. Answers to the question: "Are you aware that your university has acquired new laboratory and IT equipment as part of the Erasmus + project MSc in Sustainable Food Production Systems/STEPS?".

**The survey** "[Level of satisfaction with the new equipment purchased within the Erasmus+ STEPS project \(students\)](#)" was conducted with the first generation of **UNBI STEPS students** during the month of October 2022. The reason for the relatively late start of the survey was the initiation of the procedures for submitting the student's master's thesis topics and the start of intensive exploitation of the equipment in terms of conducting research related for the master's theses' purpose in order to obtain comprehensive and credible feedback from the student. Also, for the sake of easier presentation, the results of this survey, just like the survey for teaching, scientific and technical staff, were grouped into graphs based on the same or similar



answers during the processing of the obtained data and their analysis. Thus, the first question "Are you aware that your University has acquired new laboratory and IT equipment as part of the Erasmus+ project MSc in Sustainable Food Production Systems/STEPS" is shown independently in **Figure 31** due to the unique answer offered. From the analyzed answers to this question it is evident that the vast majority (91%) of students are generally aware of the fact that UNBI, within the Erasmus+ STEPS project, acquired laboratory and IT equipment for the purpose of strengthening infrastructure, especially laboratory capacities.

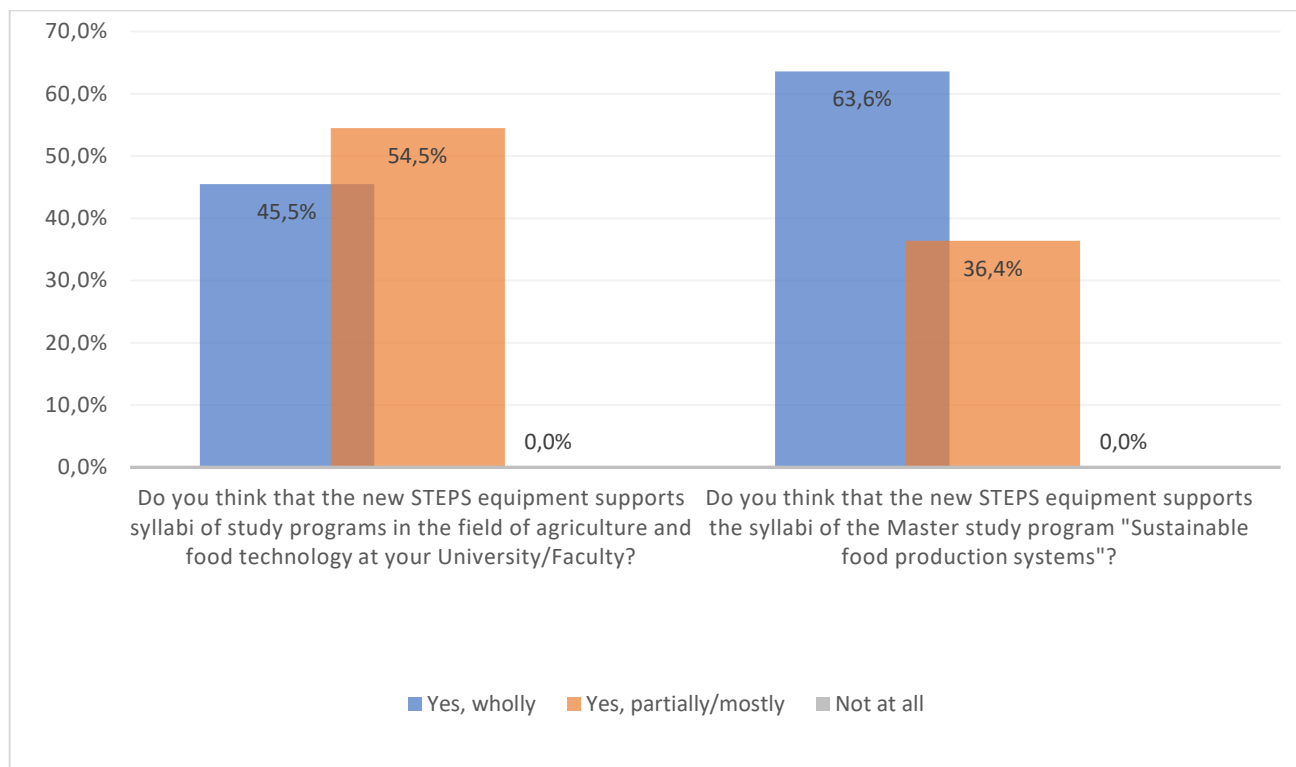


Figure 32. Answers to questions related to the quality and relevance of STEPS equipment in university and MSc program levels.

The following further series of responses to this survey (Figure 32) show that 45.5% of students believe that the new STEPS equipment at UNBI fully supports the curricula in the field of agriculture and food technology. While over 50 percent of the surveyed students (54.5%) believe that this support is partial, that is, that this equipment mostly follows the curricula of these fields. We have similar results (63,6% i 36,4%) with the answers to the question about the support of STEPS equipment to the curricula of the new MSc Sustainable Food Production Systems study program.

When students were asked whether they had the opportunity to use the new STEPS equipment during classes on the MSc Sustainable Food Production Systems study program, and whether they thought this equipment offered the possibility of modern access to instrumental methods and new software, the results, as shown in the **Figure 33**, were similar. Namely, the vast majority of respondents answered these two questions positively (90.1%), while the percentage of those who answered no, that is, they were not sure, was 9.1%. To the question related to the opportunity to participate in research/projects/seminars in which the new STEPS equipment was used, students also answered "yes" in a large percentage (81.8%). A slightly different distribution of answers was recorded for the question related to the use of equipment when working on a master's thesis. Namely, more than half of the surveyed students (54.5%) used the equipment when working on research within their master's thesis, while 36.4% answered "no". The percentage of those who were not sure was 9.1%. The high prevalence of negative answers regarding this question is probably related to the fact that at the time of the survey, all MSc STEPS students had not yet started research work within their master's theses.

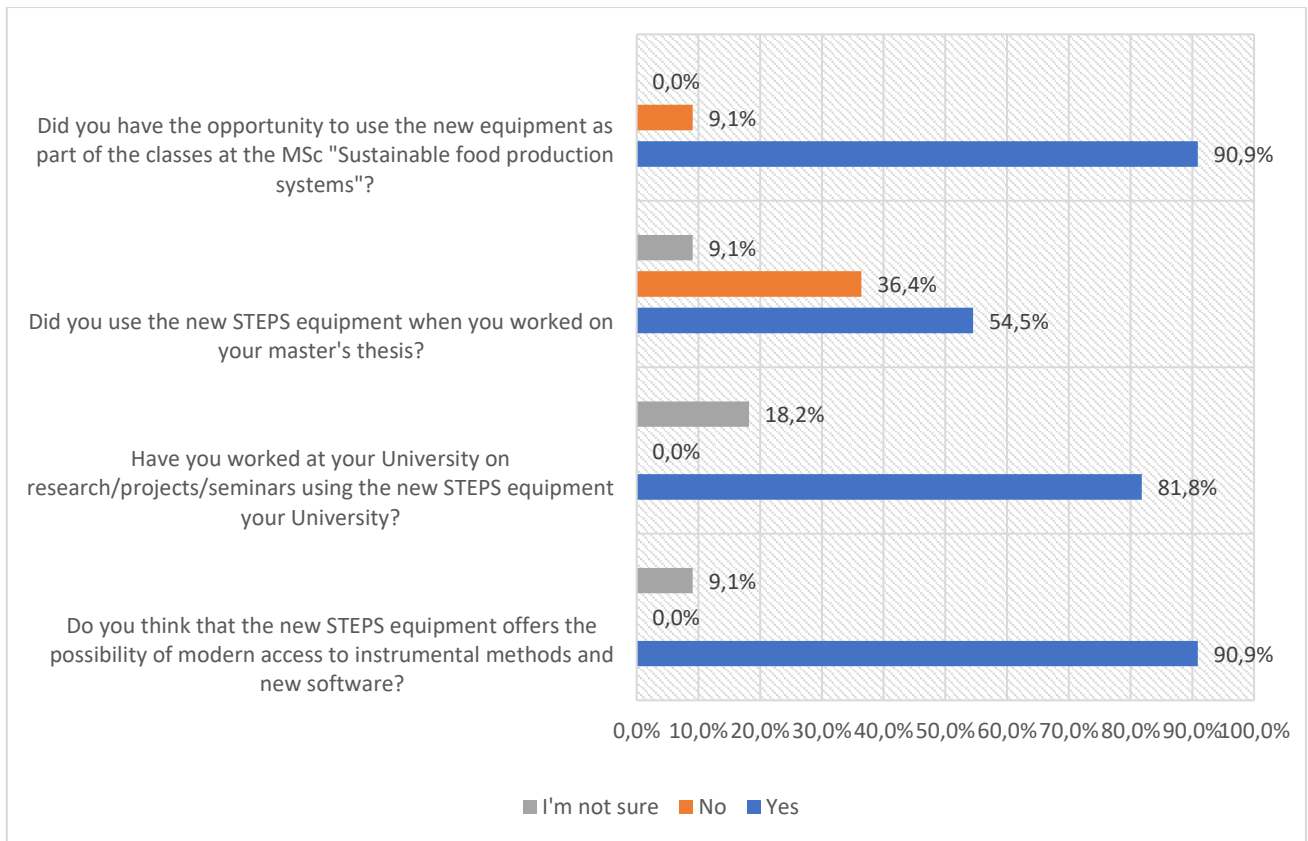


Figure 33. *Answers to questions related to the utilization and the potentials of STEPS equipment.*

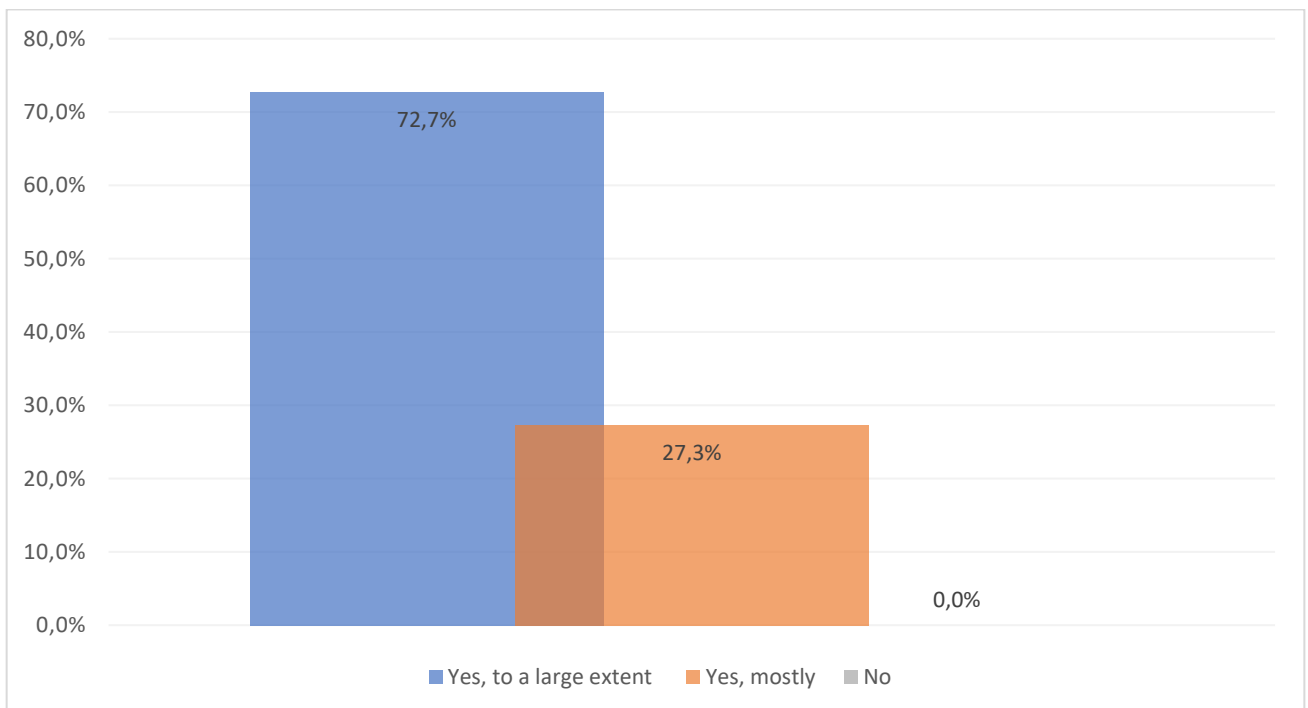


Figure 34. *Answers to the question: "Did the STEPS equipment expand your knowledge in the field of food quality control and management in food production systems?"*

The data we obtained when analyzing the answers to the questions whether the new STEPS equipment helped to expand your knowledge in the field of food quality control and management in food production systems

and whether satisfied with the new STEPS equipment at your university are encouraging. Namely, for the first question, the vast majority of student respondents answered "yes, to a large extent" (72.7% and 63.6%) and "yes, mostly" (27.3% and 36.4%), as shown by the results in **Figures 34 and 35**, while there were no negative answers. Also, as shown in **Figure 35**, a large number of students (72.7%) believe that the new STEPS equipment installed at the University is applicable for industrial simulations and project implementation together with the private sector, while 27.3% believe that this equipment is mainly applicable for conducting industrial simulations and joint application to projects with private companies.

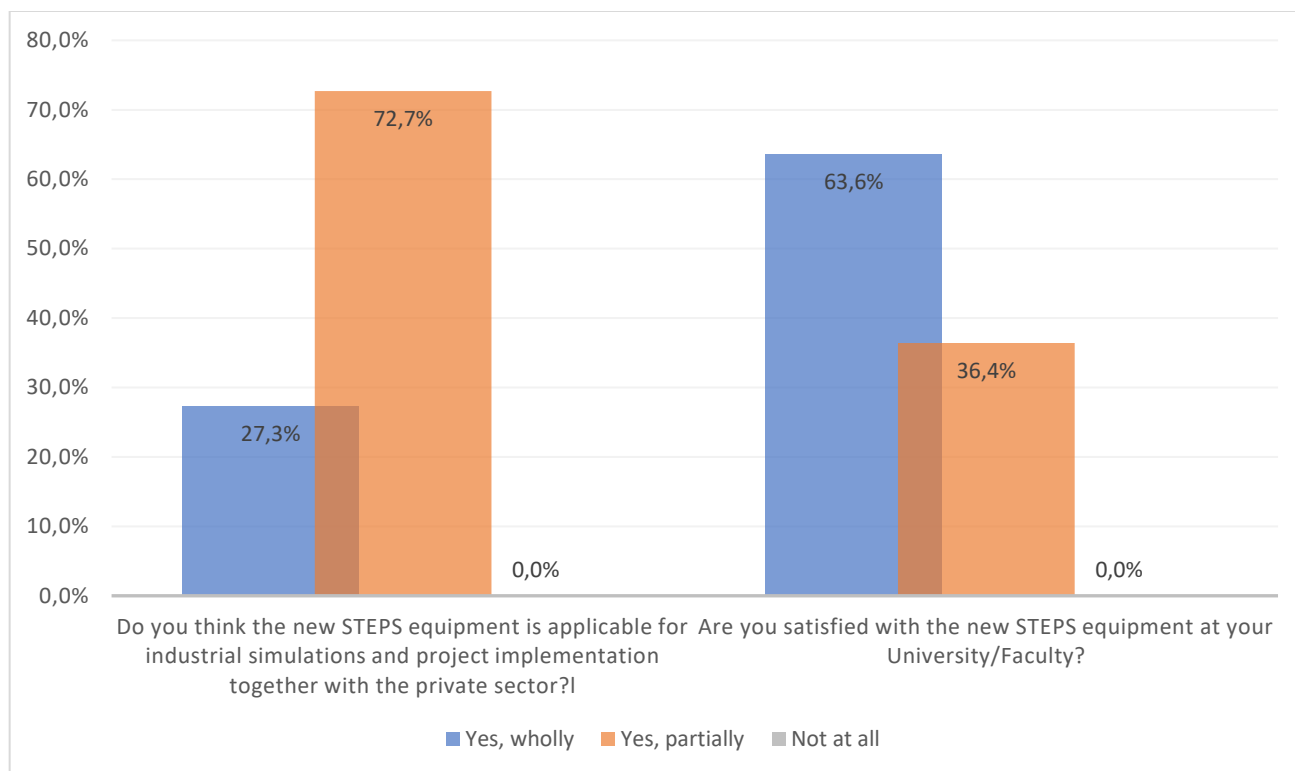


Figure 35. Answers related to the quality and relevance of the STEPS equipment in relation to industrial and academic use.

## Conclusion

After analyzing the results collected on the basis of these surveys, we can conclude that the newly acquired and installed STEPS equipment certainly contributed to the increase in the quality of teaching at UNBI, and to the expansion of students' knowledge in the field of sustainable agricultural and food production with an emphasis on quality control and management in food production systems. It is noticeable that this equipment has significantly strengthened the existing potential for scientific research projects in the field of "Food Quality Control Lab" and "Food Production Systems Management Lab". In the end, we can conclude that in addition to all of the above, this equipment provides the University of Bihać with the conditions for establishing cooperation with other universities and private companies in terms of applying for joint scientific research and development projects in the future, which is one of the goals of the Erasmus+ CBHE STEPS project.

#### 4.2 *Development of experiments/simulations and training material at University of Sarajevo (UNSA-P6)*

After the approval and establishment of the new MSc study program "Sustainable Food Production Systems" (STEPS) at the Faculty of Agriculture and Food Sciences in Sarajevo (first school/academic year 2020/2021), UNSA teaching staff began with a comprehensive approach and activities in designing and creating the necessary materials for theoretical and practical teaching of determined compulsory and elective courses/modules. In the context of fulfilling the tasks given within WP5 and defined activities (5.3. *Development of experiments / simulations and training material*), which refers to the development of experiments, simulations and materials for practical - laboratory exercises and student training, UNSA teaching staff has created and produced numerous materials for the needs of students, which consist of unauthorized exercises, scripts, manuals. In addition to the content and introductory notes, these materials contain the necessary guidelines and instructions, a description of laboratory exercises, software simulations and other forms of practical and experimental work of students.

A significant contribution to the development of quality teaching material in the form of the mentioned laboratory and other practical exercises came as a result of organized trainings based on WP2 (*D3.2 Seminars and lectures*) intended for teaching / scientific staff of HEIs partner countries, including UNSA. As planned by the project, these trainings, seminars and lectures were organized and conducted by HEIs staff from the program countries (USAMVB, ReadLab, CULS, and TEISTE/AUA).

For UNSA teaching staff, trainings conducted during the Peja and Sarajevo meeting were of special importance for the creation of the mentioned materials. However, as the development of experiments / simulations and training material is about continuous and constantly open activities and later conducted online and live trainings during the project were important for updating existing (*Bihać meeting*), and preparation for creating new training material in future (*Prishtina and Tirana meetings*). Experiments / simulations and training material was designed before the beginning of the teaching process, in accordance with the required and elective subjects or their syllabi.

It is important to point out that this material was developed for those courses that have a practical part in their teaching content - syllabus, whether it is practical, computational or laboratory exercises in the field of Food Quality Control Lab or software simulations in the field of Food Production Systems Management Lab. Thus, as part of the Advanced Food Science and Technology course, equipment purchased through the STEPS project was used, such as automatic autoclaves, an Elisa kit for the detection of total aflatoxins, or a spectrophotometer with an electronic single-channel pipette. Within the Sustainable Technology in Fruit and Vegetable Products module, pilot equipment was used for fruit processing (fruit mill, hydro press, flow pasteurizer, bottle sterilizer, etc.), while for the course Harvesting and Postharvest Technology, several student exercises were used portable NIR IR spectrometer. The ArcGIS desktop basic package is used as part of the purchased IT equipment and software solutions for the needs of the Sustainable Land Management and Food Production module.

Accordingly, for the purposes of training MSc STEPS students on UNSA experiments / simulations and training material was developed for the following compulsory (I semester) and elective courses (II and III semester):

- i) Agricultural and Food Industry Waste Management** - compulsory course of I semester. The course consists of three parts: waste management in primary agricultural production; waste management in the food industry of animal products; waste management in the food industry of plant products. For each of these three parts, exercise material was prepared as part of the

learning material for each individual part of the subject. Exercise material includes practical examples of calculation of gas emissions from agricultural production and examples of waste treatment from practice in B&H and the world (video materials, presentations and tours of farms and food plants). Based on this, students worked out their individual projects in all three parts of the course.

**ii) Advanced Food Science and Technology** - compulsory course of I semester. A total of 18 hours of practical work are planned. Laboratory work for students includes gravimetric, volumetric, thermal, titration and spectrophotometric analyses, and the use of these techniques to analyze chemical substances and their reactions. The training material is in the form of unauthorized PPT presentations.

**iii) Food Legislation** – compulsory course of the first semester. The course is of theoretical-discussion type, without planned practical or laboratory exercises. Prepared teaching materials: Power Point presentation for teaching units distributed in 15 weeks of the semester. The Power Point presentation of each teaching unit is accompanied by a reading list, links to reference websites and portals and/or links to external video contents. Teaching materials were used on an LMS platform in the conditions of online teaching during the COVID-19 pandemic, so they can be easily transferred to the STEPS LMS platform.

**iv) Low Input Agriculture** – elective course of the II semester. The training material in the form of unauthorized scripts or manuals under the title Low Input Agriculture, which accompanies the theoretical part of sliabus and its entitle is compliant with its content related to laboratory and calculation exercises. This material in addition to 10 laboratory and calculus exercises also contains chapters of the instructions, guidelines and information related to organic and integral plant and animal production.

**v) Rural Development** – elective course in II semester. The practical part of the course refers to the development of a local rural development plan for a particular area. Through 15 hours of practical work, students work on the situational analysis of the selected area, SWOT analysis, proposal of priorities and finally defining measures of local rural development of the selected area. Through various planning and programming tools, students acquire the necessary knowledge and skills in making local rural development plans.

**vi) Harvesting and Post Harvesting Technologies** - elective courses in the II semester. For the practical training of students in this subject, training material was prepared in the form of the unauthorized power point presentations, which follows the theoretical part of the silaby and they are fully consistent with its content related to Practical-Laboratory and accounting exercises. In addition to 9 laboratory exercises, this material also contains chapters of instructions, guidelines and information related to harvesting, handling, packaging and storage of fruits, vegetables and field crops.

**vii) Sustainable land management and food production** - elective courses in the II semester. A total of 15 hours of practical work are planned. The first part of the practical work (nine hours) is referring to pedological laboratory work. Students apply standard methods when it comes to the analysis of the physical, mechanical, and chemical properties of the soil. There is a total of seven thematic exercises. The second part of the exercise (six hours) refers to the application of the Geographic Information System (GIS). Within these exercises, students are getting familiar with GIS as a tool as well as the internationally recognized methods in land evaluation and agro-ecological zoning for purposes of agricultural production planning in relation to economic sustainability, quality of the environment, and social security. This part of practical work is

developed jointly with students following their needs and interests. Exercises include creating thematic maps, performing spatial analyzes, trend analysis, etc. Students use a practicum in which standard soil analysis methods are being described. When it comes to GIS practical work, students have at disposal internal materials for exercises, as well as digital data from the faculty database. The ArcGIS Desktop software package (basic and academic license), purchased by the project, is used for exercises. For the realization of practical exercises and homework as well as analyzes for the preparation of seminar and master papers, students are provided with online access to software, which is undoubtedly a significant advantage when it comes to this part of the teaching process.

**viii) Sustainable technology in fruit and vegetable products** - elective course of III semester. Since the syllabus of the course also envisages practical work with students, an unauthorized script called “Fruit and Vegetable Processing from the aspect of sustainability” was prepared. The material describes in detail the technological lines of production of fruit and vegetable products with special emphasis on the critical points of water and energy consumption and waste generation (the pilot plant for fruit processing). Also, the script describes 23 laboratory exercises for physico-chemical analysis of raw materials, semi-finished and finished products as well as waste generated from the processing of fruits and vegetables, which is a valuable source of bioactive components.

**ix) Sustainable Wine Production** – Elective course in the third semester of the study Sustainable Food Production Systems at the University of Sarajevo – Faculty of Agriculture and Food Sciences. The subject is a combination of theoretical presentations of teachers and practical laboratory exercises related to wine quality control. Teaching units are distributed in 15 weeks of teaching. A teacher's Power Point presentation was prepared for each teaching unit. Along with the Power Point presentation of each teaching unit there is a reading list (chapters from books, articles, special thematic texts, etc.), and links to thematic portals and websites with some teaching units. The entire teaching material was used in the implementation of online teaching in the conditions of the COVID-19 pandemic, so it can be easily transferred to the STEPS LMS platform. Laboratory equipment procured with the implementation of the STEPS project enabled the expansion of wine quality analysis through, eg detection of mycotoxins in wines using purchased equipment for *Elisa* testing or determining the chromatic properties of wine and other beverages using the purchased *spectrophotometer*. In addition to the realization of regular laboratory exercises, the purchased spectrophotometer is also used for research required for the master's thesis of a student of the first generation of STEPS study program at the University of Sarajevo. Through the planned innovation of the syllabus of the Sustainable Wine Production course, modeling of micro fermentations using yeasts isolated from spontaneous populations is also envisaged. For these model fermentations, the *autoclave* purchased through the realization of the STEPS project will be of great help in the multiplication of yeasts from spontaneous populations necessary for such or similar experimental yeast fermentations.

**x) Sustainable Technology of Dairy Products** - elective course of III semester. As part of this elective course of the third semester, which includes laboratory exercises in its syllabus, practical exercises were held in the production of the most important dairy products (fermented milk, sour cream, butter, cheese) and physical and chemical analysis of these dairy products, paying special attention to sustainability. Written materials were prepared and distributed to students. Also, examples of dairies (presentations and videos) from different parts of the world are presented, where examples from practice are presented.

**xi) Sustainable Technology of Meat Products** - elective course of III semester. The course in its syllabus contains laboratory exercises, prepared material in the form of an unauthorized script called Sustainable technology of meat products, which in addition to basic information about meat contains 14 laboratory exercises that give students the opportunity to easily and quickly adopt through theoretical knowledge and practical work in the laboratory basic knowledge of meat as well as methods of determining basic qualitative components.

**xii) Sustainable technology of cereal food** - elective course of III semester. No exercises are planned within the module. The independent projects or seminars will be created according to the interests of students in the field of grain processing in selected industry plant and they will concern identification and classification of waste and by-products in cereal processing and recommendations of their reduction and eventually reutilization in a particular process. Projects would be carried out in a team of 3 to 5 members.

#### **4.2.1. Progress of the tasks**

UNSA's research laboratories have been developed with new equipment acquired through the STEPS project, which will increase the quality of the teaching process and support the development and relevance of courses where this equipment is used. Equipment and "ArcGIS" software have been purchased and installed. The equipment will be used to improve the quality of teaching and the level of knowledge, but will also increase the capabilities of the scientific staff so that they can prepare and publish research papers in international scientific journals and conferences and participate in various scientific research projects. In order to monitor progress according to defined indicators, we state that for the training of MSc STEPS UNSA students in the field of Food Quality Control Lab designed and written a number of scripts and unauthorized (usually PPT) materials, which included over 100 individual laboratory exercises from different areas, and a large number of chapters of instructions, guidelines and information for students. Within the Food Production Systems Management Lab, a 3x1 Year Term License was obtained for ArcGIS software (*ArcGIS DESKTOP BASIC PACKAGE*). ArcGIS Desktop (featuring ArcGIS Pro) is the foundational piece of the ArcGIS platform. GIS professionals can create, analyze, manage, and share geographic information so decision makers can make intelligent, informed decisions. It allows you to create maps, perform spatial analysis, and manage data. ArcGIS Desktop Basic provides the tools and environment for map creation and interactive visualization.

#### **4.2.2. Collected data on the level of satisfaction regarding the STEPS equipment**

For the purpose of impartial collection and analysis of satisfaction data on STEPS equipment, UNSA will conduct two online surveys. First survey "[Level of satisfaction with the new equipment purchased within the Erasmus+ STEPS project \(Scientific/Teaching/Technical staff\)](#)" is intended for teaching, scientific and technical staff of the Faculty of Agriculture and Food Sciences of UNSA, while the second survey "[Level of satisfaction with the new equipment purchased within the Erasmus+ STEPS project \(students\)](#)" will be conducted using the MSc STEPS UNSA students as the target group.

### UNSA faculty staff answers

To impartially collect and analyse data on the level of satisfaction with STEPS equipment, UNSA, like other partners, conducted two online surveys. "Level of satisfaction with new equipment purchased within the framework of the Erasmus+ STEPS project (scientific/teaching/technical staff)" was the first survey. The target group was teachers and scientific-technical staff of the Faculty of Agriculture and Food Science of UNSA who are in the process of teaching (laboratories and software-based exercises), intensively using the new UNSA STEPS laboratory and instrumental equipment. After analysis, the results of this survey are presented in graphs grouped based on the same offered answers for a more rational presentation.

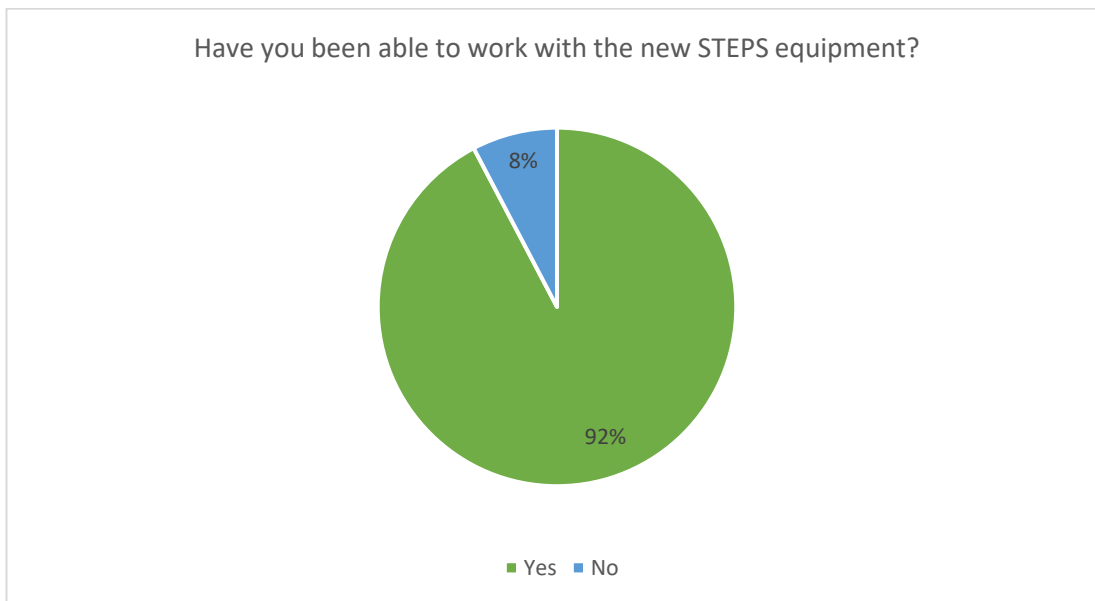


Figure 36. Answers to the question: "Have you been able to work with the new STEPS project?".

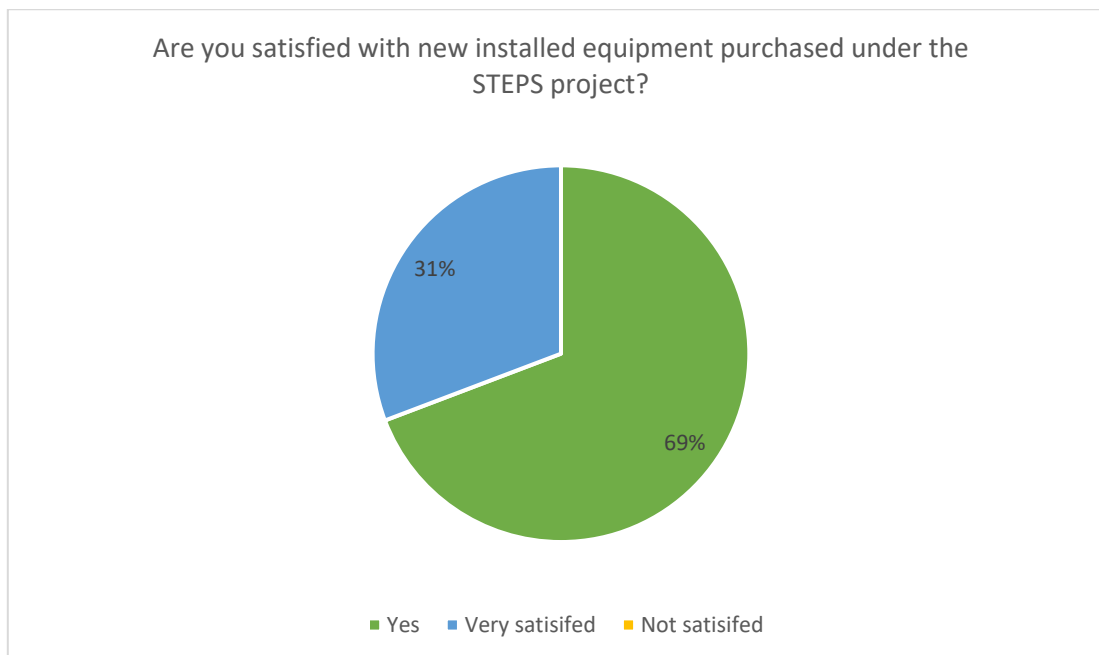


Figure 37. Answers to the question: "Are you satisfied with the new, installed equipment purchased under the STEPS project?".



Figure 36 shows the analyzed results of the first question in general, “Have you been able to work with the new STEPS equipment?” As can be seen from the presented results, the vast majority of respondents (92%) responded positively to this question, while the percentage of negative responses was 8%.

Figure 37 shows the results of the responses of respondents who had the opportunity to use this equipment in the process of performing exercises and simulations in the field of food quality control and management of food production systems during the classes process of the MSc STEPS study program. As can be seen from these results, all respondents were satisfied (69%) or very satisfied (31%) with the newly installed STEPS equipment at UNSA.

Teaching staff and associates are most invited to evaluate the usefulness of the acquired equipment through the STEPS program. Therefore, the third question asked to the respondents was, „Does the new STEPS equipment support the syllabus of the study program of the II cycle of studies „Sustainable food production systems”. As can be seen from **Figure 38**, the answers were impressive. A large number (69%) of the staff who had the opportunity to use new equipment answered that the STEPS equipment fully supports the curriculum of the Master's program of the same name. In comparison, 23% of respondents stated that the usefulness of the purchased equipment is partial, while 8% didn't know the answer to this question.

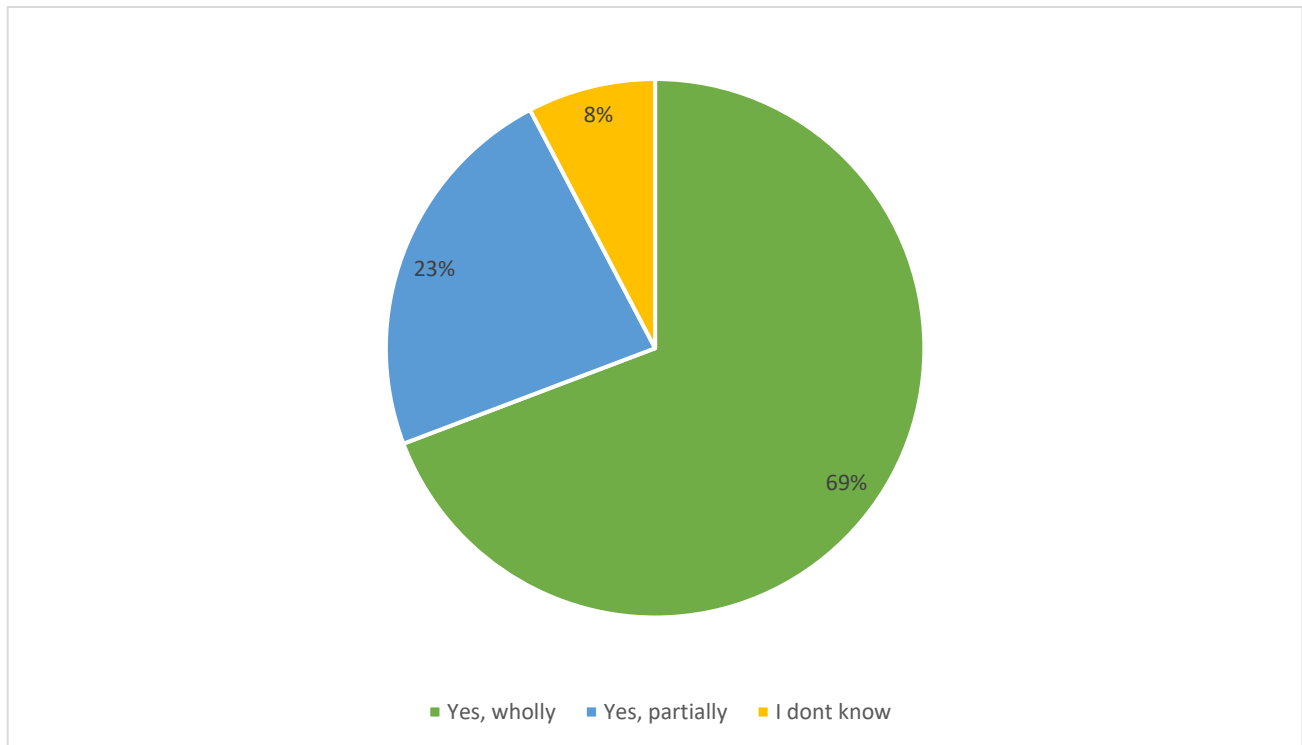


Figure 38. Answers to the question: “Does the STEPS equipment support the syllabus of the STEPS MSc program?”.

**Figure 39** presents a group of questions related to improving work in laboratories in terms of strengthening methods and standards and conducting joint research and industrial simulations with other universities and private companies. Most respondents believe that the STEPS equipment at UNSA can help introduce new methods in a laboratory and provide optimal conditions for scientific research (69%). Higher percentage (92%) believes that equipment is suitable for giving modern access to instrumental methods and applications. Also, there was a high percentage of positive answers (92%) to the question, „Has the new STEPS equipment improved the quality of teaching within your university's study program?” Only 8% of respondents are not sure this equipment will improve study programs or laboratory methods.

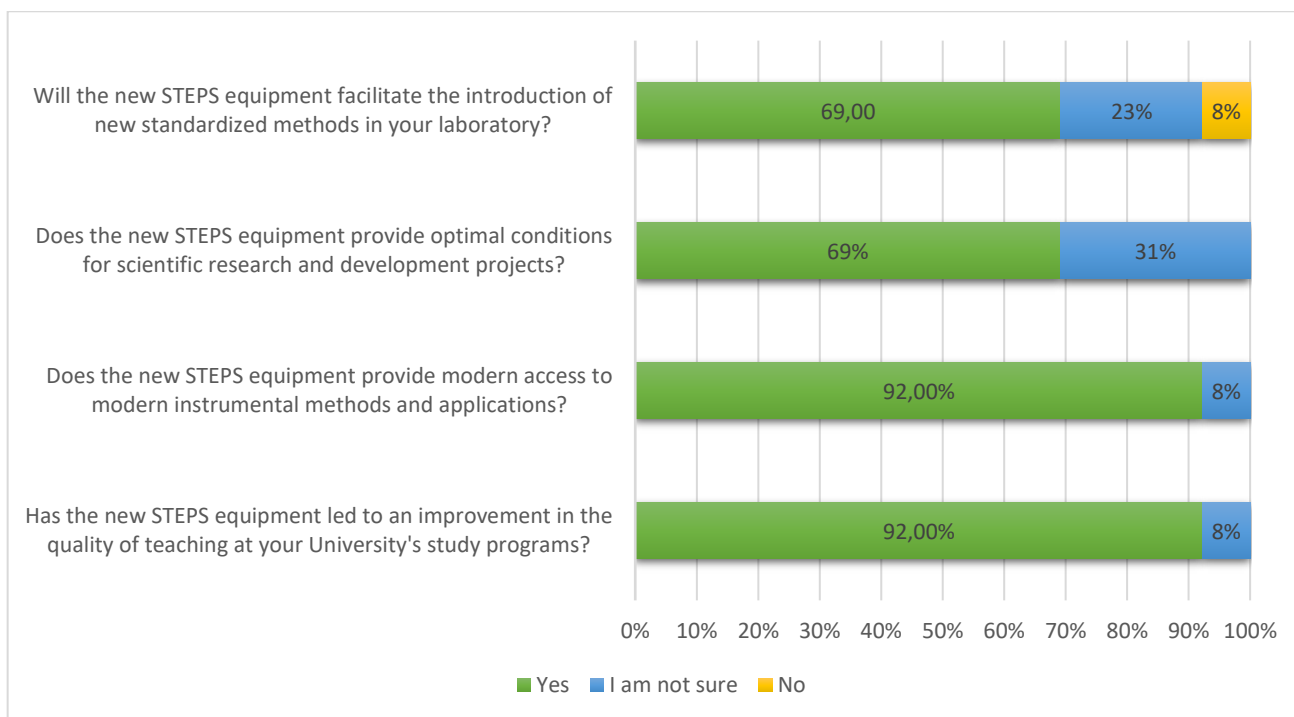


Figure 39. *Answers to questions related the quality of laboratories in terms of strengthening methods and standards and conducting joint research and industrial simulations with other universities and private companies.*

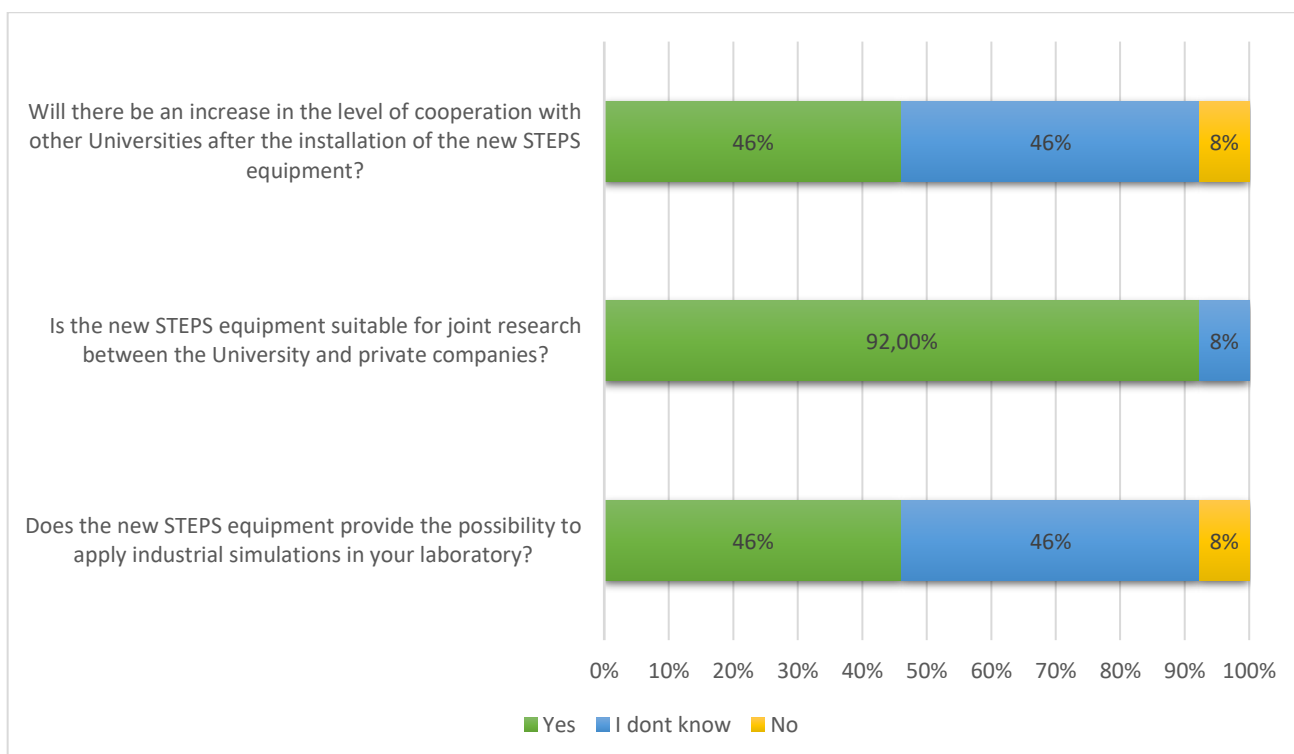


Figure 40. *Answers to a group of questions related to the establishing cooperation and conducting joint research and industrial simulations with other universities and private companies.*

Further, the results related to the potential of the newly installed STEPS equipment are shown (**Figure 40**) in terms of establishing cooperation and conducting joint research and industrial simulations with other universities and private companies. The most significant number of positive answers (92%) was to the question, "Is the new STEPS equipment suitable for joint research between the University and private companies? Only 8% of the faculty staff think they are not sure if this equipment meets their requirements for joint research between universities and private companies. However, a significantly lower percentage of affirmative answers (46%) was recorded when answering the topic of equipment support with industrial simulations compared to the previous questions. The number of negative responses to this question is 8%, while the percentage of those who are unsure is 46%. From the above results, it can be concluded that the newly acquired and installed STEPS equipment at UNSA can only partially meet the requirements for performing simulations from the industry. The same situation is with the question, "Will there be an increase in the level of cooperation with other Universities after the installation of the new STEPS equipment?" where 46% of responses have a positive answer, 46% are not sure, while only 85 think that this will not improve cooperation with other Universities.

### **Students' answers**

The second survey, "Level of satisfaction with new equipment purchased as part of the Erasmus+ STEPS project (students)," was conducted with two generations of UNSA STEPS students in November 2022. The reason for the relatively late start of the survey is the initiation of the application procedure for the topics of the student's master's thesis and the beginning of intensive exploitation of the equipment in terms of conducting research related to the needs of master's theses to obtain comprehensive and credible feedback from the student. Also, for a more accessible presentation, the results of this survey, just like the surveys for teaching, scientific and technical staff, are grouped in graphs based on the same or similar answers while processing the obtained data and their analysis. Thus, the first question, "Are you aware that your university acquired new laboratory and IT equipment as part of the Erasmus+ project MSc in Sustainable Food Production Systems/STEPS" is shown independently on **Figure 41** due to the unique answer offered. From the analyzed answers to this question, it is evident that every student (100%) is aware that UNSA, within the framework of the Erasmus+ STEPS project, acquired laboratory and IT equipment to strengthen the infrastructure, especially laboratory capacities.

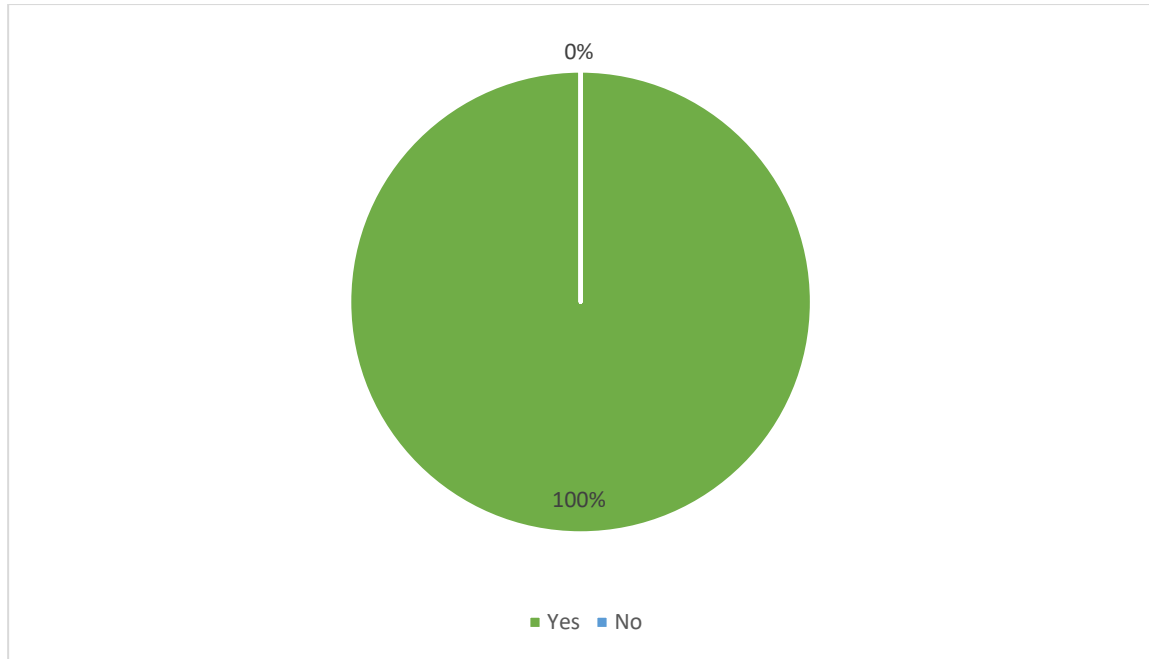


Figure 41. Answers to the question: “Are you aware that your University has acquired new laboratory and IT equipment as part of the Erasmus+ project MSc in Sustainable Food Production Systems/STEPS?”.

The following further series of responses to this survey, the analysed results shown in **Figure 42**, show that 71,4% of students believe that the new STEPS equipment at UNSA fully supports agriculture and food technology curricula. However, 28,6% of the surveyed students believe this support is partial, that is, this equipment mostly follows the curricula of these fields. With the answers to the question about the support of STEPS equipment to the curricula of the new MSc Sustainable Food Production Systems study program, 42,9% of respondents think that equipment suits all needs, while 57,1% believe this is only partial.

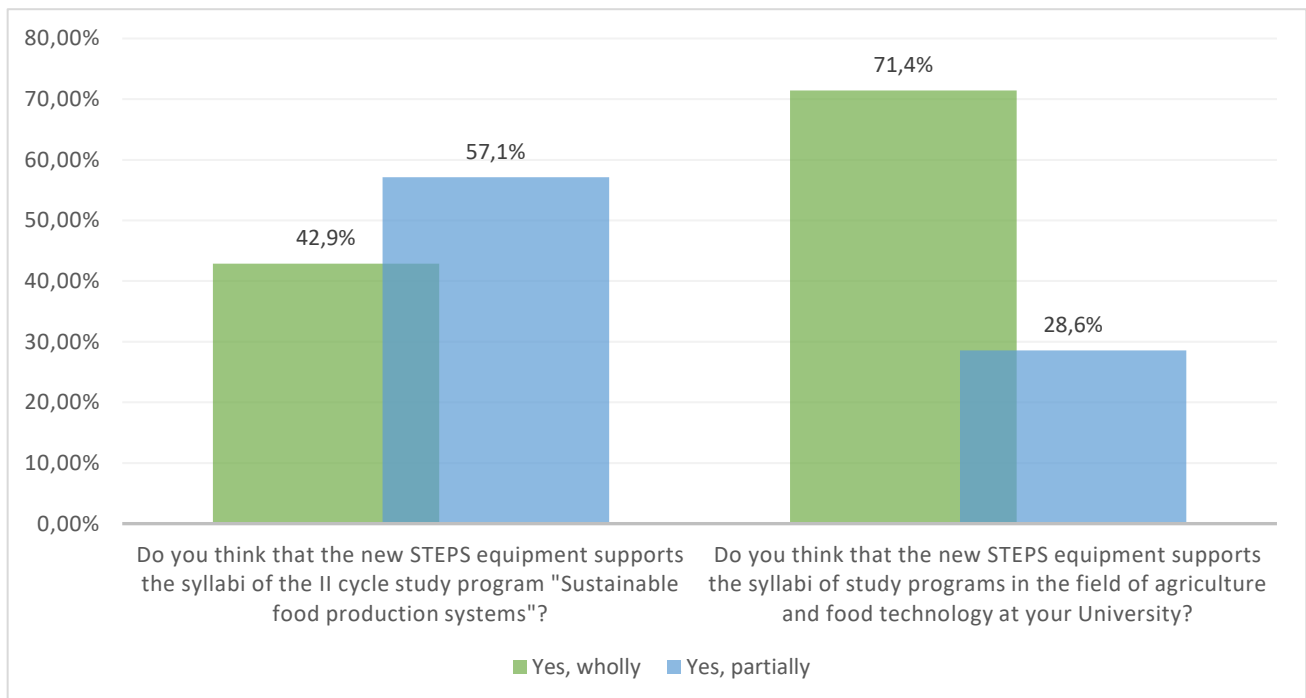


Figure 42. Answers to questions related to the quality and relevance of the STEPS equipment in MSc program faculty levels.

We asked students whether they had the opportunity to use the new STEPS equipment during classes on the MSc Sustainable Food Production Systems study program and whether they thought this equipment offered the possibility of modern access to instrumental methods and new software. The results are shown in **Figure 43**. On two questions, we have the same results. These two questions are: “Have you worked on research/projects/seminars in your University that used the new STEPS equipment at your University?” and “Do you think that the new STEPS equipment offers the possibility of modern access to instrumental methods and new software?” had most positive answers (71%), while 29% have the negative answer (first question) or not sure (second mentioned question). A total of 57% of those surveyed had the opportunity to work on new equipment as part of their classes. This percentage will be higher after the newly enrolled students who responded to the survey have completed all the planned laboratory exercises. For now, 43% are unsure if they had the opportunity to work on this equipment.

Only 14% of students had an opportunity to work on their master's thesis on new equipment. The high prevalence of negative answers regarding this question is probably related to the fact that at the time of the survey, all MSc STEPS students had not yet started research work within their master's thesis.

The data we obtained when analyzing the answers to the questions of whether the new STEPS equipment helped to expand your knowledge in the field of food quality control and management in food production systems and whether you are satisfied with the new STEPS equipment at your university is encouraging. For example, in **Figure 44**, it is possible to see that 71% of students are delighted with the equipment, while 29% are not sure. Therefore, most students (57%) think this equipment has helped expand their knowledge about food quality control and management in food production systems.

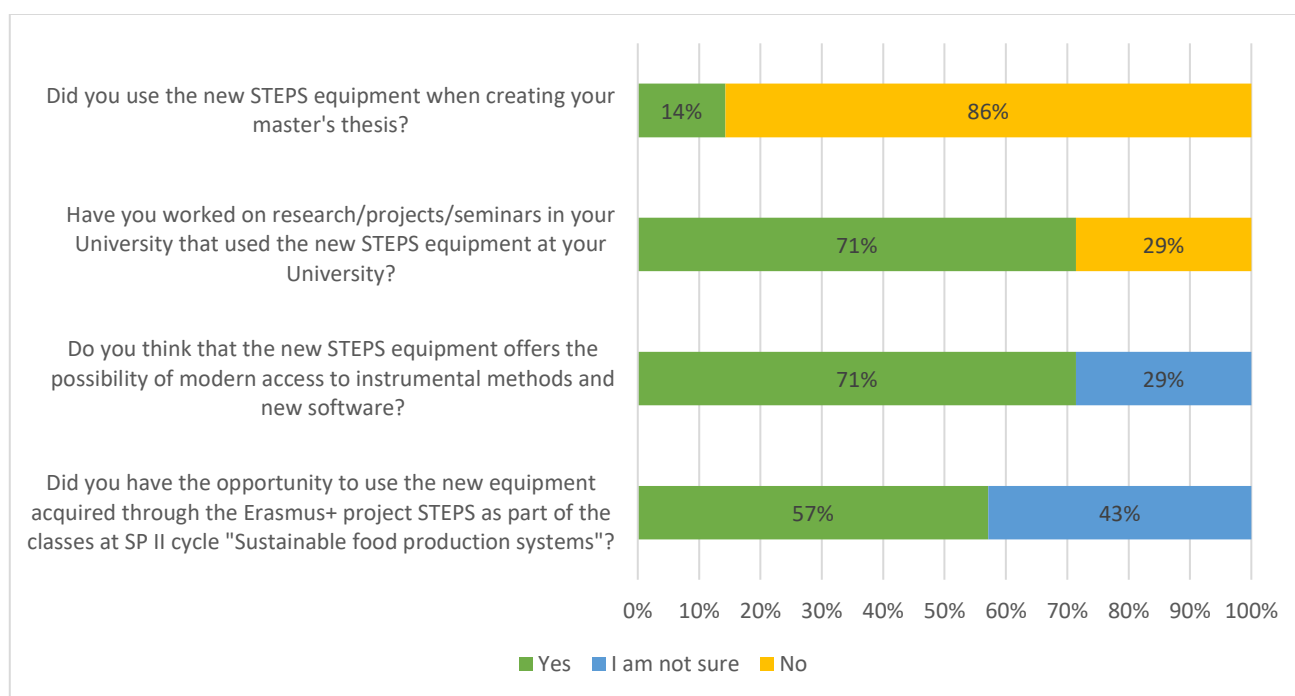


Figure 43. Answers to questions related to students' involvement in the utilization of the STEPS equipment.

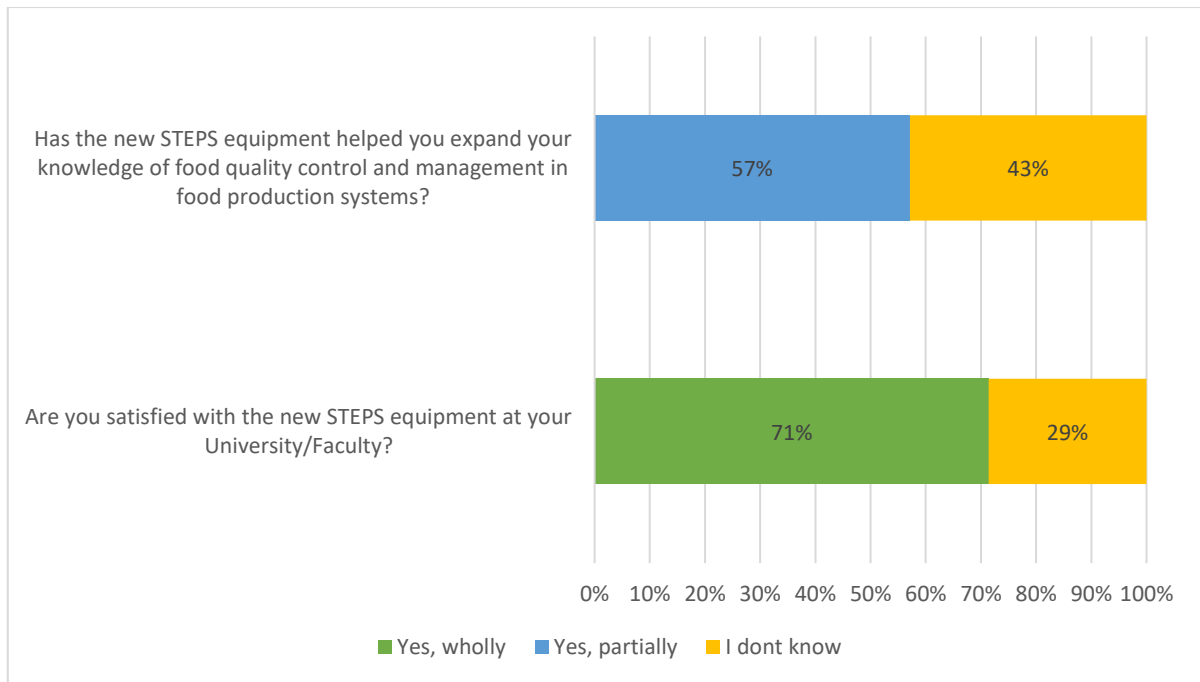


Figure 44. Answers to questions related to the STEPS equipment benefits and students' satisfaction at MSc programme and faculty level.

## 5 DOCUMENTS RELATED TO THE DEVELOPMENT OF EXPERIMENTS/SIMULATIONS AND TRAINING MATERIAL IN PARTNER COUNTRIES HEIS

1. All the documents related to the development of experiments/simulations and training material at the **AUT** can be found on the following link:  
[https://drive.google.com/drive/folders/1PLiMLgAJnBv2Y3DfHeK7jSTgDzZNzSli?usp=share\\_link](https://drive.google.com/drive/folders/1PLiMLgAJnBv2Y3DfHeK7jSTgDzZNzSli?usp=share_link)
2. All the documents related to the development of experiments/simulations and training material at the **EUT** can be found on the following link:  
[https://drive.google.com/drive/folders/1afn3l8iMwUAaUxM6b45LO1yy164k-wou?usp=share\\_link](https://drive.google.com/drive/folders/1afn3l8iMwUAaUxM6b45LO1yy164k-wou?usp=share_link)
3. All the documents related to the development of experiments/simulations and training material at the **UC** can be found on the following link:  
[https://drive.google.com/drive/folders/1K1iJdjxDuqnlK9fhiaWipV-HUfWB95?usp=share\\_link](https://drive.google.com/drive/folders/1K1iJdjxDuqnlK9fhiaWipV-HUfWB95?usp=share_link)
4. All the documents related to the development of experiments/simulations and training material at the **UHZ** can be found on the following link:  
[https://drive.google.com/drive/folders/1ZBXbwdPacZ-2E6dsOoSTR0s2VtO1rPGi?usp=share\\_link](https://drive.google.com/drive/folders/1ZBXbwdPacZ-2E6dsOoSTR0s2VtO1rPGi?usp=share_link)
5. All the documents related to the development of experiments/simulations and training material at the **UNBI** can be found on the following link:  
[https://drive.google.com/drive/folders/19riWZ7Q81mz\\_8rWAMw\\_VQCfWYE8\\_NmcR?usp=sharing](https://drive.google.com/drive/folders/19riWZ7Q81mz_8rWAMw_VQCfWYE8_NmcR?usp=sharing)
6. All the documents related to the development of experiments/simulations and training material at the **UNSA** can be found on the following link:  
[https://drive.google.com/drive/folders/1N1MI7xTDWRbHEhtv7e7WVb\\_ocy4GKRtx?usp=share\\_link](https://drive.google.com/drive/folders/1N1MI7xTDWRbHEhtv7e7WVb_ocy4GKRtx?usp=share_link)

## 6 CONCLUSIONS

From the information collected from project's partners, it can be concluded that the expected result of activity 5.3 from WP5 has been achieved at all partner countries HEIs. At the beginning of the implementation of these activities, UNBI provided guidance to align educational material with the theoretical part of the courses. Scientific staff of partner countries HEIs, supervised and mentored by the scientific staff from the program countries, designed Educational material: laboratory exercises and software-based exercises and projects with the aim of ultimately exploiting the purchased STEPS equipment and further improving the level of knowledge and the relevance of a variety of courses. This education and training material was developed for compulsory and elective courses based on learning outcomes at the experiment/simulation level. It includes detailed description of the experiments/simulations, guidance and description of steps towards the successful implementation of the study process. Scientific staff involved in the development *Food Quality Control Lab* and *Food Production Systems Management Lab* worked on training material development based on each experiment and simulation. In partner countries HEIs educational material in terms of laboratory exercises, software-based exercises, manuals, scripts were developed for a total of 42 MSc STEPS courses. In total, 106 manuals/scripts with 383 individual laboratory exercises and software-based exercises were developed for these courses. In the second part of this report, online survey results, collected for the purpose of measuring satisfaction level data with regards to STEPS equipment utilization, were presented. This Survey was conducted with scientific staff at Partner Countries HEIs and MSc students/attendees during the implementation of the MSc program.

## 7 RECOMMENDATIONS

Development of educational material that supports the laboratory and software-based exercises is an open process. Therefore, it is recommended to all partner country HEIs to continue working of existing and new MSc STEPS educational materials following trends, innovations and new technologies even after the lifetime of the project.