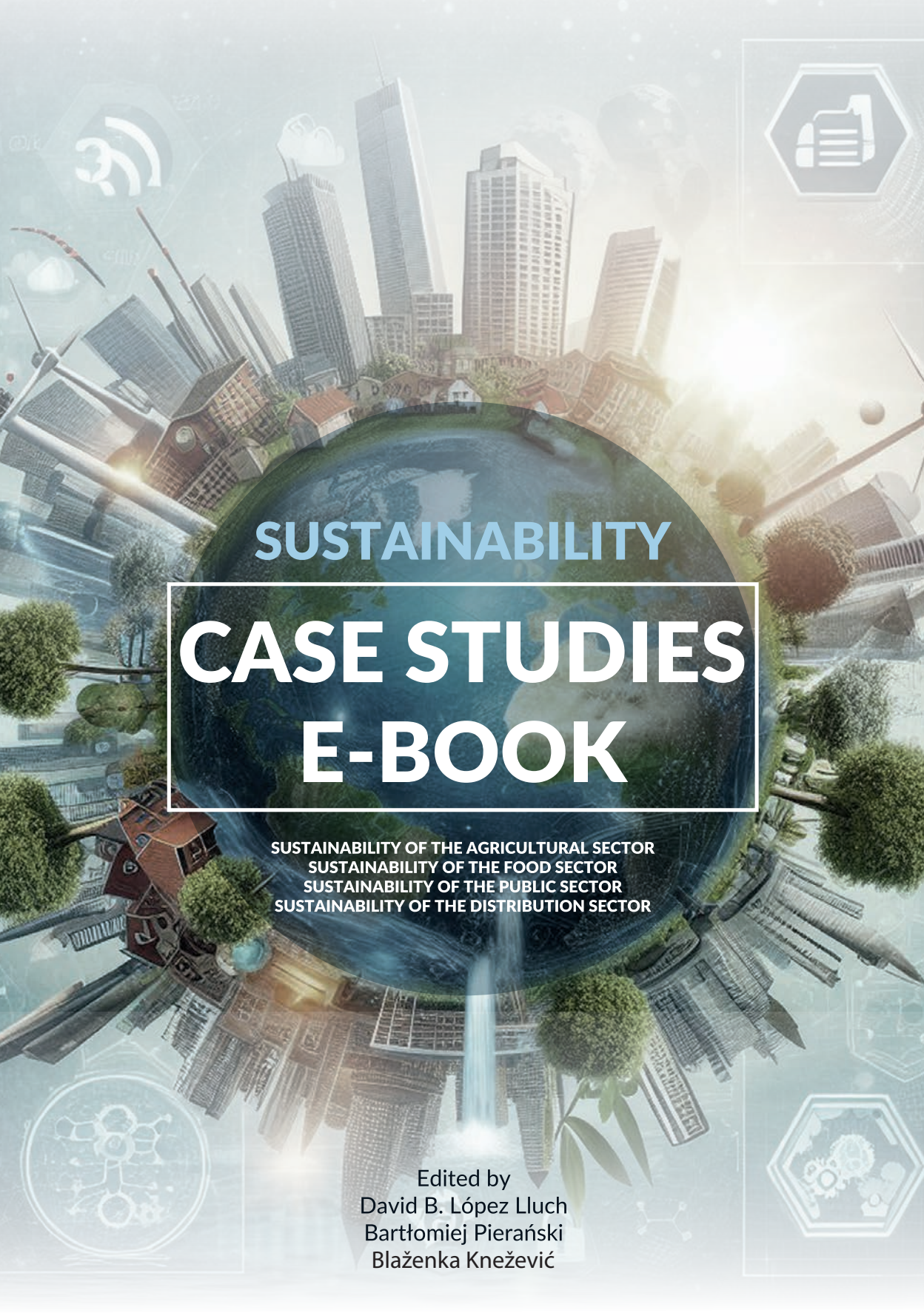

SUSTAINABILITY

CASE STUDIES E-BOOK

SUSTAINABILITY OF THE AGRICULTURAL SECTOR
SUSTAINABILITY OF THE FOOD SECTOR
SUSTAINABILITY OF THE PUBLIC SECTOR
SUSTAINABILITY OF THE DISTRIBUTION SECTOR

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Introduction

Long is the path of teaching by means of theories; brief and effective by means of examples.

Seneca

Personally, I am always willing to learn, although I do not always like to be given lessons.

Winston Churchill

1. Definition of the case method

Today's world is in the midst of two types of societies: the information society and the knowledge society:

- The **information society** is understood as one with a growing technological capacity to store and disseminate a considerable volume of information, at a speed that tends to grow exponentially.
- On the other hand, a **knowledge society** is defined as one that is capable of making a critical, and therefore selective, appropriation of the information that is acquired and generated. It is a type of society that examines, analyses and creates an opinion in order to constructively assimilate the available information.

Parallel to a society that knows, there is a society that learns and that must critically investigate its learning models. Within the framework of the European Higher Education Area in which the University currently operates, methodologies for active learning are trying to promote a teaching-learning model in which the main role corresponds to the student, who builds knowledge from guidelines, activities or scenarios designed by the teacher.

Innovation can be defined as an intentional and planned process, which is based on theory and reflection and which responds to the needs for transformation of practices to better achieve the objectives (Salinas, 2004). That is, the planned introduction of a change, which results in an optimization of pedagogical practices. Therefore, **teaching innovation would be that intentional and planned process with a view to improving the objectives of teaching.**

In this sense, if we ask several people to describe how they learned something really important and that they remember clearly, they will usually not remember formal school situations, but moments in life in which they had to face real, complex and significant problems. The real problems, the ones that are really significant, usually have nothing to do with routine mechanical exercises, with a single predetermined solution, which students are usually required to do in educational centres and which are generically known as problems.

This is true without losing sight of the premise that **best practice is good theory**. The phrase, though attributed to Popper, seems largely to be Kurt Lewin's, although its origin is earlier, and its reliable trace back to James Clerk Maxwell. Popper viewed scientific progress not as the accumulation of observations, but as t*he repeated overthrow of scientific theories and their replacement by better or more satisfactory ones*. To arrive at a good theory, Popper proposed a methodology that *started from the investigation of problems that are expected to be solved*. Faced with them, a tentative solution is offered through the formulation of theories, hypotheses, conjectures. The various competing theories are compared and critically discussed with a view to detecting their shortcomings. Finally, the results of the critical discussion emerge, what for Popper would be called the science of the day. For Popper, therefore, science is hypothetical and conjectural knowledge.

This is, perhaps, the model through which technology and science advance, interlocking with each other. This conjunction of theory and practice has a lot to do with the **case method.**

A method is a regulated procedure, configured as a step-by-step action plan and determined by the teacher's goals and the students' objectives. The selection of a methodology has to take into consideration variables such as number and characteristics of students, subject matter, teacher, circumstantial complements of the teaching-learning process, and social and cultural variables (Fernández March, 2006).

The Case Method (MoC), also called analysis or case study, is the study of a specific situation to learn or improve in a field of knowledge.

A case can be defined as a story, a story with a message. The cases are not mere narratives intended to entertain, they are stories to educate. Thus, a case is a vehicle or tool through which a real problem is brought to the classroom so that students and the teacher can carefully examine the situation raised and develop, through the discussion that is generated, knowledge and skills, attitudes and values of according to the specific objectives of the session and the general objectives of the course.

The cases relate real (or realistic) events or problems so that students can experience the complexities, ambiguities and uncertainties faced by the subjects involved in the situation being analyzed. At the same time, students must live the case. They must be able to recognize and organize the key elements based on all the available information, separating the wheat from the chaff. Just as in real life, information must be abundant, complex, and sometimes conveniently contradictory.

Used properly, it is one of the techniques that favours learning by discovery, learning that encourages students to ask questions and formulate their own answers as well as deduce principles from practical examples or experiences.

A case is a review or description of a situation or a sequence of events from which a series of questions or problems emerge for analysis and the proposal of a solution. A good case, according to Guàrdía *et al* (2007):

- Tells a story
- Delve into a topic that arouses interest
- The topic is current or relevant to training
- Create empathy with the central character
- Includes quotes and dialogues
- Is relevant to the reader
- Has pedagogical utility
- Causes conflict
- Force decision making
- Allows a certain degree of generalisation
- It has a suitable extension
- It is based on a real situation/context
- Presents or infers a problem
- Provides information (complete or partial)
- Promotes discussion
- Promotes strategic thinking
- Usually does not have a unique solution
- Interested in both the process and the result.

The MoC dates back, according to Zamora (2010), to 1870 when Christopher Laudell introduced it at the School of Law of Harvard University as a strategy for the training of professionals. The objective was, when learning Law, that law students will face real situations and have to make decisions, assess actions, issue well-founded judgments, etc. Others date its origin as a learning technique at Harvard University in approximately 1914.

Over the years, the MoC has been extended to other contexts, studies, etc. and it has become a very effective strategy for students to acquire diverse learning and develop different skills thanks to the leading role they have in solving cases.
The MoC is an active learning technique, centred on the student's investigation of a real and specific problem that helps students to acquire the basis for an inductive study (Boehrer & Linsky, 1990). It starts with the definition of a specific case so that the student is able to understand, know and analyse the entire context and variables involved in the case.
Asopa & Beve (2001) define MoC as a learning method based on the active, cooperative participation and democratic dialogue of students about a real situation. In this definition, three fundamental dimensions stand out within the MdC (Universidad Politécnica de Madrid, 2008):

- the importance of students taking an active role in the case study,
- who are willing to cooperate with their peers and
- that dialogue is the essential basis for reaching consensus and making joint decisions.

The objectives of this technique are (Rodríguez - Piñeiro, 2013):

- Train future professionals capable of finding for each particular problem the expert, personal solution adapted to the given environmental, social, human, economic, technical and legal context.
- Work from a professional perspective on the problems of a given domain.

The professional approach starts from a real problem, with its elements of confusion, sometimes contradictory, as in reality they are given and requested (Universidad Politécnica de Madrid, 2008).

- a professional, theoretically well-founded description,
- compare the concrete situation presented with the theoretical model,
- identify the peculiarities of the case,
- propose case solution strategies, apply and evaluate the results.
- create learning contexts that facilitate the construction of knowledge and favour the verbalization, explanation, contrast and reworking of ideas and knowledge.

In other words, t**he ultimate goal of the MoC is to equip students with the necessary skills to know how to analyse technical or business problems, reconcile various perspectives, decide on a solution, and convince others.**

It is, therefore, a group technique that encourages student participation, develops a critical spirit and prepares them for decision-making, defending arguments and contrasting opinions with the other components of the group (Universidad Politécnica de Valencia, 2004). Based on the previously mentioned definitions and objectives, it can be seen that the **MoC technique does not focus the emphasis on the final product but on the process followed by the students to find that solution**. Throughout this learning process, students develop the following skills and abilities (Universidad Politécnica de f Madrid, 2008):

- Information management.
- Anticipate and evaluate the impact of the decisions adopted.
- Have general knowledge for learning, linked to the subject and linked to the professional world.
- Intellectual skills, communication and interpersonal skills, and organizational and personal management skills.
- Attitudes and values of professional development (autonomy, flexibility, etc.) and values of personal commitment (responsibility, initiative, etc.)
- Autonomous work and group work.

The development of these skills will improve the preparation and adaptability of students to the job and their professional environment. The use of the case method for teaching-learning purposes rests on certain premises.

- The learning activities enable students to understand the theoretical information based on a practical assumption.
- Class sessions are set up around an active and stimulating environment. Debates encourage discussion of ideas from different points of view.
- Starting from the premise that the cases are complex situations in real life, it is possible to develop group work skills such as: negotiation, conflict resolution, decision-making and communication.
- The analysis or study of a case essentially demands a group discussion process under a collaborative approach.
- The discussions reflect the way in which, most of the time, decisions are made in real situations of professional practice. Since the essential component of the case method is the discussion, it is convenient to take into account the characteristics of a good discussion. In this regard, it must constitute a learning experience for students that allows them to:

- Understand a specific situation
- Focus the analysis of the situation both from a global perspective and from a particular perspective.
- Be sensitive to the relationship among concepts, functions and processes.
- Analyze and understand a situation from a multidimensional point of view.
- Be action oriented. This implies:
  - ◊ Accept conflict
  - ◊ Possess a sense of what is critical or key, as well as what is possible.
  - ◊ Have will and firmness to make decisions.
  - ◊ Being able to convert the desired objectives into action programs.
  - ◊ Be aware of the limits and real possibilities of action.

2. Characteristics of the case method. advantages, disadvantages and limitations

De Miguel (2005) highlights that MoC links theory and practice dialectically in a reflective process that becomes, in turn, significant learning, by having to show and analyse how experts have solved or can solve their problems, the decisions they have made or could make and the values, techniques and resources involved in each of the possible alternatives. Taking this justification as a reference, we can point out the main characteristics of this didactic strategy (Zamora, 2010):

- It encourages students, on the one hand, to work individually and, later, to contrast their reflections with their peers, developing a commitment and meaningful learning.
- It is based on real events, in cases that students can easily find in their professional practice and that other professionals have had, which increases motivation towards the subject of study, also improving their self-esteem and self-confidence.
- It focuses on students' reasoning and their ability to structure the problem and work to achieve a solution. There is no single correct answer.

Using this technique requires a greater investment of effort and dedication, on the part of the teacher and students, than other more traditional teaching and learning methods. However, learning results are more significant with the use of the new methodological models, since they allow the student to be the true protagonist of their learning (Universidad Politécnica de Madrid, 2008). The main advantages of MoC are, according to Guàrdía et al (2007):

- It is a versatile teaching method.
- Allows the analysis of situations at different levels of abstraction and from multiple points of view.
- Allows the exploration of solutions to complex problems.
- It tends to engage students and increase their participation and involvement in the learning process.
- Helps developing analytical and problem-solving skills and apply new knowledge
- Encourages reflection and decision-making for action.
- Involves students in their own learning due to their realism and their closeness to the problems of the profession.

On the other hand, it also presents a series of drawbacks or limitations:

- Its results depend to a large extent on the teaching skills of the teacher
- The number of examples varies significantly between areas or disciplines.
- The elaboration is expensive in time and effort in the early stages of its adoption.
- The cases or situations - problem, in some fields (such as engineering), can get old quickly

Teaching with cases promotes while demanding teachers and students (Díaz, 2005):

- the ability to argue with arguments,
- to generate and sustain their own ideas,
- To make decisions in conditions of uncertainty or to make value judgments, without neglecting the point of view of others and showing an attitude of openness and tolerance towards the ideas of others.

Thus, the first precaution to take is to ensure that the information is not partial, biased or misleading, and to explore various angles of the problem, different points of view and solution options.

In order to use a case, the teacher must know it perfectly and it is highly recommended that they have a minimum experience in group dynamics. At the time of its implementation, the teacher must take into account important factors such as the different units and subjects of study, the diversity of the students or the moment of its use within the course programming (Universidad Politécnica de Valencia, 2004).

3. Case types

The formats for presenting a case are varied. They may consist of formal written cases, a newspaper article, a segment of an actual video or a commercial film, a story taken from the news that appears on radio or TV, a documented file obtained from an archive, a piece of art, a scientific problem in science or mathematics, among others.

3.1. General typology

In addition to the most frequent cases focused on solving a problem or making a decision, there are other types of useful cases that complement these. The typology of cases, in general, contemplates the following (Polytechnic University of Valencia, 2004):

- the cases-problem or cases-decision or trial/opinion
- the cases-evaluation,
- cases-illustration
- information cases
- In basket case method
- research cases (Project case method)

a) Cases-problem or cases-decision or trial/opinion
It is the most frequent type. It is the description of a problematic situation of reality on which a decision must be made. The situation is interrupted just before the decision-making moment or the start of an action, but with all the necessary data for analysis and, subsequently, decision-making.
One version is the *case of solving the problem,* the organizer chooses an appropriate problem that depends on the student's conditions and his/her abilities. The student breaks down the problem into a sequence of decisive steps. Students must elaborate and work each of the steps properly,

before moving on to the next. Finally, they verify and a joint evaluation takes place.

In an *opinion case*, students receive complete information at the beginning. Along with this, a well-formulated problem and the proposed solution are presented. Students are tasked with judging the quality of this solution. In the case of decisions, complete information is also given at the beginning. The problem is formulated together with assumed alternative solutions. The student's task is to base a good decision, among the given alternatives.

For example, the situation of the construction of a new facility in a cooperative in a certain place (A or B).

b) Cases-evaluation

These cases allow students to gain practice in the analysis or evaluation of situations, without having to make decisions and issue recommendations for action.

This group includes environmental events or accidents in which it is a question of evaluating the impact generated and its scope.

c) Cases-Illustration

It is a situation that goes beyond decision-making, in which a real problem is analysed and the solution that was adopted according to the context; which allows the group to learn about the way in which a certain organization or professional has made a decision and the success of it.

d) Information cases

In the case of information, a (wrong defined) problem is presented, for which the student requests (and obtains) other information both from the helpers or facilitators (experts or organizers) and from other sources. In this variant, problem formulation skills are developed more than problem solving skills.

e) In basket case method

The caseworker receives folders and data on incidents or events in society. He/she must decide (in a certain given time) what is the problem or event that he/she wants to address and elaborate (what is the case or file), to then formulate and base decisions.

A very simple version is the problem determination method (case study method). It contains all the information at the beginning. The problem is not formulated, but the student must find it. Problem determination typically results in a complex problem package. Students then formulate the problems in a written (visualized) and structured form.

f) Research cases (project case method).
The problem is expressly given but no information is provided. Accurate information and data are taken from research (analyses) and in the field and from other sources. The task for the students is to propose solutions to the problem.

3.2. Typology according to learning outcomes

Another possible classification is the one indicated by Martínez & Musitu (1995) based on the learning objectives that students must achieve.

a) Cases focused on the study of descriptions:
In these cases, it is intended that students analyse, identify and describe the key points constituting the given situation and be able to debate and reflect with their classmates on the different perspectives of approaching the situation. In this case, students are not asked to assess or generate solutions, but rather they will focus on the analysis of the problem and the variables that constitute it. The variables that need to be analysed in these cases are:

- Describe the key facts regarding the people involved,
- Describe the facts related to the contextual variables,
- Describe the facts related to interpersonal relationships,
- Determination of the significant elements of the situation,
- Identification of the decisive moments and times of the situation.

b) Problem solving cases:
These types of cases require that students, after exhaustive analysis of the situation, assess the decision made by the protagonist of the case or make the justified decision that they believe is most appropriate. Within this typology of cases we find three subgroups:

- Cases focused on the critical analysis of described decision-making: students must assess and issue a critical judgment on the decisions made by the protagonists of the case.
- Cases focused on generating proposals for decision-making: students must find a possible solution for the situation described, after analysing it. It is important that students make decisions that can be put into practice. If they cannot be put into practice, the solution to the case is not correct.

– Cases focused on simulation: in this type of case, in addition to seeking that students analyse the variables and the context that intervene in the situation, it is intended that they form an active part of the development of the case, dramatizing and representing it. In addition to trying to find out what happens in this situation, they will be the protagonists of it, becoming the characters in the narrative.

c) Cases focused on the application of principles.
In this model, the situation presented requires the analysis and selection of those principles and norms that favour its resolution. With this type of case, the development of deductive thinking is favoured, which means starting from the generality of the situation and applying the necessary premises to reach the conclusions that give the most appropriate answer. They are usually used, above all, in the field of Law.

4. Case design

First of all, to use the MoC methodology, it is convenient to take into account the following aspects (Universidad Politécnica de Madrid, 2008):

– Choose the topic and the environment in which you want to locate the case. The subject and the objectives pursued with the case must be coherent with the subject, with the competences, abilities and with the contents that are being developed in the classes.
– It must be an event or a fact that has actually occurred. For this you can use the news, have interviews with professional colleagues who help to know the details of the situation that is intended to be raised, etc. It is necessary to collect enough information so that students can have it and properly guide their study.
– Students, when reading the case, can fall into states of confusion and demotivation given the lack of definition of the solution to be found. For this reason, it is necessary to guide them, always, proposing a question, the analyses that they must carry out.

Before writing a case, it may be interesting to follow these steps:

– Define the expected objectives.
– Select the type of case that best suits the topic to be addressed.
– Choose the specific problem and collect the information (in press articles, Internet). Sometimes it is convenient to describe the charac-

ters involved in the real event that the students are going to analyse. It must be consistent with the intended objectives.

Once these key aspects have been defined, you are in a position to start writing the case, keeping in mind that (Universidad Politécnica de Madrid, 2008):

- It must have a clear and easily understandable structure for the student taking into account the previous knowledge of it.
- It is necessary to present the key and central facts, the characters involved and the context in which the action takes place. Secondary information can be presented to encourage the student to be able to distinguish between them when analysing or resolving the case.
- Comments and personal opinions should be avoided so as not to confuse the student.
- Scientific terms or treatises on the subject must be maintained to familiarize the apprentice with said terminology.
- It is recommended that the writing be fluid and clear, with a narrative style.
- The material delivered to students can be more or less extensive depending on the objectives pursued and the type of case chosen. It can be presented in various ways: in text, in video, with graphics, etc. It is convenient to try to make the material motivating and to generate interest in the students to ensure the active participation of all of them.
- Guide with questions the analysis to be carried out; for example, what is happening? Because? What is the underlying problem? How has it come about? What interests are at stake? What theoretical models can you support these ideas? What actions would you take? In other words, prepare questions that, due to their formulation, force students to reflect intelligently on the problems posed by the case, applying the knowledge they possess and never requesting a specific answer based on remembering information.
- The estimated time for the resolution of the case must also be specified. If there will be one, two or more sessions and how the time will be divided during the learning process. For this, a schedule or a development sequence can be drawn up.
- It is also convenient to detail what the students are going to have to deliver (individually or in groups) as well as how and when they will have to do it. It will suffice with some general indications that guide the work that they will have to carry out.

5. Case development

Clearly, the case study is suitable for people who already have fundamental decision-making knowledge, are action-oriented, work in groups, and can independently obtain and provide information.
Very simple cases may be appropriate for the introductory phases of the courses or in the first years of the degree, but the study of more complex cases plays an important role both in the phase of conclusion of the courses and in the phase of connection of degrees with the transition to professional life.
First of all, it is necessary to be clear that this proposal works based on roles:

a) Role of the student
In this didactic model, the students adopt the role of a real character (actor or affected in the case) or the decision maker. They obviously know that the burden and pressures of being decision makers are on them. Occasionally they take the role of evaluators (arbitrators), of the solutions or decisions of others. Students must be in the situation, master complex relationships, and obtain relevant information. In addition, they must be highly oriented and trained in the field from which the case example comes.

b) Role of the teacher or facilitator
Authors are needed to develop the case studies. The authors work as individual experts, in the respective field, or together with other experts. Case studies require external organisers (of time and space) or coordinators, who assign or demand the type of tasks or work, provide materials for the case, introduce students to the case study, and assist in obtaining the information from the case studies. background (base), give support in planning time and space, participate (if necessary) in discussions and, in addition, can act as discussion moderators.
Students, in general, tend to propose solutions immediately. To avoid this, the first time the professor uses cases in his/her teaching, he/she must establish some analysis guidelines. For this reason, it is convenient to separate the development of the case into several phases:

- Preparation phase, the cases are prepared with their documentation and students are introduced to the subject areas, if necessary, also to the case study method.

- Reception phase (case analysis), students study the case material in depth, interpret it and seek to obtain additional information on the case topic.
- Interaction phase (work) in the learning group that has been constituted, if necessary, the definitions of the problem are compared, the possibilities of solution are examined and the decisions are proposed.
- Evaluation phase, individual solutions are presented and discussed (individually or in small groups) and, finally, the decision for the case solution is made by the whole course.
- Confrontation phase, we proceed to compare proposed (found) solutions with the decision made in the real situation.

It is evident that each type of case can have nuances in its development. Thus, returning to the classification of the cases according to the learning objectives (Martínez & Musitu, 1995):

a) Cases focused on the study of descriptions:
The development process that students can follow to analyse these cases is:

- In the first phase, students must approach the case, reading the details and understanding what is happening in the situation described.
- In the second phase, students can carry out an analysis of what is happening, why and what types of variables influence it. These analyses are carried out on an individual basis.
- It is in the third phase where students are organised in small groups (4-6 people) and share the ideas they have arrived at individually to elaborate a common analysis. The work carried out by each group is shared with all the others. This debate is always guided by the teacher who guides, organises the ideas, proposes more questions, etc.
- Finally, in the last phase, they return to the small group and write the final report on the analysis of the case.

Group work acquires great importance in the use of this methodology and requires a great effort on the part of students. After the individual analysis, they must be willing to debate, defend, modify, etc. their ideas to enrich themselves from the learning provided by interactions with their peers.

b) Problem solving cases:

- Cases focused on the critical analysis of decision-making described:

The phases proposed in the development of this case are three. All these steps are necessary to resolve the types of cases presented below, since

solutions cannot be proposed without carrying out a detailed analysis of the situation presented.

1. Study of the decision-making presented in the case: Students must issue their well-founded opinion about the process followed, taking into account the consequences that, from their point of view, the decision made entails. They can also analyse protagonists' performances.
2. Team sharing of critical contributions and joint analysis of the elements and steps of the decision-making process (actions undertaken and their consequences).
3. Contrast with the rest of the large group and proposal of theoretical issues derived from the analysis of the processes considered is carried out.

From here, a process of documentation and study of selected topics begins. The phases are similar to those discussed above with the novelty that in this type of case what is subjected to further analysis are the decisions adopted by the protagonists of the situation.

– Cases focused on generating proposals for decision-making;

The phases to work these cases can be:

1. Read, study and understand the case within the context in which it is located.
2. Analyse the different variables that describe and intervene in the narrative presented.
3. Identify if the information exposed is sufficient or it would be necessary to collect more to know the case in depth.
4. Describe and detect the strengths and weaknesses of the situation, analyse the roles that appear, the relationships between protagonists, the theoretical and ideological foundations of each of them, etc.
5. Detail the problems found, ranking them according to their urgency.
6. Analyse each problem, detecting main changes needed and generating action alternatives that could be put into practice to improve the situation.
7. Study the pros and cons of each action alternative in order to choose the one that is most viable and has the least negative effects.
8. Implement the decision made indicating strategies and resources to carry it out.
9. Guide how the evaluation of the decision made and its consequences will be carried out.
10. Reflect on the theoretical issues raised by the case presented.

This process is carried out in the same way as in the previous types. At first, students carry out an individual study and analysis, which is later shared in small groups, arriving at a joint action plan and, finally, an analysis and debate is carried out with the entire group of students.

– Cases focused on simulation:

There are basically three phases for resolving these types of cases:

1. As in previous situations, study the situation considering all the variables that are influencing it.
2. Select one of the problems detected and carry out a role-playing exercise.
3. Reflection on the process, the resolution of the situation, the consequences of decision-making and the theoretical issues involved in the actions carried out.

Perhaps in this type of case it is more appropriate to work with small groups from the beginning and after the performances, discuss each one with the whole group. At the end of the reflection, students (individually or in small groups) can be asked to write a report.

6. Evaluation through the case method

A characteristic aspect of MoC is the absence of a single correct answer (although there are more and less adequate answers) because what is truly important are the processes that students follow to reach a solution. For this reason, the most relevant aspects in the evaluation are:

– the reasoning followed by students;
– the relationships that he/she has established between the different concepts, theories and practices; and
– the modifications that he/she has introduced in his/her way of conceiving knowledge thanks to the work with his/her colleagues.

Within the complexity of evaluating this technique, the following can be used:

– A report made by the student that includes the processes and steps followed to resolve the case.
– It can also be asked to assess to what extent he/she has achieved the proposed objectives, what technical aspects he/she has acquired and what skills he/she has developed in the process.

– An exercise with a similar problem so that the student can apply what he/she has learned.

In addition, the teacher during the development of the technique can collect numerous data on the processes that students follow:

– Approach to problem analysis.
– Difficulties encountered by the student and how he/she solves them.
– Relation of diverse knowledge to respond to the demands of the case.
– Effectiveness of group work.
– Feasibility of the decision or solution taken and its theoretical and practical justification.

A good case leads students to want to know more about the issue. This can be an indicator for evaluation. Wassermann (1994) considers that, since the treatment of the case generates a challenge for the student to face, this is a great opportunity to guide him/her to read scientific, journalistic and literary texts, or to watch commercial films and documentaries. Sometimes it can lead the student to search for primary sources, to interview key informants or to carry out some experimentation or application activity. In this way, the approach of follow-up or post-case activities will broaden and deepen the understanding of the issues and concepts related to the original case.
In relation to the basic principles to take into account in the evaluation of learning by working with the case, it can be said that it is important (Díaz, 2005):

– To obtain information from the learning process itself, that is, how students are thinking, how they apply the knowledge they build personally and jointly in solving posed problems or in a wide spectrum of significant tasks.
– To pass the evaluation oriented to memory measurement of the declarative information related to the analysed problem. That is to say, to abandon the approach of the examination of short and univocal answers.
– To provide feedback to the student and the teacher with a view to improving the teaching-learning process and the curriculum and not only with a view to certification or administrative control.

For Boehrer (2002), the great achievements or objectives that are pursued in learning through cases, which constitute the aspects to be evaluated, are integrated into eight categories:

- To encourage critical thinking
- To promote student responsibility before the study.
- To transfer information, concepts, techniques.
- To become an authority on the subject in a specific field.
- To link affective and cognitive learning.
- To strengthen class dynamics encouraging motivation.
- To develop cooperative skills.
- To promote self-directed learning.

In relation to the above, some key issues that the teacher and students themselves have to consider in the evaluation process and learning self-assessment in case-based teaching situations are to elucidate the following (Díaz, 2005):

- Do students learn to obtain and manage information in a more intelligent and profound way?
- Are they more and better informed?
- Do they significantly apply and integrate knowledge?
- Do they develop thinking and decision-making skills?
- Do they develop professional skills?
- Do they acquire or change attitudes?
- Do they learn to solve problems?
- Do they improve their oral and written communication skills?
- Do they work cooperatively?
- Do they show dialogue skills, tolerance, empathy?
- Do they increase their understanding of and interest in the discipline and in regard to the issues of the world in which they live?
- It must be remembered that this is an eminently experiential and inductive teaching method, and that it seeks not only to educate the intellect, but also the person or professional in training.

Regarding the approach assumed by the evaluation of case-based learning, the reviewed authors agree on the following points:

- Emphasis on a formative, dynamic and contextual evaluation (authentic evaluation).
- Development and application of mostly qualitative evaluation materials and instruments that assess student performance, their level of ability, their disposition and attitudes.
- They involve self-assessment based on the part of students and the work done in the discussion groups.

- It requires the definition and consensus of performance criteria or minimum standards that allow qualifying the learning achieved.
- It requires teachers to exercise their professional judgement in assessing the achievements and quality of student work.

In any case, when evaluating, **the teacher will start from the objectives set in the didactic unit and will analyse the achievement of each of them.** It will be necessary to evaluate, at least:

- The case study (by the teacher and the student). The logical thing is that each teacher develops his/her own according to his/her classroom observations, the comments of the groups and his/her own teaching-learning objectives.
- The work and the process carried out both individually and cooperatively. Group work encourages dialogue and critical thinking of its members, hence the learning that students get from teamwork is not only knowledge of the subject matter but also attitudes and values. Since the case method requires students to analyse, judge, and make decisions, most of the actions that groups take will not be considered good or bad. The teacher's direct criticism of any judgment or decision of a group will never be made in front of the rest of the groups as they are harmful and can affect everyone's dynamics. The type of evaluation will depend on the type of case used. Thus, for example, for a case-decision, the result of the actions undertaken at the time will take time after having taken them and our students do not have that possibility. The teacher's job will be to encourage students to contribute observations that they consider useful, without expecting one solution to be the correct one compared to all the others. Yes, they will need to be able to argue their solution. In addition to qualifying the written work that can be derived, this is obvious, the result of the work must continue to be evaluated, the quality of the technical solutions provided. It is also a requirement that the participation of students in the discussions be taken into account when evaluating the student. The teacher, while the different groups carry out their homework, should take notes on the performance of the different groups, the participation of their members, difficulties, doubts, comments, etc. In the same way, if you want to be consistent with the way of learning that promotes the case method and other autonomous learning techniques, students must be increasingly involved in evaluation practice. To this end, it is possible to start from criteria agreed upon by the class that evaluate the per-

formance of their classmates and their own within and outside the work group, through anonymous questionnaires.

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COLLECTION OF CASE STUDIES

SUSTAINABILITY OF THE AGRICULTURAL SECTOR

Organic agriculture in Georgia

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Problem description

Brief Introduction to Georgia

Georgia is an eastern-European country located in the South Caucasus with a transitional economy and population of 3,7 Million people (World Population Review, 2022). The typology of the country is still varied regardless of its small area (69,7)(*Library of Congress*). The Northern part is partly defined by the Caucasus range. *"Complex mountain landscape and shortage of arable land prevent Georgian agriculture products from competing with cheap analogues produced by intensive farming that dominates the world market" (Biomarket in Georgia, 2019).* However, regardless its shortage of arable land, country's climate and soil have made agriculture one of its main economic sectors, providing 32% of the republic's Net Material Product (NMP) in 1990 (*Library of Congress*).
Historically, Georgia has always been largely conducting agricultural activities and has been producing diverse agricultural production with numbers of indigenous plants. Percentage of labor employed in agricultural sector has been decreasing. In 2020, according to the World Bank collection of development indicators, the employment in agriculture was reported at 41.29%, compared to 55% in 2010 (Trading Economics, 2020). Naturally, with the decline of labor in the sector, the contribution to GDP also reduces. According to FAO, in 2010 share of agricultural sector in total GDP was less than 10%, while in 2020 it decreased to 8,3% (FAO, 2020).

[1] Great thanks to Anna Tsenteradze, who provided big support in preparation this document and information input.

History of Georgian Organic Farming

Bioproduction in Georgia started in 1990s[2], during the Soviet Union. At the same period farmer-based organization – Biological Farming Association Elkana was established (Biological Farming Association Elkana, 2019). During the USSR, agriculture was characterized by absolute state ownership of all agricultural land and concentration of production in large-scale collective farms. During the era, the irrigation system became complex, draining swampy areas in the west and salvaging drained places in east, which allowed Georgian agriculture to expand production between 1918 and 1980 (Curtis, 1995). Agricultural and biological production was obstruct in Soviet period, and its emphasis on labor-intensive crops such as tea and grapes kept rural work force at unsatisfactory level of productivity (Curtis, 1995). Misallocation of agricultural land also resulted in lowering share of Georgian work force by 12% from 1970 (37%) to 1990(25%) (Curtis, 1995).

"The propagation of the biofarming idea and establishment of biofarms in Georgia was made possible with a long–term aid of the German organization Bread for the World[3] and the groundwork by Elkana. Later, the bioproduction support projects in Georgia were funded by Oxfam Novib, Avalon, Cordaid, HEKS EPER, ADA"(Biological Farming Association Elkana, 2019).

When Georgia became independent in 1991, after the dissolution of the USSR, the country was facing very difficult economic and social times. Country's agriculture had crises and the land held by large collective farms was quickly distributed to rural households in an attempt to avoid famine (Hergnyan and Kraemer, 2010). The universality of land distribution of rural families produced relatively small landholdings. Thus, the average size of an individual farm in Georgia is 0.96 ha and only 5% of farms are larger than 2 ha (Kan, Kimhi and Lerman, 2006).
During the interview the director of Biological Farming Association – Elkana, Mrs. Mariam Jorjadze[4] said*, "The agricultural practices employed*

[2] Bioproduction, in this case means producing organically, without certification programme.

[3] In 90s of the 20th century, first projects were financed by two funds of the German protestant church: Diakonisches Werk and EZE/EED. Later these funds were united into a single organization - Bread for the World which remains a supporter of Elkana.

[4] Online video Interview with the director of the organization, Mrs. Mariam Jorjadze and author on Aug 17, 2022. Interview conducted by Anna Tsenteradze.

during the Soviet period resulted in significant erosion of biodiversity in agriculture, which undermined sustainability of crop production, loss of many indigenous types of seeds. Valuable collections and stocks of endemic varieties quickly began to disappear. Simultaneously, farmers had large stocks of previously marketable varieties of crops for which they were no longer able to purchase the necessary agrochemicals or irrigate due to the underdeveloped irrigation system".

Even though there was a quick recovery in 1993 – 95, which raised the volume of agricultural production in recent years (by 25% - 30% compared to 1993), in 2008 production was still 40% below what it was in 1988 (Curtis, 2008).

By 2006, the main agricultural[5] products were grapes, potatoes, and maize, with the following volume shown in the Figure 1.

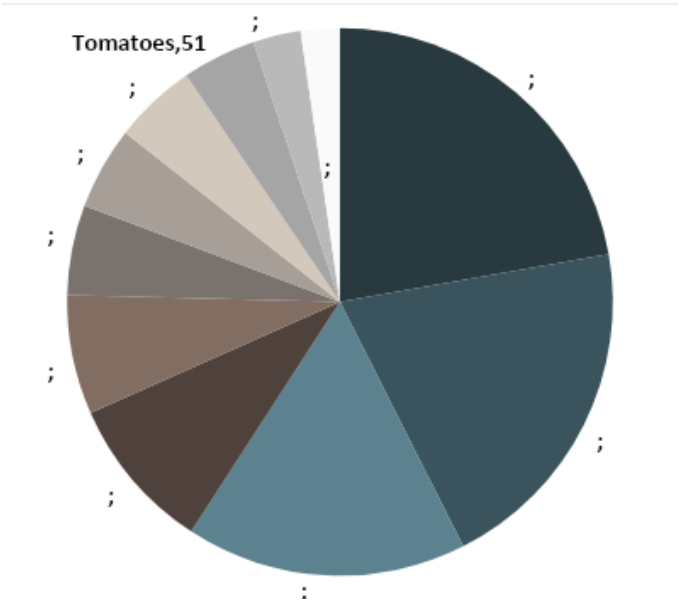

Figure 1: General agricultural production in Georgia (thousand tons), 2006

Author's formation, data source: (Kan, Kimhi and Lerman, 2006)

[5] General agricultural production produced by both conventional and organic manners

Institutions related to Organic Farming in Georgia

There are number of institutions related to organic farming in Georgia. One of the most significant parties is the Rural Development Agency (RDA), which conducts different projects supporting bio-farming, including grants and financial support for farmers. One of the latest projects of RDA supporting bio-farming aims: (1) to help farmers transfer their conventional farms into organic ones; and (2) to finance acquiring environmentally friendly pesticides, fertilizers, and for bee farmers special organic medicines and bio honeycomb. The programme is covering every region of Georgia, and it also co-finances the costs of bio certification (70% of maximum 7,000 GEL), consultation costs and laboratory services[6] (Machaidze, 2022).

Other important government institutions are Ministry of Environmental Protection and Agriculture of Georgia (MEPA), National Environmental Agency (NEA), National Food Agency (NFA).

There is also a small number of non-commercial organizations, whose one of the main lines of activities is plant bioproduction. One of the very important NGOs actively working on the issue of organic plant growing and processing are Berry Growers Association, whose actively encompasses both conventional and organic berry growers, Bioproducers Association (Bioginger and Bioharicot trial projects), and Organic Tea Growers Association (Biological Farming Association Elkana, 2019).

One of the principle non-governmental organizations, who has been actively working in direction of biological farming is Elkana. The organization has implemented dozens of large, medium or small projects for systematic promoting individual bioproducts, including support of biocertification. As mentioned during the interview [7], *the association runs own experimental farms in the villages of Tsnisi (Samtskhe-Javakheti region) and Zemo Khodasheni (Kakheti region).*

There are other organizations contributing to the bioproduction: Taso Foundation (which also promotes empowering women in rural areas); LLC Bioagro (produces biofertilizers & popularizes bioproduction), LLC Saperavi TV (aims to raise bio-awareness of population through media).

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[6] The information is based on the video shared by Rural Development Agency, speaker – Seva Machaidze. (Programme supporting bio production (ბიოწარმოების ხელშეწყობის პროგრამა), 2022)

[7] Online video Interview with the director of the organization, Mrs. Mariam Jorjadze and author on Aug 17, 2022. Interview conducted by Anna Tsenteradze.

The support of international organizations and donors are also very important in the country. One of the major players is UNDP in cooperation with competent governmental organizations. Also, since 2019, EU ADA and SIDA are jointly implementing a multi-million project (GRETA), which promotes mountain tourism and organic agriculture in Georgia's mountainous regions (Biological Farming Association Elkana, 2019).
A Czech NGO, People in Need (PIN) aims to reduce poverty and inequalities by empowering people, particularly in rural areas. Promotion of bioproduction is one of the topics it addresses to achieve its objectives.
USAID is also an important organization; it aids development of organic agriculture within the framework of its formidable agricultural programme. Additionally, USAID's previous programme in Georgia called Restoring Efficiency to Agriculture Production (REAP) also gave heed to bioproduction (Biological Farming Association Elkana, 2019).

The Sector Performance

The number of organic areas and organic farmers in Georgia is very small. Therefore, sales of bioproducts in the country are noted for small product ranges and output. Although certified Georgian organic products are not usually sold on the local market, there is a network of leading supermarkets (such as Goodwill), that take care of the imports of organic products. These supermarkets offer organic products like tea, coffee, vermicelli, can-

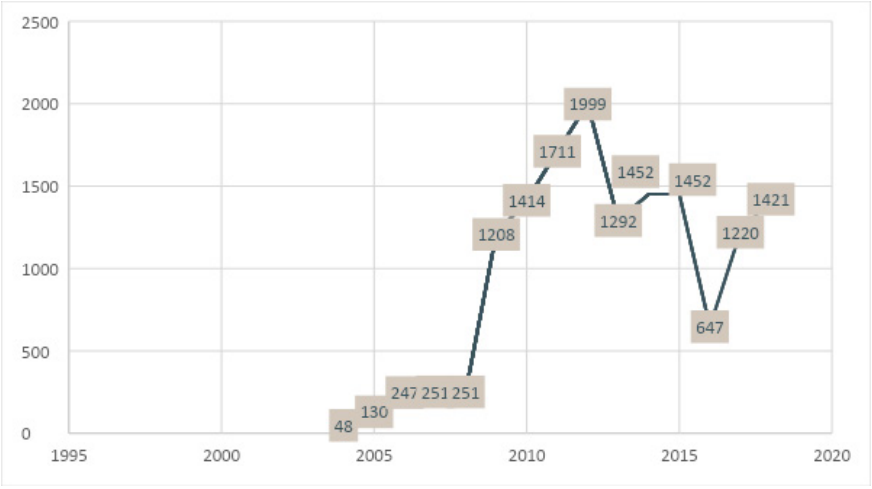


Figure 2 Land Area Used for Cultivation of Organic production in Georgia (ha)
Author's formation, data source: (USAID, 2019)

dies, cosmetics, etc. Even though there are biomarking and certification on the imported products, it is still marketed as usual products (Biomarket in Georgia, 2019).

The growth of both organic certified areas (Figure 2) and the number of organic farmers and companies in 2010-11 and 2014-15 respectively is associated with two important factors. First, in the period, Elkana with the donor support, was subsidizing organic certification, which led to a rapid increase in the number of products; And second, the entry of HiPP to the Georgian market, which would buy non-timber forest products, eventually rising area of organic farmers (Biomarket in Georgia, USAID, 2019).

The inspection body Caucascert claims that as of 2020, 2,158 ha of agricultural land had been certified, of which 484 ha were under conversion (Gengenbach, 2021).

Germany is the primary destination of Georgian exports of organic products. Certification in accordance with the EU organic standard is a requirement. The most significant organic products that are certified and exported are wine, hazelnuts, honey, organic tea, and wild plants. Due to the growing popularity of organic products, fresh and processed fruits, berries, and vegetables are becoming more popular both nationally and internationally. Georgian organic wine is still a niche market despite the state's long history of wine production (Gengenbach, 2021).

Certification and Organic Farming

As explained during the interview with Mrs. Nino Jorjadze, "*for the Georgian local market, the association Elkana helps its member farmers acquire printed bio-badges, after meeting the quality requirements and standards. For the foreign markets, there are two independent certification bodies in Georgia, which are accredited by European standards. There is a budget of 300,000 GEL for subsidies (mainly for winery and beekeeping). As the costs are quite high for acquiring certificates, farmers do not usually attempt to get the certification for the local market. Therefore, the farmers willing to export were mostly doing organic certifications*"[8].

One of the issuers of organic certificates is Caucascert, founded within the framework of the project initiated by Elkana. It certify the following categories (Biological Farming Association Elkana, 2019):

[8] Online video Interview with the director of the organization, Mrs. Mariam Jorjadze and author on Aug 17, 2022. Interview conducted by Anna Tsenteradze.

– Primary / unprocessed plant products (agricultural crop growing and wild plant collection.
– Live animals and unprocessed animal products (including beekeeping).
– Processed agricultural products (including organic wine).
– Plant programming material and seeds.

Producers of organic inputs must go through both registration and certification of their innovative products. The registration process takes approximately 6 months, it is costly and has several stages. Certification takes 3 years; it is also expensive and has several stages. Naturally, the costs and complications result in poor choice of local alternatives on offer, whereas imported organic inputs are expensive and has a small range.
Most of the locally produced certified organic products are exported to foreign markets. It is also interesting to see that there is many products produced by using organic methods but not certified (yet).
It would be safe to say that organic production in Georgia is still in its infancy. However, there is a tendency and potential of growth. The foreign

Table 1 Output of organic certified products

Product	Amount, 2016	Amount 2018	Unit
Wine (Saperavi)	1,965	2,400	Bottle
Licorice, dried	300	182.5	Ton
Nettle, dried	52	40.5	Ton
Wild Apple, dried	42	51.18	Ton
Rosehips	30	12.4	Ton
Rohesip seed	30	39.4	Ton
Cowberry, dried	2,581	-	Ton
Black tea	1.71	0.5	Ton
Green tea	1.71	-	Ton
Grapes (Usakhelauri)	1,235	-	Ton
Sea-buckthorn, dried	1,025	-	Ton
Wild plum	1	-	Ton
Bilberry leaves, dried	0.93	31.834	Ton
Silver fir cones	-	5.73	Ton
Silver fir seeds	-	5.158	Ton
Cowberry	-	12.575	Ton
Cowberry leaves, dried	-	33.77	Ton
Non-timber forest products	-	6.889	Ton

Authors' formation, data source: (Sirbiladze, 2019); Power Point Presentation written by Gocha Sirbiladze, shared to Anna Tsenteradze by Mariam Jorjadze.

market demand for Georgian organic products has been increasing (Hergnyan and Kraemer, 2010). Research conducted by Gocha Sirbiladze[9] shows number of certified organic products in Georgia.
Also, the Euromonitor database (2022) presents the following data on Current prices of organic products in Georgia. It is clearly visible, that the market is growing fast. The annual average growth rate exceeds 8% for the 2007 – 2021 period. As the market is relatively underdeveloped, further growth is expected,

Table 2 Retail Value of organic products (current prices)

	Million GEL	Million USD[10]
2007	1.5	0.898
2008	1.4	0.94
2009	1.3	0.78
2010	1.1	0.62
2011	1.2	0.71
2012	1.2	0.73
2013	1.4	0.84
2014	1.6	0.91
2015	1.6	0.71
2016	1.9	0.8
2017	2.3	0.52
2018	2.7	1.07
2019	3.1	1.1
2020	3.4	1.09
2021	3.9	1.21

Source: Passport / Euromonitor International (2022)

PEST Analysis

Based on the received information, the PEST analyses have been conducted. See the Figure 3.

Elkana

The Biological Farming Association Elkana, a Georgian non-governmental organization, was founded in 1994 by five representatives of the Georgian

[9] Senior researcher, evaluation and learning officer
[10] Values transferred to USD using historic exchange rate (OECD, 2022).

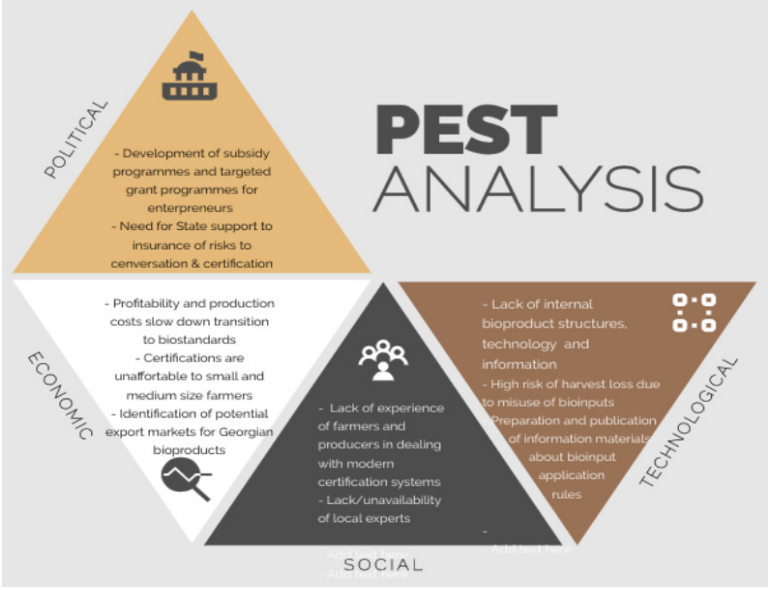
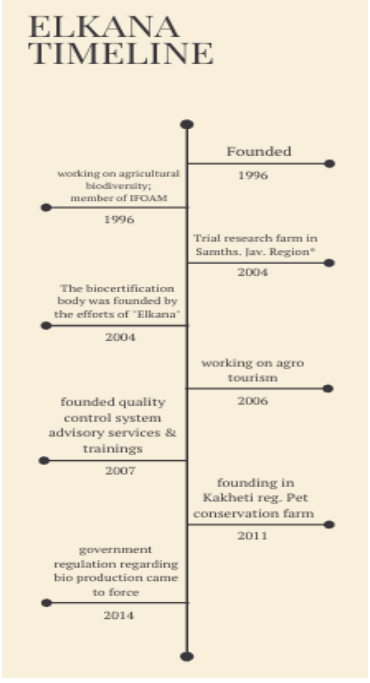


Figure 3: General agricultural production in Georgia (thousand tons), 2006

Author's formation, Information based on (Biomarket in Georgia, USAID 2019)



Green Movement NGO. Since 1994, Elkana has published the magazine "Bio-farmer" and conducts seminars and conferences for farmers in all regions of Georgia to raise farmers' awareness on organic farming and to provide information. Elkana also invests in leveraging the strengths of the poor to grow organic produce through seminars, consulting, trainings and through providing technical assistance (Hergnyan and Kraemer, 2010). The timeline with the main events are presented in the Figure 4.

Any farmer, farming association/ group, cooperative, enterprise, that is willing to produce organically, can become a member of Elkana. The membership has a symbolic annual fee. In case of consultation services and business plan consulting, the price increases accordingly. During the interview, Mrs. Jorjadze mentioned that currently there are over 2,500 members. The Association is financially supported by international and donor organizations for majority of its activities.

Elkana has a head office in the capital of Georgia – Tbilisi, however there are other offices in different regions. The organization operates in almost every region of Georgia.

Core Activities

1. Assistance in the conversion to organic farming through the supply of seed and planting material of traditional crops, training, and other related agricultural extension services.
2. Advice in business planning and marketing.
3. Community mobilization (for example, through the organization of cooperatives and associations).
4. Promotion of organic agriculture to end-markets.
5. Lobbying public entities.

Vision & Mission

Elkana's goal is the improvement of the socio-economic conditions of the rural population of Georgia and increased environmental protection through fostering the development of sustainable organic farming and increasing the self-reliance of the rural population. Also, one of the biggest objectives of Elkana is to recover, conserve and use sustainably the biodiversity of Georgia. The representatives promote agricultural practices that eliminate the use of pesticides, preserving country's old agricultural traditions (Hergnyan and Kraemer, 2010).

Support

Elkana with the help of the international donors (e.g. EU, Brot für die welt, HEKS, UNDP, FAO, etc.) has implemented over 120 projects in agriculture and rural development, agricultural biodiversity and rural tourism (Elkana, 2021). It was mentioned during the interview with Mrs. Nino Jorjadze, that finding donors is not difficult per say, however it does take lots of resources from the organization, it is quite time consuming. On the other hand, their existence without donor organizations and international partners would be almost impossible.
In 2021, some of the most important projects were[11]:

- Supporting Organic farming, rural development, and agricultural biodiversity conservation in Georgia – Supported by Brot für die Welt, Germany
- Organic Agriculture and Rural Tourism / Development in Mtskheta-Mtianeti region – Supported by Austrian Development Cooperation
- Organic Hazelnut Value Chain Creates Income and Decent Employment in Western Georgia – Supported by DANIDA, HEKS-EPER (Switzerland)
- Collaborative Agri-food Chains – by Horizon 2020 through Coventry University
- Small Business Development Program 3 East along WREP (SBDP 3 East) – supported by bp, USAID program "ZRDA".

The above-mentioned programs are less than a half of the organizations' projects realized in 2021. Duration varies from 1– 5 years.
To scale-up organic farming in Georgia, a major constraint identified by Elkana was the absence of clear market opportunities for farmers. As a result, Begeli Ltd. – a commercial company, selling and promoting local organic products – was founded in 2005 to help market the products of its 400 members (quantity of members in 2010), who range from individual farmers to farmer groups and farmer associations (Hergnyan and Kraemer, 2010).
As mentioned above, the Begeli was a market initiative founded in 2005 (for more information see below). Elkana helped Begeli to achieve its goals by supporting its members in increasing sustainable production of different varieties of crops, fruits and vegetables, which were destroyed or became extinct as a result of existence and collapse of the USSR. El-

[11] Information based on the source: (Elkana, 2021)

kana provides periodical trainings to farmers in crop cultivation and production. The associations' agrobiodiversity and organic farming projects provide more than 600 people with income generating jobs and varied skill sets, enrich the variety of Georgian agricultural products and increase the awareness of the importance of healthy eating among the population. More precisely, Elkana collaborates with several international and donor organizations and some institutes, providing public affairs support and acting as a point of contact for Begeli. Elkana and all the cooperating international and donor organizations assisted Begeli in the extension of its technical and marketing services to farmers, as well as in the organization of educational trainings for the farmers in the field of organic farming. Together with international partners, Elkana organizes organic farm exhibitions and conferences, thus promoting local organic food both in local and international markets. In the course of its activities, Elkana also implements micro projects in the fields of rural infrastructure and sustainable agricultural development.

Begeli

Begeli Ltd was a for-profit marketing and sales company focused on the distribution and promotion of organic produce of Elkana's members. The company served as a direct marketing and distribution channel for local farmers. Begeli provided farmers an alternative to the traditional distribution system, helping them to bypass middlemen. Begeli paid farmers a 10-15% higher price compared to the market wholesale price, thus encouraging farmers to intensify the cultivation of organic produce and allocating larger land plots for it. The company, along with Elkana, carried out marketing studies and supported local farmers with consultations on business planning and marketing issues (Hergnyan and Kraemer, 2010).
The company was founded by Elkana, along with the Georgian Fruit and Vegetable Ltd. Begeli's board of directors consisted of seven people. Four of them represented Elkana and three represented the Georgian Fruit and Vegetable Ltd. The CEO of Begeli was appointed by the board of directors and reports to them on a semi-annual basis.
The biggest partner of Begeli was one of its founders, Elkana. Begeli was housed in Elkana's office in Tbilisi. Elkana collaborated with a number of international and donor organizations and several institutes, providing public affairs support and acting as a point of contact for Begeli. Elkana and all the cooperating international and donor organizations assisted Begeli in the extension of its technical and marketing services to farmers, as

well as in the organization of educational training for the farmers in the field of organic farming (Hergnyan and Kraemer, 2010).

Begeli's objective was to make profits through providing support to local farmers in accessing markets in Georgia and abroad, conserving and sustainably using local agricultural biodiversity and promoting organic production and consumption in local markets. Also, these activities were aiming to provide maximum possible returns to the rural population and raising awareness among the Georgian public about the benefits of organic production. It was supported by its founding organization Elkana in its endeavours. The farmers Begeli worked with were Elkana's members, who received direct technical assistance from the latter.

Begeli's sales began in 2006. The initial product mix consisted of three sorts of cereals, two types of honey, tea, two types of juice and fruits and vegetables. By 2010 the product mix has significantly enlarged to included packaged food (five different kinds of wine, two kinds of tea, five sorts of cereals, four types of vegetable squash, two kinds of organic juice) and bulk food (two types of white wine, two types of red wine, two types of tea, two types of honey, three types of vegetables) (Hergnyan and Kraemer, 2010).

By 2010, Begeli had several sales channels including supermarkets, telephones, as well as online shops. However, the demand for the online orders was very low (approximately 10%) (Hergnyan and Kraemer, 2010). The main market of activities was in the capital, Tbilisi.

The major supermarkets which Begeli used as distribution channels included Goodwill supermarkets, Georgita international food supermarket store in Tbilisi, Ebis supermarket chain, Populi supermarkets, the Begeli specialised wine store, three small private stores and the US Embassy.

Regarding the exports, the principal products were wine, tea, vegetable squash and cereals. Begeli faced constraints in accessing international markets. In addition, the long process of food certification also hinders the export process. Moreover, in 2010, not many farmers had incentives for producing large quantities[12].

At the time of its operations, Begeli did not have a significant competitor. The organically produced products (non-certified), were usually sold by farmers through a longer supply chain, from farmers to wholesalers, making the farmer having less profit. Therefore, the biggest competition were the imported products.

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[12] as according to the Value Added Tax law, farmers are exempt from paying VAT if their annual revenues are equal to or less than $50,000.

According to the case study by Business Works for Development, the largest customers of Begeli are mainly healthy life-style followers who have an average monthly income above the average salary in Georgia (1,092 GEL in 2019 - (Agenda.ge, 2019)). "*Most of our customers are middle aged, well-educated people, who are health conscious and have families. We also target several sports schools and people who work in international organizations. Our consumers are also Georgian people who follow the fasting rituals of the Orthodox Church in Georgia. Organic certification plays an important role too, as it will let us expand our sales by exporting products to foreign markets"* - said Irakli Javakhishvili – former CEO of Begeli (Hergnyan and Kraemer, 2010). Begeli described its target customers as "*healthy life-style followers who have an average monthly income above $1,000 (1,686 GEL at the time). As well as foreigners living in Georgia, people with allergy problems and sports school students*" (Hergnyan and Kraemer, 2010). The company sells its products through supermarkets and privately placed orders.

However, when speaking about the Georgian organic market, as mentioned earlier, other studies say that in general, the organic products have been sold together with the rest of the products, without being separated while by higher prices. This trend is being slowly changed. The prices of organic products in Georgia are related to the certification. Earlier the farmers hesitated to get certified for the local market (but only for the export), therefore the prices of organic products and the conventionally produced products were very similar. They had no extra costs of certification and kept prices at the same level. The late tendences show that organic certification starts becoming more popular even for the products intended to be sold locally. Which naturally raises the prices and develops a new, small bio market where the prices start differing from the rest.

Failing expectations

Even though Begeli had an established, strategically thought through business model, it failed to survive some of the challenges in 2010. The organization had many obstacles to overcome - the underdeveloped physical infrastructure in Georgian rural areas, high costs of food processing, a small domestic market as well as restricted access to export markets, etc. One of the major constraints was the lack of skills and experience among farmers in the area of organic farming. Farmers mostly practised traditional agricultural methods that required intensive manual work and are very time-consuming and ineffective. Some farmers have had limited access to markets other than local ones. The awareness can also be limited with

regards to the international farming standards and the possible types of crops to grow (and which entities could help them).
The lack of storage facilities was a burden for farmers, as they must face the risk of product spoilage and unreliable supplies since they cannot transport the products to far regions.
Another challenge was the lack of financial resources amongst farmers. Since access to credit markets was very limited in rural areas – the average bank loan interest rate is 24% per annum - there was no incentive for farmers to enlarge their organic agricultural activities[13] (Hergnyan and Kraemer, 2010). To provide incentives for the same, Begeli purchased products from Elkana farmers with a 10-15% markup compared to other middlemen, significantly increasing income opportunities for the farmers. Also, Begeli's founder and partner Elkana attempted to resolve this obstacle through several initiatives. Farezi, one of Elkana's member associations, provides the farmers machinery at a 50% discount. Secondly, Elkana started a program to facilitate access to seeds for financially limited farmers.
When speaking about Begeli with the director of Elkana, Mrs. Jorjadze, she mentioned two principal reasons for the company to stop functioning. The first reason was the breakage and technical issues with sorting machinery, which was too expensive to fix. And the second reason was that the organization wished to move its sales into online shopping platforms too early, for which Georgian customers were not ready at that point. The website was created in 2006, when according to the World Bank only 7.5% of the population used the internet (Worldbank, 2020). In addition, some of the farmers that used to use Begeli's help found their own way to sell their products in the market.

Ecomart.ge

Even though Begeli had to exit the market, Elkana took it as an opportunity to learn. The organization developed a new e-commerce shop called Ecomart.ge. The e-shop was created in 2020, in partnership with Procredit Bank. Ecomart's main customers are wholesalers. However, it also functions as a retail shop, as people can order in any quantity. The website has several pages, classified regarding the products (and there are also sub-categories), e.g., food, beverages, healthy plants, products for plants caring, self-care products, etc. Unfortunately, some of the pages are still empty, which could be a little irritating for customers that only want to use the website for placing their orders.

[13] Information based on the source from 2010

Elkana also has an agreement with one of the supermarket chains – Goodwill, where the farmers have an opportunity once a month to participate in a two-day (on Friday and Saturday) market at the store. Now, there is an increasing demand from the customers, asking for the products from the farmers market at the store, therefore Goodwill is considering giving a free place for Elkana's farmers[14]. The product quality would be controlled directly by Elkana. The ultimate goal of Elkana is to eventually create a market of locally produced organic agricultural goods differentiated from the conventionally produced products.

When talking about the future of Elkana, Mrs. Jorjadze said that the organization plans to continue achieving their aims in the fields of organic agriculture, agritourism, and preventing agricultural biodiversity.

Future Challenges and opportunities

Certification of organic products remains to be one of the biggest challenges in Georgia. Small ranges of certified products do not allow formation of a local market. Some small-scale farmers take advantage of the current market situation. Today the main market segment has moved from agrarian markets to the networks of large supermarkets. It means that the segment development now requires a certain minimum range of goods, regular supply and relevant quality with guarantees (i.e. organic products need to have certificates) (Elkana, 2019).

As can be seen, high certification costs under the underdeveloped market conditions hinder involvement of the bulk of farmers (who are basically small- and medium-size producers) in the certification of their organic products.

Creation of a sales network for organic inputs is no less important issue. In this regard, the already established and well-developed network of farmer service centres can well serve the purpose because it covers practically all of Georgia and not only works on sales of agricultural inputs but also undertakes farmer consultations.

The Georgian population is getting more and more interested in paying more for quality products (see Table 2). In addition, owing to uncontrolled and excessive application of chemicals, the interest of the population in alternative products increases.

[14] The idea of farmers markets at different stores had been considered before, however due to the charges required from the supermarkets, the organization was not able to participate.

The subsidies and government programs including various grants and agricultural credits, as well as harvest insurance programs increase year over year, to support organic production. The legislation on organic production is also in effect. There are also a variety of State and Donor-supported investment programs and projects underway.
Also, organic farming became one of the priorities for Georgia development, supported by, for example, the Czech Republic development program CzechAid.

Questions for Students:

1. How does organic farming help the environment?
   - Is certification important to differentiate organic products?
2. What should have been done to prevent Begeli exiting the market?
3. How can Ecomart gain a competitive advantage?
   - Can international organic e-commerce shops be considered as competitors of Ecomart?
4. What is the situation in organic farming in your country?
5. What government policies should be implemented to help the formation of an organic market in the country?
   - How does the government help promote organic farming in different European countries?

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Agri-voltaics[1] (agro-photovoltaics, agrisolar)

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Introduction

Solar panels or potatoes? You can really have both in one field. In recent years, farmers, not just in the West, have shown that combining the two in the landscape is possible. Sometimes even desirable. However, it is not only about energy, as one might think at first. In fact, the technology of agri voltaics is much richer and represents a great opportunity for many farmers, if it is grasped correctly, of course.
It is no coincidence that this system of farmland management is attracting the attention of many entities. Logically, each stakeholder has a different perspective on this issue. A farmer, a scientist or an investor will look at the same thing through different eyes. Fruit cultivation is an intensively researched area within agrivoltaics. For example, Wageningen University & Research is intensively investigating the effect of solar panels with different light transmission levels on the yield of raspberries, currants, blueberries and pears. Of course, energy companies are also entering the field, seeking installations that will yield interesting results in the future by buying back electricity. However, it is essential that farmers, investors and other stakeholders do not compete but cooperate.

Problem description

At a time when climate change is already affecting our daily lives, agrivoltaics is becoming very relevant. Drought, affecting not only Europe but

[1] Many thanks to David Brýdl, who provided valuable support during this Case Study preparation

also areas in the USA and India, is one of the factors motivating agricultural and technological innovators to develop new improvements. About half of Europe is threatened by drought (FERREL, 2021).
At the same time, we know that agricultural water consumption alone accounts for approximately 70% of all human water consumed. Agri-voltaic systems are significantly more economical with water and the energy obtained from solar radiation. Agrivoltaics (hereafter also as APV) responds to weather fluctuations and extreme growing conditions (hail, windstorms, scorching heat, etc.). Agrivoltaic systems can make a significant contribution to energy self-sufficiency not only for farmers but also for local communities living near fields or farms.
In addition to the macro issues mentioned above, there are also issues of a more local nature. This is the loss of agricultural land. The trend towards the loss of cultivated agricultural land continues. Since 2000, in the Czech Republic, the total area of agricultural land has decreased by 130,300 ha, i.e., by 3.6%, to 3 493,600 ha. A simple calculation shows that an average of 17.9 ha of land has been lost daily during this period. (MÁCOVÁ, ČERMÁKOVÁ, 2021).

Why do agri-voltaics arise, and how do we define it?

Agri-voltaics as a concept emerged in the 1980s.
Agri-voltaics play a vital role in today's and tomorrow's world. It seeks answers to energy and food transformation questions until 2050. Pilot projects and research on agri-voltaics systems mainly focus on more efficient resource management. In particular, managing agricultural land, water, and solar energy has enormous potential for humanity.
Agri-voltaics systems mean a dual use of land for agriculture and energy. The concept eliminates clean energy production through photovoltaic panels on the ground without its primary function - food production. The idea is being tested in Germany, the Netherlands, France, Japan, Italy, the UK, India, and China. Pilot green projects are waiting to be also launched in the Czech Republic, where the first one may be built in 2024 or earlier (DENIK.CZ, 2022).
The Fraunhofer Institute for Solar Energy defines Agrivoltaics as "*Agrivoltaics means the use of agricultural land for the simultaneous production of crops and the generation of electricity from photovoltaics*." (FRAUNHOFER ISE, 2022).

This new technology also promises to improve food production, reduce water consumption, and enable energy production as an additional income. Solar panels placed on the same land, where crops are grown, allow growers to double the use of the sun's energy (OREGON STATE UNIVERSITY, 2022).
The APV covers various intensities, agricultural use types, and the additional costs of building a PV system. This spectrum ranges from growing specialty crops and intensive crops on arable land with unique PV mounting systems (for example fruits under semi-permeable photovoltaic pan-

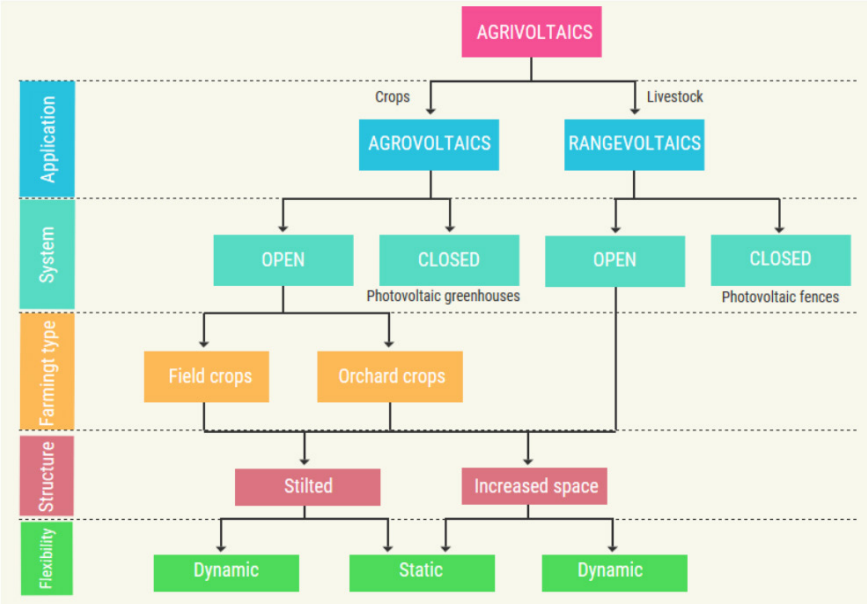

Figure 1: Possibilities of agri-voltaics
Source: WILLOCKX, et al., 2020

els) or there also exist greenhouses with photovoltaic roofs. It could also be used for extensive grazing with marginal modifications on the photovoltaic side. The range of possible applications are mentioned below:
In terms of design, the most common horizontal placement of PV panels is on a special elevated structure above the land so that labour and farm machinery can move underneath (Figure 2). The clear height of the structure is typically 3.5 to 5 metres. It depends on the height of the machinery used and the crops grown. For example, for hops the height of the structure can be over 8 metres. (JÍLEK et al., 2022).

Figure 2: Horizontal system

Source: Fraunhofer ISE (2022)

Figure 3: Vertical system

Source: JÍLEK et al. (2022)

Vertical structures are also used. This can be imagined as a fence line (Figure 3). In the case of a vertical APV, the width of the structure is about 20 cm. To this width a 0.5 m buffer strip on each side must be added. The line of a vertical PV system can also be used as a fence for protecting buildings, pastures, meadows.

Agri-voltaic systems are also being tested in fruit or specialty crop production, where PV panels serve as protection against adverse weather conditions such as heavy rain, strong winds or hail (Figure 4). In a pilot project with raspberry growers in the Netherlands, the foil shelters were

replaced by semi-transparent PV panels. At the same time, they reduced energy costs and gained additional income from the sale of surplus energy. The area under cultivation remained the same and the impact on production volume, with a maximum decrease of 3.5 %, seems almost negligible (JÍLEK, et al., 2022).

Agri-voltaics thus increases the efficiency of land use and enables the expansion of PV capacity while maintaining fertile arable land for agriculture.

The technology of agri-voltaics has been developing dynamically in recent years and can be found in almost every corner of the world. The installed capacity of AUVs has grown exponentially from approx. 5 MWp in 2012 to approx. 2.9 GWp in 2018 to more than 14 GWp in 2021, with national funding programmes underway in Japan (since 2013), China (approx. 2014), France (since 2017), the USA (since 2018) and most recently in Korea (FRAUNHOFER ISE, 2022).

Figure 4: Fruit protection system

Source: JÍLEK et al. (2022)

Why is agri-voltaics important?

The Food and Agriculture Organisation (FAO) aims to ensure sufficient food and drinking water for the population, not only in developing countries. Over time, food and drinking water have been accompanied by affordable access to renewable energies (FAO, 2014).
Linking these three interdependent areas is becoming increasingly relevant. In particular, the area of energy availability is becoming very relevant for farmers worldwide. According to the FAO, the interconnection between water, energy and food security means, among other things, that water, energy and food security are very closely interlinked, which means that actions in one particular area can often have an impact on one or both areas.
Agri-voltaics addresses all three of these areas and answers some of the questions related to more efficient water, food and energy management in agriculture. The study, published in the scientific journal Nature Sustainability in 2019, shows, among other things, the implications associated with each of these three areas. The researchers found that agrivoltaic systems have promising impact on food production, water conservation and renewable energy production. Reducing direct sunlight under photovoltaic panels led to lower air temperatures during the day and higher temperatures at night, allowing plants under solar panels to retain more moisture than control crops growing in open-air areas (NREL, 2019).
Some of the critical benefits of the APV are mentioned below:

- The total fruit production of chiltepin (wild chilli pepper) was three times higher in the agri-voltaic system compared to conventional cultivation.
- Water use efficiency for jalapeño was 157% higher in the agri-voltaic system.
- For cherry tomatoes, water use efficiency was 65% higher and total fruit production doubled in the agri-voltaic system.
- Under irrigation every second day, the soil moisture in the agrivoltaic system remained approximately 15% higher. Under daily irrigation, soil moisture in the agri-voltaic system remained 5%.
- Traditional ground-mounted PV panels were significantly hotter during the day than panels with vegetative understory.
- Agri-voltaic panels were cooler during the day than a traditional panel array by approximately nine °C, allowing for better performance. (BARRON-GAFFORD et al., 2019).

The benefits and challenges of agri-voltaics

Benefits

- Mitigating the effects of soil erosion.
- More efficient use of agricultural land (up to 186% more efficient).
- More efficient water management (water harvesting and subsequent irrigation; less evaporated water).
- Symbiotic benefits for both the panels - increased PV efficiency by 3% (higher efficiency) and the soil (mutual cooling, less erosion).
- Externalities with less impact on crops (hail, direct sun, high winds, etc.).
- Diversification of risks and income + stabilisation of farmers' economic situation.
- Energy self-sufficiency, lower energy costs + renewable resources.
- Positive perception of photovoltaics by the farming community (win-win).

Challenges

- Investment-intensive.
- Perception of AUVs by the public.
- Aesthetics of the landscape.
- Legislative anchoring.
- Possible misuse for pure energy purposes.
- Threats to food production, soil quality, landscape character and landscape aesthetics.
- Lack of available information and data about effects on production.

Barriers for agri-voltaic projects

- *NIMBY effect*

In recent years, the NIMBY effect has become an integral part of the process accompanying a particular construction project from its inception to its successful or unsuccessful completion. The NIMBY (Not-In-My-Backyard-Effect) attitude is characterised as a negative public attitude to-

wards upcoming construction projects, both private and public. Citizens in whose neighbourhoods construction is planned (typically highways, airports, sewage treatment plants, incinerators, or wind or solar power plants, for example, but also residential or office projects), while aware of the benefits to them and society of the project, do not want it in their neighbourhoods. Cancelled or delayed projects then cost investors and taxpayers millions. Therefore, active communication with the public is essential (EURACTIV.CZ, 2018).
A typically problematic project could be a project, also called "pseudo-agri-voltaic", where a giant solar power plant is built on good quality land, with a handful of sheep hiding under the panels under the pretext that it is a purely "green" project. However, it is a conventional solar power plant.

– *Bureaucracy*

Furthermore, agrivoltaics can be hampered by rules, regulations and bureaucracy, which vary from country to country and even from city to city. In the EU, agri-voltaic systems are usually considered physical structures regarding building regulations, so they need building permits. In Germany, for example, such construction is generally forbidden in rural areas unless it conflicts with a list of public interests. However, agr-ivoltaics are not yet on the list of public interests.
"*Under its agricultural policy, the EU provides direct payments for land primarily for agriculture. An important question is whether agricultural land loses its entitlement to financial support due to the use of agri-voltaics. The decisive factor is whether the land is predominantly used for agricultural purposes''* (FRAUNHOFER ISE, 2020).

– *Free market*

The market mechanism is probably the most important factor here, where costs and investment are the primary concerns. The cost per kWh is a crucial question, no matter what kind of photovoltaic installation. Since agri-voltaics solar does not provide as much energy per square metre as a traditional solar park, the cost per kWh can be 10-20% higher (AGOSTINI et al., 2021).
Of course, the critical question is, who owns the agrivoltaic farm? In the case of the **Babberich project** (raspberry farm in the Netherlands, see below), the farmer was neither the investor nor the owner of the installation. The farmer's willingness to participate in the project is primarily based on avoiding the negative impacts of solar installations on crop

yields and farm economics. In the Dutch example, the solar owner could compensate for the farmer's economic losses (FERREL, 2021).

How can each obstacle be overcome?

The following three recommendations are selected based on the document Agrivoltaics: opportunities for agriculture and the energy transition - a guideline for Germany 2020 (Fraunhofer ISE, 2020).

a) Agrivoltaics should be used primarily to achieve synergies, for example, by reducing the need for water or avoiding climatic hazards (hails, heavy rains, or winds).
b) From the perspective of the local economy, APV should be preferably operated by local farms, energy cooperatives or regional investors.
c) Energy storage systems shall be combined with APV to increase resource efficiency and meet local demand.

Best practice – Babberich, Netherlands

This is a project that is being jointly developed by farmers and the energy company BayWa r.e., namely its Dutch subsidiary GroenLeven B.V., which is active in the renewable energy sector, in particular in the field of agri-voltaics. The project covers raspberry cultivation, however now, trials are also underway for growing pears or apples.
The following information is based on the diploma theses of David Brýdl (2023). The size of the area under agri-voltaics is 3.3 ha, with a total number of 10 250 PV panels with a transparency of 59%. The panels are supplemented with a hail net. It is an in-ground structure with a height of 3 metres (sufficient for the height of the plants and the passage of machinery). The area is irrigated. The grower tentatively estimated the irrigation rate at 2 l/plant/day - compared to the foil cover (reference control area) the water saving is about 20-30 %, on hot days up to 50 %.
The temperature difference under the panels and under the foil was 2-7 °C (7 °C on very hot days), on the contrary, during spring frosts the temperature was slightly higher. However, the workers also praise the better microclimate under the PV contour. From the agronomy perspective, it is

estimated that there is no difference from conventional planting related to fertiliser consumption.
The plants are grown in containers, there are a total of 10,000 plants/ha, the width of the inter-row is estimated at 3.5-4 metres. Plants are brought to the plantation each year as pre-grown 1-year-old cuttings to optimise income - 2-year-old plants produce the most. There are 2 harvests per year, the first about 3 months after the containers have been “weighed” into the planting (June), the second harvest in August/September.
The profit from raspberry cultivation is reported by the grower as EUR 180 000/ha/year. The yield was only monitored for one year during the second raspberry harvest of that year - the data are therefore not indicative. The Benefits of energy generation are not known.

Picture 4: Agrivoltaic farm Babberich, The Netherlands

Current legislation in the Czech Republic

The problem in the Czech Republic is the legislation that makes it impossible to have both agricultural production and electricity production on one plot of land. So far, the agricultural investor has had to remove the land from the agricultural land fund (ZPF), thus losing the right to agrarian subsidies. This did not make economic sense. At the same time, farmers have to pay special fee/tax for the removal of the land from the Agricultural Land Fund. This removal also requires the approval of the agricultural land protection authority. The granting of this consent is, among other things,

a prerequisite for the issuance of a zoning decision and a building permit. (SOLÁRNINOVINKY.cz, 2022).

According to Minister Hubáčková, the Ministry of the Environment will prepare an amendment to the Act on the Protection of the Agricultural Land Fund, which would partially remove these obstacles. That amendment shall significantly reduce the overall investment costs for farmers, who will also benefit from subsidies for photo-voltaics, said Agriculture Minister Nekula (BROŽ, 2022).

Martin Abel of the Czech Agri-voltaics Club welcomes the relaxation of the rules. At the same time, however, he reproaches the state for the fact that farmers will still have to remove their land from the fund. "*The land removal will only apply where the structure touches the ground, but even that involves unnecessary paperwork for farmers*" says Abel. He also criticises that agri-voltaics in the Czech Republic should only apply to permanent crops, i.e., vineyards, hop farms and orchards, not giving potential for much wider usage of the concept (BROŽ, 2022).

Currently, there are projects in the Czech Republic focusing on the construction of APV systems. Specifically, this is a project prepared by Solar Works, s.r.o. in cooperation with ČZU, where the test field of ČZU will be used for growing hops and apple trees under PV panels. Another project is taking place in Litomyšl, where an APV system for raspberry cultivation will be built on private farmland in cooperation with other research institutions. In addition, there are approximately 100 other projects in the process of preparations in the Czech Republic (ABEL, 2022).

Questions for students

- How to approach the problem of climate and demographic change?
  - How to feed 1.2 billion people in 2035?
  - How to better manage water?
- Is there another innovative solution in the area of food production, similar to agrivoltaics?
- What is the situation with APV systems in your country?
- What are the barriers in the way of applying APV systems?
- In which areas/regions of the world can APV installations find their applications?
- Is APV economically worthwhile or are there any subsidies needed?

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Tajikistan: Sustainable agriculture under the process of climate change development

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Problem description

Tajikistan is a mountainous country with an altitude of between 300 and more than 8000 metres, whereas 93 percent of the country is a mountain range, some of which are among the highest in Asia - Tien Shan and Pamir. Tajikistan's relatively low level of socio-economic development, lack of infrastructure, and high dependence on climate-sensitive sectors make the country extremely vulnerable to the risks associated with climate change and related extreme weather events.

Tajikistan is generally the poorest country in the former Soviet republics, with low incomes with a gross national income (GNI) per capita (GNI) of 4,050 Int $ * and a population of 9.1 million by 2018.

Agriculture is the second largest sector of the economy, and in 2018 it represented 19% of the country's GDP of $ 7,523 billion and 51% of its employment. While agriculture and livestock dominate the Tajik economy, only about 30% of the total land area is classified as agricultural and 7% as arable. Of this agricultural land, 81% is pasture. Of the permanent arable land, 68 percent of the land is irrigated. Food is primarily produced to meet national consumption. However, about 120,000 tonnes of food products are exported each year, which represents about 2-3% of total exports by volume. Climate change could affect food production through direct and indirect effects on crop growth processes. Direct effects include changes in carbon dioxide availability, precipitation, and temperatures. Indirect effects include impacts on water availability and seasonality, soil organic matter conversion, soil erosion, changes in pest and disease profiles, the arrival of invasive species, and the loss of arable land due to

desertification. With projections of a significantly increased probability of drought and heat waves, agricultural production is likely to be less stable. The climate change in Tajikistan is observable and can be predicted via temperature increase (0,26-0,37 ^{0}C per 10 years, all districts), increase in yearly precipitation (Kanibadam and Shaartuz), change in seasonality of precipitation (all regions), increase in wind (Kanibadam) and evaporation indices (all districts), and extreme weather events (sudden rains, spring frosts, heat waves, etc.)

Climate change is already affecting the country's economy, society, and ecosystems. Tajikistan is at risk of soil erosion due to weather events, and water availability and quality are deteriorating. Extreme weather events (such as floods, droughts, avalanches, and landslides) regularly destroy land, crops, and infrastructure, with average annual losses between 1996 and 2015 estimated at 7.4% of the country's GDP. These losses indicate the need for immediate adaptation activities. The most common impacts are soil degradation and fertile topsoil erosion, as well as infrastructure impacts due to extreme weather events, such as torrential floods, drought, and more. The combination of increasingly unpredictable frequency and intensity of extreme weather events and changes in the hydrological cycle reduces productivity and food safety but also affects the health of the population. It is assumed that higher temperatures combined with high levels of flood-related water contamination will increase the risk of infectious diseases and gastrointestinal infections.

In the middle of the 20th century, about 6% of Tajikistan's area was covered by glaciers. At the beginning of this century, this number dropped to 5 percent. By the end of the century, glaciers in Central Asia are expected to lose about 50-70%. This melting is likely to have a very significant impact on the Amu Darji and Syr Darji river basins. Melting glaciers and snow usually ensure water availability throughout the year. Continued melting of glaciers will mean increased runoff, and once smaller glaciers disappear, flow on smaller tributaries can drop dramatically.

1. The observable climate change over the last 30 years, the predicted climate change

The country lies on the border of the subtropical and temperate zone, it is generally characterised by - high intensity of sunlight, dry and dusty climate, low cloud cover and very large daily and seasonal temperature

fluctuations. Aridness, extreme temperatures and significant year-on-year and regional climate variability are due to Tajikistan's location at the intersection of atmospheric circulation from the tropics to the southeast and Siberia to the north. Annual average temperatures range from 17 ° C in the south to -6 ° C in the lower part of the Pamirs. Maximum temperatures are usually observed in July and minimum in January. Minimum temperatures below -50 ° C have been recorded in the Eastern Pamirs, while in the south the maximum surface air temperature may exceed 40 ° C. Annual rainfall in the lowlands, hot deserts of northern Tajikistan and cold mountain deserts in the eastern Pamirs average 70 mm to 160 mm, while in central Tajikistan rainfall can exceed 1,800 mm per year. The lowest precipitation is observed during the months of July, August and September, which contributes to frequent droughts. The ten years in 2001-2010 were the warmest since instrumental temperature measurements began in Tajikistan as seen in Figure 1. In the lowland areas the temperature

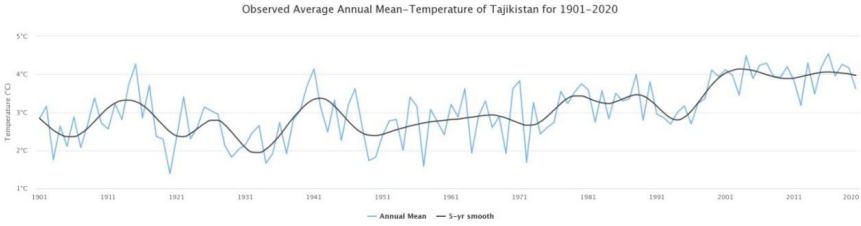

Figure 1-1 Observed average annual mean temperature for Tajikistan from 1901 to 2020

Source: https://climateknowledgeportal.worldbank.org/country/tajikistan/climate-data--historical

increased by about 1oC above the long-term average, in the middle positions it warmed by 0.8°C and in the hills by 0.2°C. In the years 1930-2010, temperatures grew at an average rate of 0.1 ° C over the decades. The weather remains very unstable from year to year, mainly due to atmospheric circulation processes, which bring unusually hot or cold air. Over the last century, temperature rises have been most pronounced in the autumn and winter months and lower - less pronounced - in the spring and summer as seen in Figure 1-2. The precipitation trend is very diverse and is subject to changes according to the microclimate of the site. In general, an increase in average annual precipitation of approximately 5-10% was observed. However, this increase is primarily associated with higher intensity rainfall events, and in some areas the frequency of rainfall days has

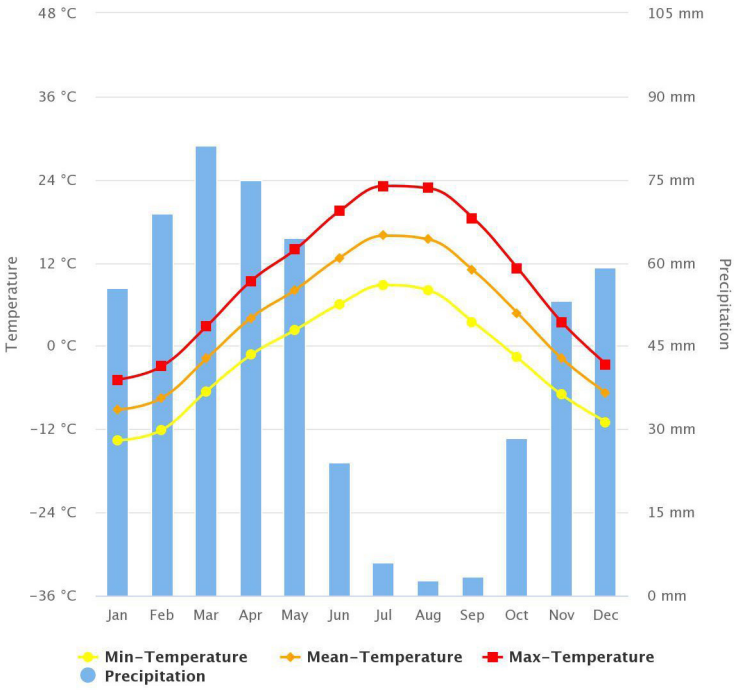

Figure 1-2 Monthly Climatology of Min Temperature and Mean Temperature, Max Temperature and Precipitation 1991-2020 for Tajikistan

Source https://climateknowledgeportal.worldbank.org/country/tajikistan/climate-data-historical

actually decreased. This has led to some of the last extremely dry years - notably 2000, 2001 and 2008, when rainfall was 30-50% below average. The changes in the precipitation regime observed in the 20th century are in line with global trends. Extreme rainfall increases with temperature, which is consistent with evidence from various countries in the Asian regions. Projections suggest that this trend will continue into the future.

Climatic characteristics of Tajikistan

Climatic conditions. The territory of Tajikistan is characterised by an arid climate, an abundance of heat and significant intra-annual variability in almost all climatic elements[1].

[1] Leningrad Gidrometeoizdat 1988. Scientific and applied reference book on the climate of the USSR, series 3, long-term data, part 1-6, issue 31, Tajik SSR.

Tajikistan's climate covers a wide range of temperatures, moisture conditions, rainfall patterns, and intensity of solar radiation. Average annual temperatures, depending on the altitude of the area, can range from + 17°C or more in the south of the country to - 6°C or less in the Pamirs. The maximum temperature is in July and the minimum in January. The climate is particularly harsh in the Eastern Pamirs, where the absolute minimum reaches -63°C. In the south of the country, the absolute maximum temperature reaches + 47°C. In the hot lowland deserts of Southern Tajikistan and the cold highland deserts of the Eastern Pamirs, average annual precipitation ranges from 70 to 160 mm, while the maximum precipitation is observed in Central Tajikistan, and can exceed 1,800 mm.

The territory of Tajikistan is under the influence of two powerful and active centres of atmospheric action, which determine the climate not only of Central Asia, but also of most of the Eurasian continent. One is a Siberian anticyclone and the other is a summer thermal depression. Despite the different nature of thermal effects, their development is associated with the predominance of north and northeast winds. The atmospheric circulation is significantly distorted by mountainous topography, which leads to the development of different types of local circulation.

Air temperature. Given the diversity of Tajikistan's climate, a number of areas with similar physical and geographical conditions have been identified to characterise the thermal regime of its territory.

Wide valleys and plains with altitudes up to 1,000 m are the main areas for agriculture and cotton growing. These include the south-western part of the republic, Gissar, Vakhsh, Lower-Kafirnigan, Kulob valleys, and Fergana valley with adjacent plains of Sugd region. Broad valleys and plains are characterised by high air temperatures in summer, when summer thermal depression prevails. Summers are characterised by clear and hot weather, when the maximum temperatures can reach 43-47°C. The average monthly temperature in the hottest month of July is 28-30°C.

The transition zone from valleys to highlands up to an altitude of 2,500 m includes: Zeravshan Valley, mountainous areas of Central Tajikistan and part of the Western Pamirs. In summer, low clouds and dry weather persist here, but it is cooler. This zone is characterised by a consistent decrease in temperature with altitude. The hottest month of the year is July, with average monthly temperatures ranging from 25°C in the Zeravshan Valley to 18°C in the mountains of Central Tajikistan. The absolute maximum reaches 36-40°C.

High altitude areas above 2,500 m include the Central and Eastern Pamirs and mountain ranges. The climatic conditions in the Eastern Pamirs are

particularly harsh. Winters here are long and cold. The average January temperature drops to -14°C to -26°C. The absolute lowest temperature is -63°C (Bulunkul). Summers are short and cool. The average temperature in July does not exceed +15°C (Ircht). Absolute maximums range from +20°C (Fedchenko Glacier) to +34°C (Ircht).

Atmospheric precipitation. There are mainly two zones in Tajikistan in terms of precipitation conditions. The dry climate zone covers the valleys of South-Western and Northern Tajikistan, the foothills of the Turkestan mountain range, as well as the vast highland area of the Eastern Pamirs (50-300 mm per year). The rest of the territory belongs to the zone of insufficient moisture (up to 900 mm). The exception is the windward southern slopes of the Gissar Ridge, where the zone of humid climate (more than 1800 mm) is distinguished by separate spots.

The annual course of precipitation varies in different regions of the republic. Most of the territory is characterised by an annual pattern of precipitation, with a minimum in the summer months. The maximum of precipitation falls in March-April in the valleys and foothills, and in April-May in the highlands.

The maximum monthly precipitation in most parts of the country is 30-100 mm, and in some areas up to 200-300 mm. In the north of Tajikistan and the Eastern Pamirs the maximum precipitation decreases to 12-20 mm per month. During the months of minimum precipitation throughout the territory, the amount of precipitation does not generally exceed 5 mm, and only in some high-altitude areas does it amount to 10-20 mm per month.

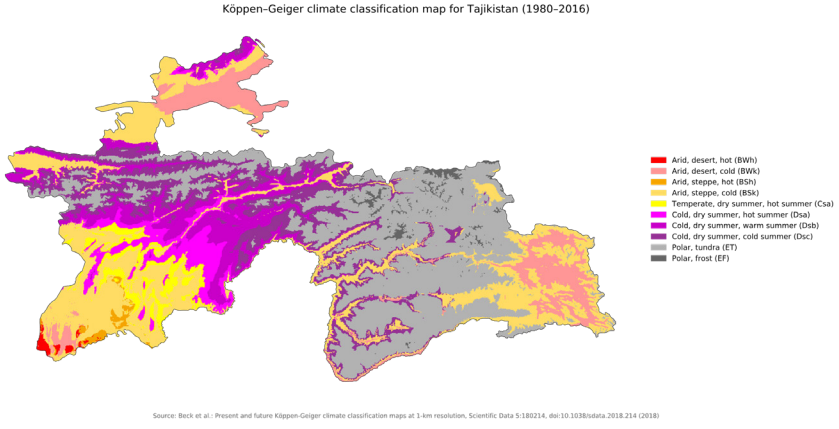

Figure 1-3 Köppen-Geiger Map of Tajikistan (Beck et al. 2018)

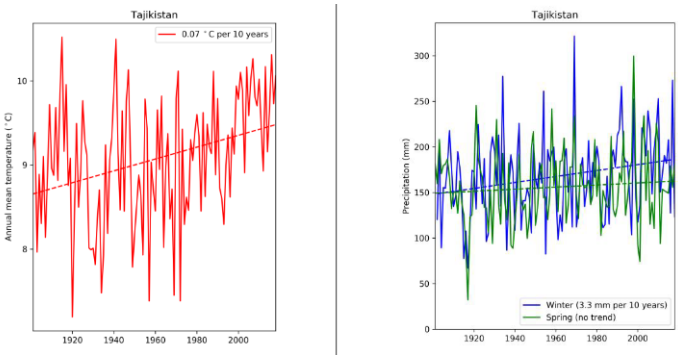

Figure 1-4 Average temperatures Precipitation rates (winter, spring) in Tajikistan (1900-2016)

Source: Pfefferle, 2020, GIZ

On average, 15-20% of all precipitation falls as snow in the foothills of Tajikistan during the year. With altitude, the amount of solid precipitation increases to 50-70%, reaching a maximum in the Pamirs (85-90%), including the Fedchenko glacier (100%). The number of days with precipitation of 0.1 mm and more varies in the plain part within 50-80 days, in the foothills - 80-100 days, which number increases with altitude up to 125 days. The lowest number of days with precipitation in the highland desert of the Eastern Pamirs is 50 days.

2. Climate trends and predictions in Tajikistan

The existing trends in Tajikistan suggest temperature increase of approximately 0,07 °C per 10 years, increase in precipitation in winter by approximately 3,3 mm per year, and no increase in precipitation in spring (Pfefferle, 2020, GIZ.)

2.1 The projected climate trends

Most of the existing scenarios of climate change in Tajikistan predict the increase in average temperatures (Pfefferle, 2020; Climate Risk Country Profile: Tajikistan, 2021; Climate change knowledge portal, 2022). The extent of this increase varies according to the scenario of CO2 production,

the model and the time span. Compared to 1986-2005 levels, the average annual temperature in Tajikistan is to increase by 1.3-6.3 °C by 2080 depending on the emission scenario of (Pfefferle, 2020). Similarly, Climate Risk Country Profile: Tajikistan (2021) predicts average temperature increase of 1.5 to 5.8 °C by 2080.

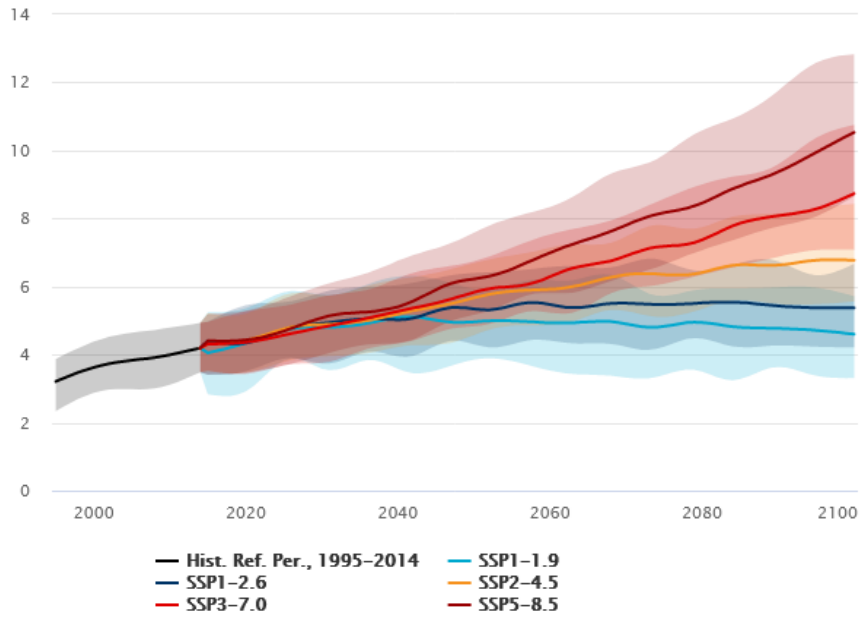

Figure 1-5 Projected Mean Temperatures, Tajikistan. Reference period 1995-2014, Multi-Model Ensemble

Source – Climate change knowledge portal (2022)

The multi-model predictions expect the temperature increase approximately till 2040 followed by a wide variation of the scenarios till 2100 (Climate change knowledge portal, 2022 Figure 1-5). Some of these scenarios predict a decrease in the average temperatures if the underlying factors including the emissions of green gases develop in a more favourable way. From the predictions follow, that the impact of the particular model or scenario on the temperature increase is most pronounced starting from 2040. Given that this study concentrates on the period till 2040, we can effectively exclude the impact of the emission model from the analysis and concentrate on trend predictions.

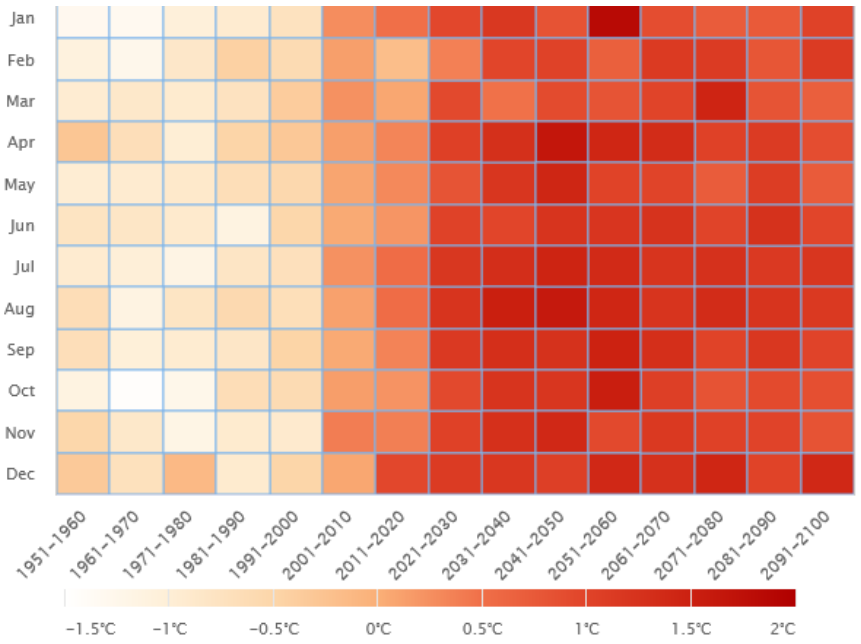

Figure 1-6 Projected Mean-Temperature Anomaly, Tajikistan Reference period 1995-2014, Multi-Model Ensemble

Source – Climate change knowledge portal (2022)

The regional distribution of the temperature increases by 2040 does not present any significant variations with the average increase of approximately 1 (ibid).

The change in the average temperatures by 2040 is least pronounced in February (+0,37 °C) and, surprisingly, May (+0,81 °C) and the most pronounced in summer months (up to 1,2 °C, Figure 1-6.) This distribution is rather unfortunate for agricultural production in Tajikistan, as in most of the regions, including most of the target districts (excluding Kuhistoni Mastchoh), the summers are already very hot, which is disadvantageous for many agricultural crops, increases the need for irrigation and damages the human health.

The limited mean temperature increase in February may be also viewed as disadvantageous, as farmers tend to move the planting season from March to February. The low temperature increase may be associated with the sudden frosts, which will damage the production. However, this effect might be eliminated with the further increase in the temperatures beyond 2040.

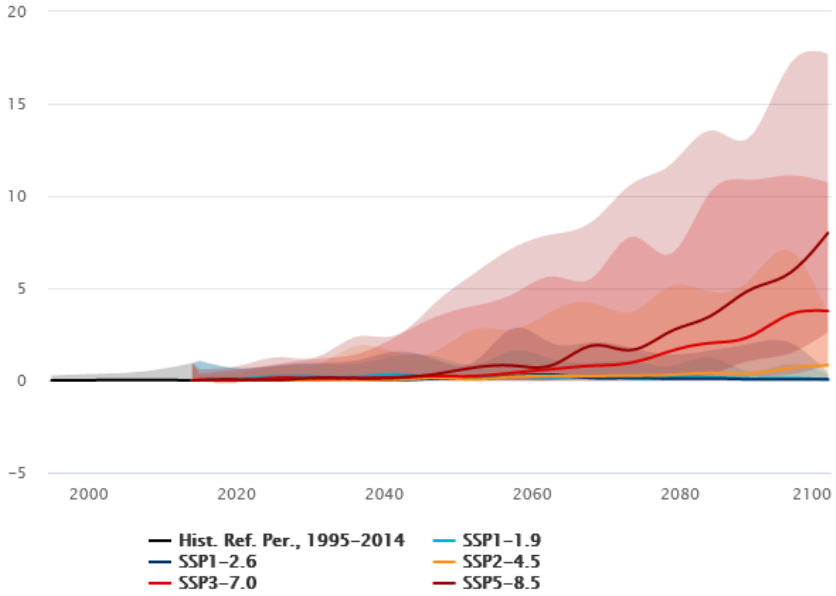

Figure 1-7 Projected days with heat index >35 °C, Tajikistan, Reference period 1995-2014, Multi-Model Ensemble

Source - Climate change knowledge portal (2022)

Similarly, to average temperatures, the heat waves, approximated by the projected number of days with heat index >35 °C start also to be more pronounced from 2040 on (figure 3), which is out of the time span of the current study.

The regional distribution of the projected number of days with heat index >35 °C show significant regional variations. In the Sogd region (including the districts of Kuhistoni Mastchoh and Kanibadam), no increase in the number of days with heat index >35 °C is expected by 2040. In the middle of Tajikistan (including the districts of Hissor and Faizabod) the increase is 0,32 days. In the region of Khatlon (including the districts of Mumonobod and Shartoos), the increase in the number of days with heat index >35 °C equals 3,53. However, the Kuhistoni Mastchoh and Faisobod are on the edge between the regions, thus the changes might be smaller.

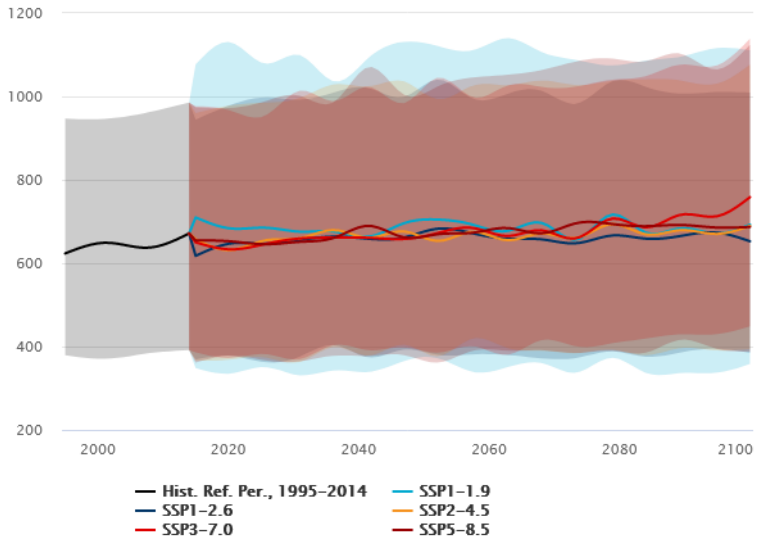

Figure 1-8 The projected precipitation, Tajikistan, Reference period 1995-2014, Multi-Model Ensemble

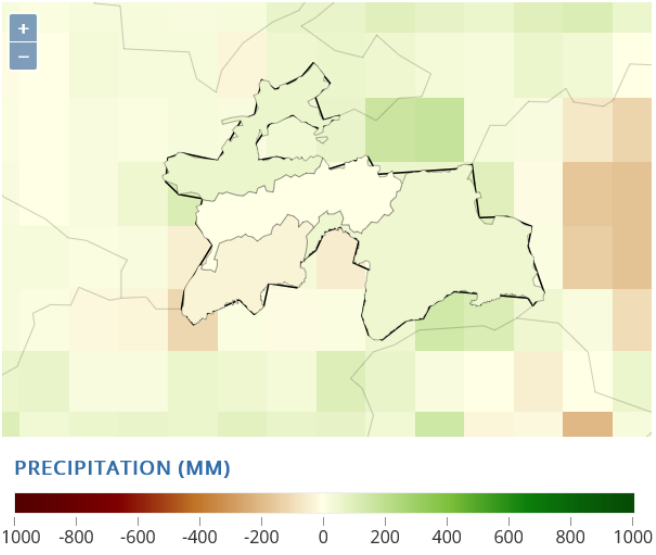

Figure 1-9The projected precipitation anomaly 2020-2040, Tajikistan, Reference period 1995-2014, Multi-Model Ensemble

Source: Climate change knowledge portal (2022)

2.2 The projected precipitation

The projected precipitation over the country presents a slight upward sloping trend with relatively small change till 2040. However, there are significant intra-regional variations.

There are significant intra-regional variations in precipitation projections (figure 5) In the Sogd region (including the districts of Kuhistoni Mastchoh and Kanibadam), the overall precipitation is supposed to increase by 53 mm, by 2040. In the middle of Tajikistan (including the districts of Hissor and Faizabod) the increase is smaller and will amount to only 0,51 mm by 2040. In the southern region of Khatlon (including the districts of Mumonobod and Shartoos), the precipitation is supposed to decrease -31 mm. However, the Kuhistoni Mastchoh and Faisobod are on the edge between the regions, thus the changes might be smaller.

From the above follows, that we expect all the districts to experience the increase in average temperatures by approximately 1 °C. The southern districts of Mumonobod and Shartoos will be more affected by the increase in number of days with heat index >35 °C and the diminishing precipitation, while the Kuhistoni Mastchoh and Kanibadam is supposed to experience no change in the number of days with heat index >35 °C and increase in overall precipitation. The districts in the middle part of Tajikistan (Hissor and Faizabod) present the middle way between the scenarios above.

The following climatic characteristics of the six target districts were compiled based on the long-term average meteorological information Agency for Hydrometeorology for the period 1961-2010.

3. The effects of climate change on agriculture

Tajikistan has a large and diverse agricultural sector with overall production amounting to 24% of GDP in 2020 (World Bank data, 2022) employing an estimated 44% of the workforce in 2020 (World Development Indicators, 2022). Key crops in production include grain, potato, fruits and vegetables. The strategic export crop is traditionally cotton. The strategic import crop is grain The national policy of Tajikistan ensures almost total self-sufficiency in food production. The exports of agricultural products are relatively low, ranging from around 120,000 tons of exported food products per year, which constitutes 2% to 3% of the total exports by volume (TajStat, 2018).

3.1 The effects of climate change in Tajikistan

The following effects of climate change are described in the literature (Pfefferle et. al., 2020; Zholdosheva et al., 2017).

The movement of ecosystem zones (forests, pastures) upwards vertically in mountainous areas. Along with this, there is an observed shift in species composition of biodiversity of flora and fauna. There is a shift in species composition of plant and animal biodiversity and in species ranges and their quantity, which affects agricultural activities in mountainous areas - changes in pasture rotation and crop rotations.

Rising temperatures and changes in precipitation patterns lead to changes in the hydrological regime and the reduction of water resources. The problem with projected decline in water resources is exacerbated by the increasing demand for water due to the growth of the population.

Increase in the number of extreme weather events and natural disasters, affecting the safety of people and countries' economies. Each year these disasters cause significant damage to settlements, agricultural land and infrastructure.

Climate change is likely to exacerbate existing vulnerabilities and risks to infrastructure. Roads are particularly susceptible, caused by temperature fluctuations and extreme heat. Moreover, changes in river flow levels can lead to fluctuations in the production of hydropower. In addition, identified risks associated with climate change to infrastructure due to climate change include debris flows, droughts, high temperatures, and high winds.

Rising temperatures can lead to snow line retreat and loss of glacial mass and, as a result, reduced water retention capacity. An increase in temperature will lead to increased variability in streamflow, as well as fluctuations in water availability and quality; in this negative effects are to be expected for agriculture. In addition, an increase in temperature is associated with a probable increased risk of springtime flooding and glacial lake outbursts in the process of melting snow.

As a result, the temperature increase is expected to result in a decrease in the number of frosty days. According to the scenario with high emissions - RTC 8.5 - the number of frosty days would decrease to about 212 days in 2030 2030, to 200 days in 2050, and to 170 days in 2080. The pest invasion is then probable.

The number of hot days with temperatures above 40°C is expected to increase by 2080 by 12.5 over the period from 1986 to 2005. Consequently, this will lead to an increase in cases of heat-related illnesses such as heat stroke and increased heat-related mortality rates. Increased food

shortages combined with expected declines in agricultural agriculture and pastureland will likely have a negative impact on the already critical nutritional population's nutritional status. Along with increased pollution waters associated with flooding, as well as increased exposure to disease, water- and food-borne diseases, gastrointestinal infections are predicted to increase. Climate change increases the likelihood of more frequent and severe outbreaks of infectious diseases, particularly the resurgence of the spread of malaria.

In some cases, climate change is also creating new opportunities in some sectors of the economy. For example, in the agroforestry sector, whose development agroforestry sector, for example, is becoming more promising to develop as a result of shifting climate belts or changing precipitation patterns. Climate change is also contributing to the development of adaptation measures aimed at more efficient use of natural resources and to improve management practices in other spheres of human activity. (Zholdosheva et al., 2017)

The duration of the growing season (GWP). B According to the high emission scenario - RTC 8.5 - in 2030, the GWP would be 150 days, In 2050 - 165 days and in 2080 - 200 days. However, rising temperatures counteracts the positive effect of a longer RTP period. (Pfefferle et. al., 2020) In addition, the lack of water does not allow for the prolongation of the growing season.

3.1.1. Climate change impacts on agriculture

Taking in consideration already published available materials it is possible to confirm the following statements: Food security, health, livelihood assets, food production, and distribution channels are affected by climate change (FAO 2008; UNECE 2012). Heltberg, Reva, and Zaidi (2012) suggest that climate change can potentially deepen poverty by lowering agricultural yields, raising food prices. In their earlier work, Heltberg and Bonch-Osmolovskiy (2011) assessed Tajikistan's vulnerability and capacity to adapt to ongoing and future climatic changes.

Projecting impacts, vulnerabilities, and adaptations in Asia, Hijioka et al. (2014) suggest that water scarcity is expected to become a major challenge in many parts of Asia, including Central Asia. Tajikistan's main agricultural valleys are among the most vulnerable to the impact of climate change, where water availability is a major climate-change-related concern (Heltberg and Bonch-Osmolovskiy 2011). Bobojonov and Aw-Hassan (2014) suggest that the impact of climate change on incomes derived from agriculture in Tajikistan is expected to be crop-specific.

There have been a number of analytical assessments of the impact of climate change on agriculture and food security in Tajikistan (e.g. Bobojonov and Aw-Hassan 2014; OSCE 2010; CAREC 2013; Heltberg, Reva, and Zaidi 2012; Lerman and Wolfgramm 2011; Makhmadaliev et al. 2008; Bann et al. 2012; FAO 2008; Fay, Block, and Ebinger 2010; Khakimov and Mahmadbekov 2009).

3.1.2. The character of Tajik agriculture

Tajikistan has an area of around 141,000 km2 (14,100,000 ha) of which about 90% is considered upland and mountainous. More than two thirds of the population is rural and dependent on 4.6 million ha of agricultural land, the majority of which is rain-fed pasture. More than 90% of the total rangeland is degraded. All pasture lands of Tajikistan are strongly subject to erosion - with 89% of the summer pastures and 97% of winter pastures suffering from medium to strong erosion (FAO, 2021).
Agriculture is the second largest sector of the economy, accounting for 20% of the country's GDP of 7,523 billion USD and about fifty per cent of its employment in 2020 (WB, 2018). While the agriculture and livestock sector dominates the Tajik economy, only around 30% of the country's total land area is classified as agricultural and 7% as arable. Of these agricultural lands, 81% consist of rainfed pastureland (USDA, 2016). Of the permanent cropland, only 68% is being irrigated which makes Tajikistan the Central Asian country with the lowest irrigated land to population ratio (USDA, 2016). Moreover, cotton, the country's most important cash crop, as well as other primary agricultural products such as fruits and vegetables are all water-intensive crops that withstand the current arid climate conditions; therefore, Tajikistan's agriculture is heavily dependent on irrigation (FAO, 2018). This situation partially accounts for Tajikistan's high susceptibility to the effects of climate change (Pfefferle et al., 2020)
Tajikistan has a large and diverse agricultural sector. Key crops in production include wheat, potato, vegetables (particularly onion), melon and other fruits. Food is primarily produced to satisfy national consumption. Climate change could influence food production via direct and indirect effects on crop growth processes. Direct effects include alterations to carbon dioxide availability, precipitation and temperatures. Indirect effects include through impacts on water resource availability and seasonality, soil organic matter transformation, soil erosion, changes in pest and disease profiles, the arrival of invasive species, and decline in arable areas due to desertification.

The outlook projected for agricultural production in Tajikistan is mostly negative. One study suggests yield declines are likely for several key crops including wheat, barley, maize, vegetables, and fruits, typically in the order of 5%–10% by 2050. Rice, potato and cotton yields are projected to experience small (<5%) yield gains over the same period (Aliev, 2016)

Taken together these changes could reduce national food security and community well-being. There is some disagreement over the outlook for wheat, a key staple crop. Studies have suggested that rising temperatures may, over the long-term, improve conditions for wheat growth, increasing achievable yields by up to 12% (Sommer et al., 2013)

However, such projections should be treated with extreme caution because models typically assess the compatibility of average climate conditions with plant physiology and do not capture the impact of climate extremes. In addition, over the longer-term future, there is concern that loss of glacier and snow cover could significantly reduce the available water resource, potentially leading to major water shortages for irrigation purposes (Reyer et al., 2017)

With projections of considerably increased drought and heat wave probability, agricultural production is likely to become less stable, and net production may suffer (Bobojonov & Aw-Hassan, 2014)

3.1.3. Historical Trends of Temperature and Precipitation Changes

Relying on historical and projected trends in temperature and precipitation, Broka et al. (2016) suggest that Tajik agriculture is particularly vulnerable to climate change, with rising temperatures and falling precipitation projected in both the medium and long term. In the medium term, rising temperatures are expected to increase the rate of glacial melt and the associated risks of flooding. In the long term, together with falling precipitation, water availability for irrigation will become a major challenge (Khakimov et al., 2020).

According to historical data provided by the Climate Change Knowledge Portal for Development Practitioners and Policy Makers (CCKP), average annual precipitation levels might not be significantly different between the periods of 1961–1990 and 1991–2016. However, changes in precipitation levels have taken a more seasonal pattern, which directly affects agricultural activities. While precipitation levels increased in January–February of the 1991–2016 period more than from 1961–1990, the reverse can be observed during March–May. From August onward precipitation patterns for the two date ranges remain more or less the same. Contrary

to precipitation data, the average monthly temperature has increased for all months during the 1991–2016 period compared to 1961–1990. Overall, the average annual temperature increased by about 0.63°C between 1991 and 2016 compared to 1961–1990 (Khakimov et al., 2020).

3.1.4. The impact climate change effect on Land, Soil, and Biodiversity

Historical warming has already had an impact on large scale vegetation health across Central Asia and locally in Tajikistan. Over the period 1992–2011, rising air temperatures were associated with significant loss of 'greenness' (Zhou et al., 2015). Above mentioned trend has even accelerated during the last decade. These losses have been linked to increased water deficits driven primarily by greater evapotranspiration which can result in stunted plant growth and desiccation. Tajikistan's lowlands are also among the areas already being affected by increased aridity, Huang & Xie (2016) as reported in the nation's TNC. Persistent drought periods degrade grassland areas, causing transition to sparsely vegetated lands and shrubs (Khakimov et al., 2020).

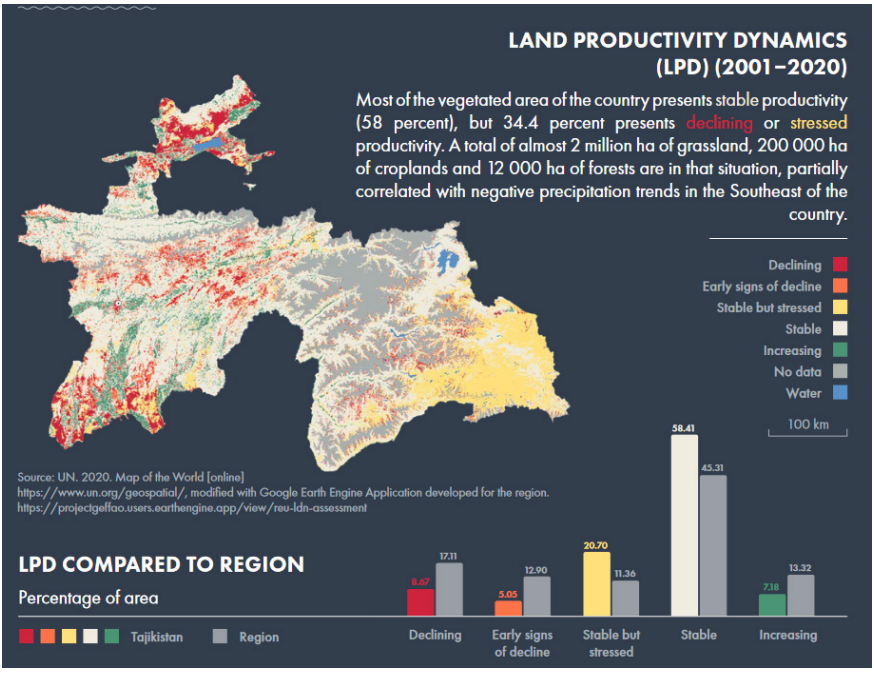

Figure 2-1 Agricultural land productivity dynamics development in Tajikistan

Source: FAO, 2021

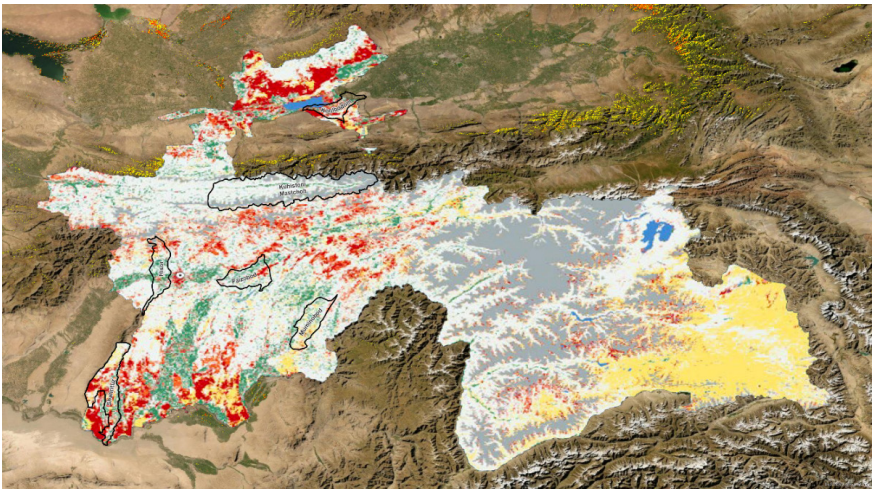

Figure 2-2 Agricultural land productivity dynamics development in Tajikistan – selected regions specifics

Source: own processing and FAO, 2022

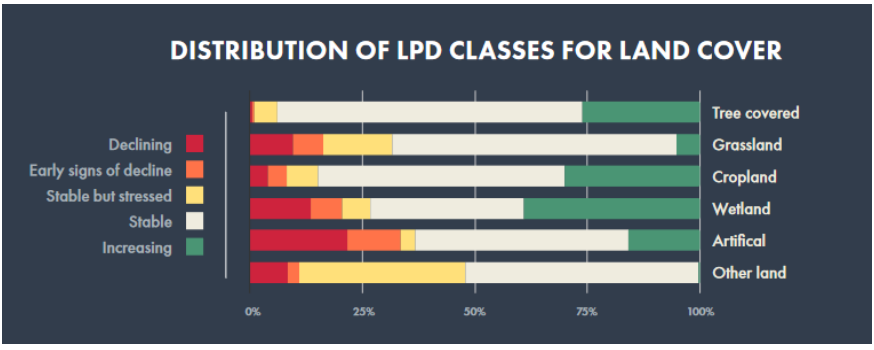

Figure 2-3 Distribution of land productivity dynamics at the level of individual land areas

Source: FAO, 2021

Indeed, over the Central Asian region, an estimated 8% of grasslands and 10% of forest land converted to shrubland between 2000–2013 (Li et al., 2015). The Central Asia region is identified as a hotspot of potential dry-land expansion under future climate change (Huang et al., 2016). Desert-ification may also be a risk, but evidence from 2017 suggested Tajikistan contained most of the land that is immediately vulnerable (Zhang et al., 2018), The future of land and soil health in Tajikistan will depend strongly on local land management and development practices, such as biomass

burning and soil conservation, Loboda et al. (2012) but sustainability challenges are likely to be exacerbated by climate change. Issues such as the projected increase in the erosive capacity of rain, and its impact on soil quality, will increase the pressure on key ecosystem functions (Duulatov et al., 2019). These changes, in combination with issues such as glacial melt and drought will likely result in significant shifts in species' viable ranges (both in natural ecosystems and for agricultural purposes) (Luo et al., 2018). Climate change impact is also associated to the problem of significant changes in the area of land productivity dynamics (FAO, 2021) (Khakimov et al., 2020).

The problem of land productivity development under the climate change process is related to both positive and also negative dynamics development. On the other hand, the negative trend is associated with only marginal agricultural land area (FAO, 2021).

3.1.5. Changes in Crop Yields

Quite important material devoted to the problem of changes in agricultural production under the process of climate change was published by Khakimov et al. (2020]. The key findings related to climate change's impact on agricultural production are stated below.

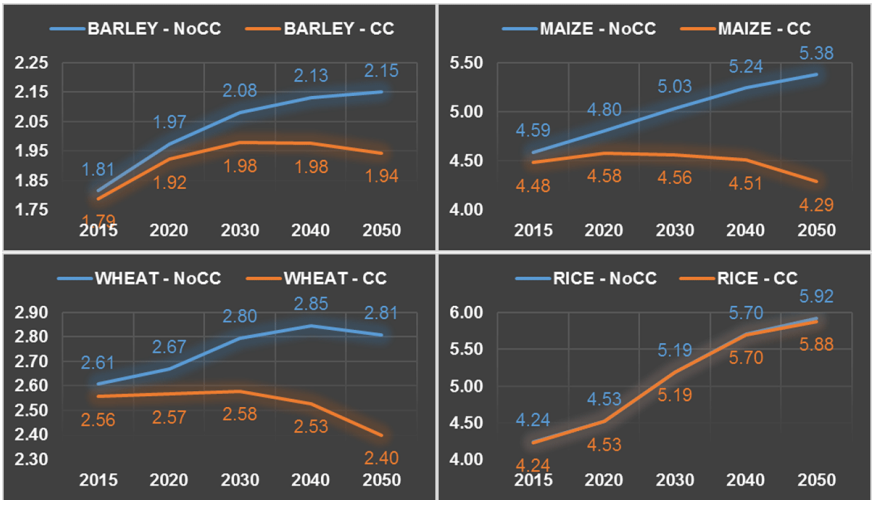

Figure 2-4 Irrigated crop yields in climate-change vs no-climate-change scenarios, metric tons/ha: barley, maize, wheat, and rice.

Note: 'CC' averages the yields from the four different climate models.

Source: Khakimov, P. & Aliev, J. & Thomas, T. & Ilyasov, J. & Dunston, S., (2020)

Climate-change 'CC' effects on individual crops will depend on their tolerance of heat and water availability. Winter crops in temperate climates often increase productivity in warmer temperatures, in contrast to spring crops which are more likely to experience heat stress in response to warming. Changes in seasonal rainfall patterns and severe weather events may affect planting and harvesting. Most arable land under major crops is irrigated in Tajikistan. Figure below presents projections on yield changes on irrigated land. The climate change scenario 'CC' represents the average value obtained from the four different climate models (Khakimov et al., 2020). The findings suggest that by 2050, barley, wheat, and maize yields will suffer a substantial decline due to climate change. On the other hand, the growth in rice yields between 2015 and 2050 shows virtually no difference between the baseline and climate-change scenarios. Overall, rice yields are expected to increase by about 40 per cent (Khakimov et al., 2020).
Figure 2-5 shows the results of a similar exercise involving crop categories such as vegetables, fruit, potatoes, and cotton. Under the no-climate-change scenario, vegetable yields are projected to rise steeply until around 2030 and then level off through 2050. Under the climate-change scenario, however, yields are projected to rise more modestly through 2030, then decline through 2050. A similar pattern can be observed in the case of temperate fruits (Khakimov et al., 2020).

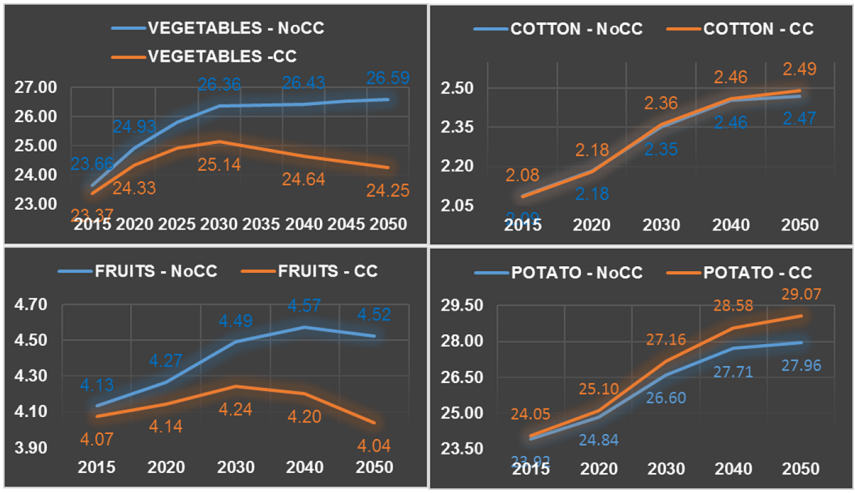

Figure 2-5 Irrigated crop yields in climate-change vs no-climate-change scenarios, metric tons/ha: vegetables, cotton, fruit, and potatoes.

Note: 'CC' averages the yields from the four different climate models.

Source: Khakimov, P. & Aliev, J. & Thomas, T. & Ilyasov, J. & Dunston, S., (2020)

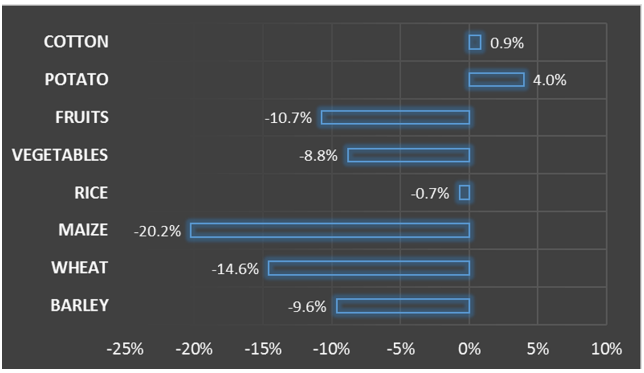

Figure 2-6 Changes in irrigated crop yields under climate-change scenario, 2050/2015 (%).

Source: Khakimov, P. & Aliev, J. & Thomas, T. & Ilyasov, J. & Dunston, S., (2020)

Two points must be considered with respect to how fruit and vegetables are estimated. First, they are aggregates of many different crops, and as such, it is difficult to interpret effects on individual crop types. Second, climate impact on yields is inferred from the crop model results for other crops, and therefore one should exercise caution in making direct comparisons. For potatoes, the climate impact on yield is expected to be small but positive, unlike for any of the other aforementioned crops. Potato yields are projected to increase by about 21 per cent under the climate-change scenarios. Likewise, cotton yields are projected to increase by about 20 per cent over the same timeframe. Projected climate-change-induced yield changes for 2015–2050 are summarised in Figure 2-6 (Khakimov et al., 2020).

3.1.6. Area Changes

Farmers make choices about expanding or reducing the area allocated for crops in response to signals such as productivity, expected prices, competition from other crops, and land demand. These are all factors that alter the profitability of a particular crop. Climate change ultimately affects area choices through all of these avenues. Figures 2-7 and 2-8 display differences in allocated area between the climate change and baseline scenarios (Khakimov et al., 2020).

3.1.7. Changes in Domestic Supply and Demand

Continuing population growth in Tajikistan is expected to lead to an increased demand for many agricultural products. The ability of farmers

to expand production will be limited by climate change and the other constraints mentioned earlier. The excess demand can be satisfied by importing foods. Figures 2-9 and 2-10 show projected shifts in domestic supply and demand for selected categories of crops by 2050. Projection estimates suggest that climate change is going to have a negative effect on

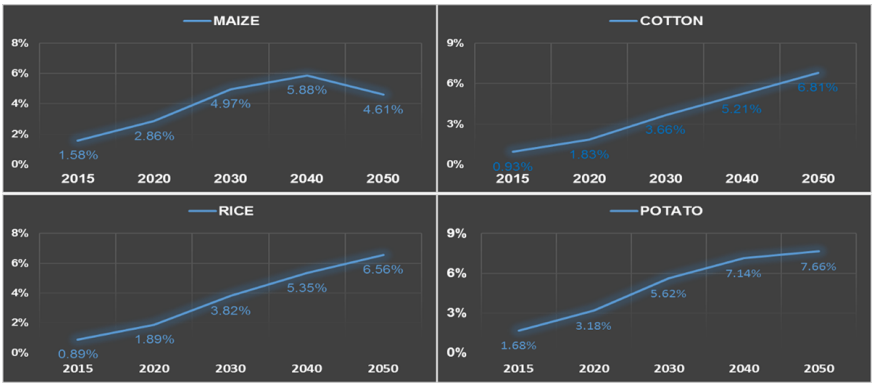

Figure 2-7 Changes in areas allocated to crops in climate-change vs no-climate-change scenarios (%): maize, cotton, rice and potatoes

Source: Khakimov, P. & Aliev, J. & Thomas, T. & Ilyasov, J. & Dunston, S., (2020)

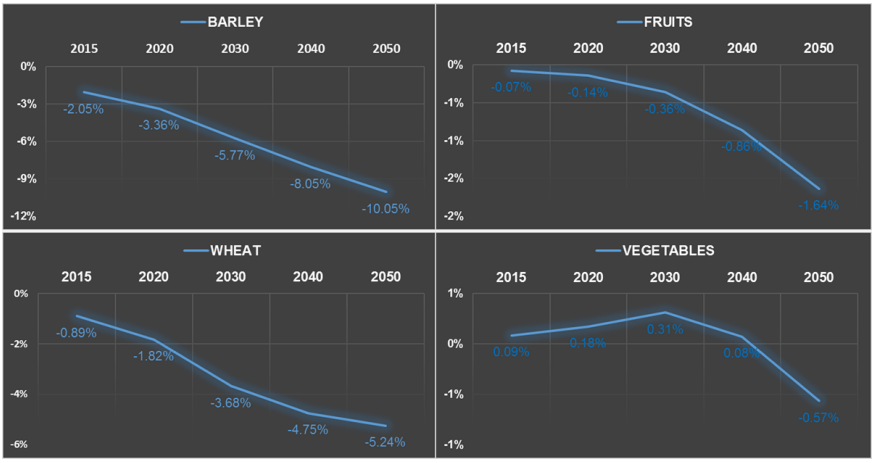

Figure 2-8 Changes in areas allocated to crops in climate-change vs no-climate-change scenarios: barley, wheat, vegetables, and fruit.

Source: Khakimov, P. & Aliev, J. & Thomas, T. & Ilyasov, J. & Dunston, S., (2020)

domestic supplies of barley, wheat, and maize, whereas the supply of rice is projected to be positively affected (Khakimov et al., 2020).

Figure 2-9 Crop supply and demand shift in response to climate change (000 metric tons).

Source: Khakimov, P. & Aliev, J. & Thomas, T. & Ilyasov, J. & Dunston, S., (2020)

Figure 2-10 Crop supply and demand shift in response to climate change (000 metric tons).

Source: Khakimov, P. & Aliev, J. & Thomas, T. & Ilyasov, J. & Dunston, S., (2020)

3.1.8. Overall effect of climate change

Speaking about individual already published studies and research outputs – it is possible to highlight the following: The findings show that the effect of climate change on Tajikistan's agricultural sector is mostly negative. Table 2-11 summarises the overall impact of climate change on area, production, demand, and producer prices for selected agricultural products. From the table, we note that wheat, barley, maize, fruit, and vegetables seem to be particularly vulnerable to climate change in Tajikistan, having some large negative values in the yield and supply columns. Increases in producer prices could be specifically good for export crops, because they improve the trade balance. Yet while the effect is somewhat mixed for farmers, price increases are bad for consumers who have to use a higher proportion of their income on food (Khakimov et al., 2020).

Table 2-11 Overall effects of climate change: climate-change vs no-climate-change in 2050 (percentage difference).

	Yield	Area	Supply	Demand	Producer price
Maize	-21,80	3,90	-18,60	-4,70	41,00
Cotton	0,90	7,00	7,90	-1,90	17,00
Rice	-1,20	6,40	5,40	-4,90	20,50
Potatoes	3,90	7,70	10,70	-6,90	30,60
Barley	-9,60	-10,00	-18,20	0,20	-3,10
Fruit	-10,70	-1,60	-12,20	-1,30	9,70
Wheat	-14,60	-5,30	-21,10	-2,20	10,10
Vegetables	-8,80	-0,60	-9,20	-2,70	10,70

Source: Khakimov, P. & Aliev, J. & Thomas, T. & Ilyasov, J. & Dunston, S., (2020)

Table 11 only tells part of the story – what will probably happen, compared to what could have happened without climate change. Table 2-12 presents a more complete story and displays what the future will look like compared to what the present is. From this table, we can better understand that while both wheat and maize yields are projected to decline in absolute terms between 2015 and 2050, the area under wheat will decline while the maize area will expand, because wheat prices will only rise by 28 per cent while maize prices will rise by 75 per cent (Khakimov et al., 2020).

Table 2-12 Change in agriculture between 2015 and 2050 under climate change (percentage difference)

	Yield	Area	Supply	Producer price
Wheat	-7,50	-9,40	-16,10	27,90
Cotton	18,60	21,00	45,20	36,90
Fruit	-2,20	27,80	25,00	27,80
Barley	6,90	-9,90	-3,60	9,80
Maize	-8,60	29,20	17,90	75,30
Potatoes	16,10	27,30	48,40	41,30
Vegetables	2,50	19,40	22,40	47,20
Rice	38,70	19,50	66,20	42,40

Source: Khakimov, P. & Aliev, J. & Thomas, T. & Ilyasov, J. & Dunston, S., (2020)

3.1.9. Conclusion and Policy Implications

Climate change is one of the main challenges for Tajikistan's agricultural development and food security both in the medium and longer term. It is considered one of the key obstacles to achieving the country's strategic objectives as defined in the National Development Strategy for 2016–2030, which includes ensuring food security and access to quality nutrition by 2030. Climate change will be one of the main challenges for food security, leading to an increased number of people at risk of hunger, malnourishment, especially among children and other vulnerable groups, and insufficient per capita calorie intake. Lower food availability may lead to higher food prices, which would negatively affect the livelihood of the population (Khakimov et al., 2020).

Available data analysis of main crop yields shows that climate change will have a negative impact on crop yields with three exceptions – cotton, potatoes, and rice, which will have either small positive gains or an almost indiscernible reduction in the case of rice.

Taking in consideration the key findings published by Khakimov et al. (2020) – the following statements have to be highlighted.

Climate change will negatively affect the demand side through changes in global prices, reducing consumption and slowing the reduction of malnutrition and food insecurity. The net trade situation will worsen in both scenarios, due to increased domestic demand through population and income growth, and the negative effects of climate change on the production of most commodities.

The Growing Season Length (GSL) is expected to increase. Under the high emissions scenario, RCP8.5, GSL will be approximately 150 days in 2030,

165 days in 2050, and 200 days in 2080. Increased temperatures, however, counteract the positive effect of a longer GSL.
Despite an extended GSL, agricultural productivity during the growing season is at risk due to rising temperatures, more frequent and intense heat waves, as well as the risk of less irrigation water availability due to higher evaporation and glacier retreat (especially in late summer).
Climate change will likely increase the existing vulnerabilities and risks for agriculture. Further climate-related risks identified regarding infrastructure are mudflows, droughts, high temperatures, and strong winds.
Increasing temperatures will lead to a retreating snowline and a loss of glacial mass which will cause a decrease in water storage capacity. Increasing temperatures will generate an increase in the variability of river discharge as well as fluctuations in water availability and quality; therefore, negative repercussions on agriculture are to be expected. Additionally, increasing temperatures are associated with a likely increase in the risk of spring flooding and glacial lake outbursts during snowmelt.
The number of heat days above 40°C is expected to increase by 12.5 days by 2080 compared to the 1986-2005 period. Consequently, this will lead to an increase in heat-related health issues such as heat stress and heat-related mortality. An increase in food insecurity in conjunction with an expected reduction in agriculture and pasture productivity will likely cause negative effects on the already-critical nutritional status of the population. An increase in gastrointestinal infections is projected alongside an increase in floods, flood-related water contamination, and the increase of exposure to water and foodborne diseases. Frequent and severe infectious disease outbreaks are more likely because of climate change, as is the re-emergence of Malaria.
Climate change can be considered one of the key obstacles to the achievement of the country's strategic objective defined in NDS 2016–2030, which is to improve the living standards of the population, and one of the four strategic priorities, which is to ensure food security and access to quality nutrition in 2030.

4. The impact of climate change on agricultural business activities within the next two decades – prediction

Taking in consideration the available data and prevailing agricultural performance development trends, it is necessary to expect the continual growth of agricultural production performance (For details see Table 3-1).

Table 3-1 Tajikistan - agricultural gross production value development and prospect

	Agriculture, Gross Production Value (constant 2014-2016 in thousand US$)	Cereals, Gross Production Value (constant 2014-2016 in thousand US$)	Crops, Gross Production Value (constant 2014-2016 in thousand US$)	Food, Gross Production Value (constant 2014-2016 in thousand US$)	Livestock, Gross Production Value (constant 2014-2016 in thousand US$)	Meat indigenous, Gross Production Value (constant 2014-2016 in thousand US$)	Milk, Gross Production Value (constant 2014-2016 in thousand US$)	Oilcrops, Gross Production Value (constant 2014-2016 in 1000 thousand US$)	Roots and Tubers, Gross Production Value (constant 2014-2016 in thousand US$)	Vegetables and Fruit, Gross Production Value (constant 2014-2016 in thousand US$)
1992	988 170	67 117	482 192	809 612	340 378	141 461	168 733	16 965	40 043	341 436
1993	843 696	66 909	417 974	660 790	257 163	86 127	157 226	17 352	35 163	288 898
1994	817 244	55 516	400 290	634 502	246 762	79 783	156 605	17 477	32 053	288 141
1995	756 089	61 143	405 312	614 732	218 681	85 012	127 330	13 659	26 695	295 829
1996	630 708	92 647	383 138	525 210	147 061	85 775	58 625	10 259	25 762	247 781
1997	695 259	142 040	429 691	573 748	151 956	72 195	77 588	11 650	30 647	232 346
1998	668 644	126 480	400 814	533 939	144 443	56 348	85 742	12 757	41 752	197 202
1999	665 422	124 183	404 185	555 199	159 666	56 983	99 684	10 657	57 315	195 084
2000	802 632	149 366	531 407	685 948	163 367	57 014	102 036	11 273	72 532	288 382
2001	839 149	123 549	500 138	687 222	193 432	61 937	125 896	15 326	73 720	281 623
2002	981 077	175 791	592 282	808 787	223 041	74 412	142 081	17 607	85 325	297 473
2003	1 065 628	220 375	639 400	889 048	253 439	92 994	151 378	18 900	113 223	265 539
2004	1 225 932	216 678	773 561	1 040 837	273 269	100 549	161 323	19 514	126 118	356 596
2005	1 247 764	229 256	805 085	1 098 324	298 649	112 740	175 290	16 464	132 788	378 588
2006	1 312 114	223 748	859 636	1 165 776	311 637	113 739	179 236	17 330	137 228	452 530
2007	1 352 208	227 579	883 869	1 212 256	333 355	120 916	191 858	15 724	158 375	444 526
2008	1 483 056	229 171	1 016 311	1 364 764	353 190	132 172	197 451	13 370	162 605	555 500
2009	1 682 643	348 040	1 208 959	1 582 483	378 499	142 481	206 866	13 106	165 255	594 552
2010	1 780 361	346 415	1 283 369	1 675 015	397 130	146 733	217 053	14 932	181 828	632 193
2011	1 837 409	264 046	1 283 173	1 697 606	420 312	157 035	228 576	18 464	206 457	687 030
2012	2 015 758	298 205	1 425 573	1 875 037	455 782	161 270	255 645	19 783	237 062	769 056

2013	2 212 664	333 436	1 569 750	2 079 665	516 604	176 442	296 919	19 364	266 879	831 451
2014	2 208 307	317 163	1 539 897	2 082 206	548 582	202 111	303 527	19 105	204 218	873 051
2015	2 310 020	333 591	1 587 518	2 217 144	635 668	271 565	318 170	17 523	212 274	923 923
2016	2 331 132	346 258	1 623 862	2 233 713	615 721	248 584	322 223	18 048	214 833	932 237
2017	2 825 309	345 908	1 681 902	2 695 184	1 019 123	640 638	332 874	23 613	187 271	982 054
2018	2 760 204	374 903	1 765 990	2 648 659	888 936	356 743	342 933	19 659	200 376	1 045 460
2019	2 903 453	387 415	1 807 005	2 791 998	991 174	419 940	353 003	18 552	209 711	1 078 366
2020	3 046 702	400 162	1 848 021	2 935 336	1 093 411	483 137	363 073	19 811	219 046	1 111 273
2021	3 189 951	412 909	1 889 036	3 078 674	1 195 649	546 334	373 143	23 459	228 381	1 144 179
2022	3 333 200	425 655	1 930 052	3 222 012	1 297 886	609 530	383 213	25 393	237 716	1 177 085
2023	3 476 450	438 402	1 971 067	3 365 351	1 400 124	672 727	393 283	26 686	247 051	1 209 991
2024	3 619 699	451 149	2 012 083	3 508 689	1 502 361	735 924	403 353	27 302	256 386	1 242 897
2025	3 762 948	463 895	2 053 098	3 652 027	1 604 599	799 121	413 423	24 256	265 721	1 275 803
2026	3 906 197	476 642	2 094 114	3 795 365	1 706 837	862 318	423 493	22 841	275 056	1 308 709
2027	4 049 446	489 389	2 135 129	3 938 703	1 809 074	925 514	433 563	22 748	284 391	1 341 616
2028	4 192 695	502 135	2 176 145	4 082 042	1 911 312	988 711	443 633	22 171	293 726	1 374 522
2029	4 335 944	514 882	2 217 160	4 225 380	2 013 549	1 051 908	453 703	21 063	303 061	1 407 428
2030	4 479 193	527 629	2 258 176	4 368 718	2 115 787	1 115 105	463 773	22 322	312 396	1 440 334
2031	4 622 442	540 375	2 299 191	4 512 056	2 218 024	1 178 301	473 843	25 971	321 731	1 473 240
2032	4 765 691	553 122	2 340 207	4 655 395	2 320 262	1 241 498	483 913	27 904	331 066	1 506 146
2033	4 908 940	565 868	2 381 222	4 798 733	2 422 499	1 304 695	493 983	29 197	340 401	1 539 052
2034	5 052 189	578 615	2 422 238	4 942 071	2 524 737	1 367 892	504 053	29 813	349 736	1 571 958
2035	5 195 439	591 362	2 463 253	5 085 409	2 626 974	1 431 088	514 123	26 768	359 071	1 604 865
2036	5 338 688	604 108	2 504 269	5 228 747	2 729 212	1 494 285	524 193	25 353	368 406	1 637 771
2037	5 481 937	616 855	2 545 284	5 372 086	2 831 450	1 557 482	534 263	25 260	377 741	1 670 677
2038	5 625 186	629 602	2 586 300	5 515 424	2 933 687	1 620 679	544 333	24 682	387 076	1 703 583
2039	5 768 435	642 348	2 627 315	5 658 762	3 035 925	1 683 875	554 403	23 575	396 411	1 736 489
2040	5 911 684	655 095	2 668 331	5 802 100	3 138 162	1 747 072	564 473	24 834	405 746	1 769 395

Source: FAOSTAT, own processing, 2022

On the other hand, its dynamic growth is expected to be reduced. The most significant agricultural value dynamic growth is expected in the case of livestock production. But the significant dynamic reduction is also expected in the case of crop production value performance. The most affected aggregations are expected to be the following: roots and tubers, oil crops and cereals on the other hand vegetables and fruit production value performance are expected to continue a rather progressive production value dynamic (For details see the Table 3-2).

The above-mentioned problem could be demonstrated also at the level of expected production volume. However, data available for future production prospect development provides the pro-growth production trend – the inter-annual production volume dynamic is expected to be reduced (For details see Table 3-3 and Table 3-4). The only exceptions are expected to be roots and tubers and citrus fruits.

The available data could be considered as rather tricky speaking about the future prediction as the really negative impact of climate change development is expected after 2040. Taking in consideration available predictions and models the direct climate change impact associated with agricultural production volume reduction is expected for the period not covered by this analysis. The majority of prediction models expect possible reductions during the period 2040 – 2060.

Next two decades' development summary (prediction for 2030 and 2040)

Speaking about the next two decades' development – it is possible to expect especially indirect negative effects related to upcoming climate change. The reduction of the inter-annual growth rate of yields and production volume is expected. Agricultural production will suffer because of limited water availability. There is also a problem related to a continual process of land degradation as the result of intensive agricultural activities and bad agricultural land management. The agricultural sector will suffer because of limited ability to reach effective economies of scale as the farm size is very low. The majority of farms are suffering because of too low agricultural land area and also because of limited access to capital. The only limited trade-off between labour and capital is also possible to consider as a significant weakness. Agricultural production and capacities are considered to be limited with respect to the only limited area of agricultural land suitable for intensive agricultural activities and also because of biological and genetic limits.

Taking in consideration the state of Tajik agriculture, its dependency on old technologies and its extreme decomposition into many extremely

Table 3-2 Tajikistan – an average inter-annual growth rate of agricultural gross production value development

	Agriculture, Gross Production Value (constant 2014-2016 in thousand US$)	Cereals, Gross Production Value (constant 2014-2016 in thousand US$)	Crops, Gross Production Value (constant 2014-2016 in thousand US$)	Food, Gross Production Value (constant 2014-2016 in thousand US$)	Livestock, Gross Production Value (constant 2014-2016 in thousand US$)	Meat indigenous, Gross Production Value (constant 2014-2016 in thousand US$)	Milk, Gross Production Value (constant 2014-2016 in thousand US$)	Oilcrops, Gross Production Value (constant 2014-2016 in thousand US$)	Roots and Tubers, Gross Production Value (constant 2014-2016 in thousand US$)	Vegetables and Fruit, Gross Production Value (constant 2014-2016 in thousand US$)
1992-2000	0,982001	1,070151	1,004068	0,981954	0,939139	0,912317	0,9679836	0,988774	1,0701656	0,978828
2001-2010	1,082	1,079	1,099	1,095	1,081	1,098	1,061	1,019	1,108	1,093
2010-2020	1,056715	1,045725	1,039431	1,0613355	1,110205	1,132782	1,0502301	1,024233	1,0101434	1,05233
2021-2030	1,037788	1,027269	1,019843	1,0389654	1,063742	1,079891	1,0241791	1,010223	1,034864	1,0256
2031-2040	1,027711	1,021621	1,016682	1,0283348	1,039311	1,044735	1,0196366	0,995039	1,0261142	1,020561

Source: FAOSTAT, own processing, 2022

Table 3-3 Tajikistan – an average inter-annual growth rate of agricultural production volume development

	Cereals, Production in tonnes	Citrus Fruit, Production in tonnes	Fruit Primary	Pulses, Production in tonnes	Roots and Tubers, Production in tonnes	Treenuts, Production in tonnes	Vegetables Primary Production in tonnes	Production in tonnes crops production
1992-2000	1,0647	1,0106	0,9802	0,9515	1,0702	0,9976	0,9725	1,0114
2001-2010	1,0804	1,1454	1,0922	1,2620	1,1085	0,9776	1,1184	1,1009
2010-2020	1,0469	0,9827	1,0470	1,0360	1,0101	0,9816	1,0617	1,0349
2021-2030	1,0273	1,0351	1,0223	1,0176	1,0349	1,0192	1,0342	1,0099
2031-2040	1,0217	1,0263	1,0184	1,0151	1,0261	0,9866	1,0257	1,0091

Source: FAOSTAT, own processing, 2022

Table 3-4 Tajikistan - agricultural production volume development and prospect

	Cereals, Production in tonnes	Citrus Fruit, Production in tonnes	Fruit Primary	Pulses, Production in tonnes	Roots and Tubers, Production in tonnes	Treenuts, Production in tonnes	Vegetables Primary Production in tonnes	Production in tonnes crops production
1992	271 733	2 000	419 600	9 524	167 400	7 565	545 267	1 423 089
1993	266 735	1 600	343 900	6 039	147 000	6 300	487 890	1 259 464
1994	215 435	1 600	340 700	5 219	134 000	6 344	493 199	1 196 497
1995	242 350	1 600	361 100	5 672	111 600	6 252	495 876	1 224 450
1996	387 377	2 564	299 964	4 877	107 700	5 600	405 422	1 213 504
1997	559 463	2 200	303 691	8 307	128 119	4 900	361 990	1 368 670
1998	490 619	2 100	232 113	8 974	174 545	6 200	347 255	1 261 806
1999	474 338	2 640	214 564	8 144	239 609	6 250	403 352	1 348 897
2000	544 994	2 900	375 462	5 108	303 223	6 100	368 335	1 606 122
2001	477 651	2 200	350 398	6 087	308 189	7 400	424 113	1 576 038
2002	687 559	3 678	343 787	13 017	356 703	5 800	498 701	1 909 245
2003	866 197	5 744	263 174	18 252	473 331	5 466	609 511	2 241 675
2004	860 340	5 953	392 447	31 259	527 240	5 617	712 463	2 535 319
2005	902 912	5 800	413 330	31 968	555 125	5 875	755 761	2 670 771
2006	892 884	6 350	536 103	19 398	573 687	6 100	803 939	2 838 461
2007	906 552	6 391	532 895	24 652	662 093	5 700	885 351	3 023 634
2008	909 500	6 378	668 928	33 682	679 774	5 700	964 813	3 268 775
2009	1 399 868	6 370	781 026	44 587	690 853	5 700	1 105 579	4 033 983
2010	1 382 559	6 551	835 343	53 972	760 139	5 700	1 180 989	4 225 253
2011	1 034 798	8 551	846 351	62 394	863 100	5 900	1 298 699	4 119 793
2012	1 175 450	8 127	950 328	56 746	991 044	6 000	1 417 368	4 605 063
2013	1 328 800	7 913	1 002 811	63 549	1 115 696	5 900	1 592 913	5 117 582
2014	1 257 989	8 114	1 080 241	67 767	853 738	5 900	1 644 245	4 917 994

2015	1 324 045	9 484	1 136 857	67 136	887 418	5 801	1 778 034	5 208 775
2016	1 367 078	5 732	1 144 978	67 019	898 116	5 751	1 824 282	5 312 956
2017	1 365 515	5 998	1 200 828	79 578	782 892	5 789	1 918 738	5 359 338
2018	1 483 987	6 294	1 240 801	83 787	837 678	5 906	2 079 846	5 623 699
2019	1 534 650	6 591	1 273 865	85 479	876 703	6 215	2 174 328	5 683 866
2020	1 585 313	6 887	1 306 929	87 171	915 728	5 424	2 268 810	5 744 033
2021	1 635 976	7 183	1 339 993	88 863	954 753	4 898	2 363 292	5 804 201
2022	1 686 640	7 480	1 373 056	90 555	993 779	5 682	2 457 774	5 864 368
2023	1 737 303	7 776	1 406 120	92 247	1 032 804	5 803	2 552 256	5 924 535
2024	1 787 966	8 072	1 439 184	93 939	1 071 829	5 761	2 646 738	5 984 703
2025	1 838 629	8 369	1 472 247	95 631	1 110 854	6 070	2 741 220	6 044 870
2026	1 889 292	8 665	1 505 311	97 323	1 149 879	5 279	2 835 702	6 105 037
2027	1 939 955	8 961	1 538 375	99 015	1 188 905	4 753	2 930 184	6 165 205
2028	1 990 619	9 258	1 571 439	100 707	1 227 930	5 538	3 024 666	6 225 372
2029	2 041 282	9 554	1 604 502	102 399	1 266 955	5 658	3 119 148	6 285 539
2030	2 091 945	9 850	1 637 566	104 091	1 305 980	5 616	3 213 630	6 345 707
2031	2 142 608	10 147	1 670 630	105 783	1 345 005	5 926	3 308 112	6 405 874
2032	2 193 271	10 443	1 703 693	107 475	1 384 030	5 135	3 402 594	6 466 041
2033	2 243 934	10 739	1 736 757	109 167	1 423 056	4 609	3 497 075	6 526 209
2034	2 294 598	11 035	1 769 821	110 859	1 462 081	5 393	3 591 557	6 586 376
2035	2 345 261	11 332	1 802 885	112 551	1 501 106	5 514	3 686 039	6 646 543
2036	2 395 924	11 628	1 835 948	114 243	1 540 131	5 472	3 780 521	6 706 711
2037	2 446 587	11 924	1 869 012	115 935	1 579 156	5 781	3 875 003	6 766 878
2038	2 497 250	12 221	1 902 076	117 628	1 618 182	4 990	3 969 485	6 827 045
2039	2 547 913	12 517	1 935 139	119 320	1 657 207	4 464	4 063 967	6 887 213
2040	2 598 577	12 813	1 968 203	121 012	1 696 232	5 248	4 158 449	6 947 380

Source: FAOSTAT, own processing, 2022

small farms – it is not possible to continue in the current trend forever. Agriculture is pressed to produce more and more outputs – but the main limit of production growth is water availability. More production means more water consumption, but there is no additional source of water. The frequency of precipitation is not increasing. In some regions, the amount of precipitation is even decreasing and a significant portion of precipitation is even realised in the non-vegetative part of the year. Glaciers as a significant source of water could be considered only as a temporary source. As the volume and area of key glaciers are constantly decreasing – it is not possible to consider glaciers as a long-term and sustainable water source. Speaking about underground water sources – there is also a significant problem. Underground water accumulation takes hundreds or even thousands of years. Underground water extraction for agricultural purposes cannot be considered as full compensation of low precipitations and increasing water demand. It is also necessary to highlight the fact that agriculture is not the only sector consuming water. As the population is increasing and also as Tajikistan is in the process of economic transition – the water consumption at the level of households, services and industry is also increasing and the agricultural sector has to compete for water to other consumers. It is also necessary to mention the problem of water transfer at the international level. However, there are several significant rivers spread over the territory of Tajikistan – the water availability for local purposes is limited. A significant portion of water is already consumed in countries taking control over individual rivers before the water reaches Tajikistan. The second problem is the obligation of Tajikistan not to consume all available water and to transfer the specific amount of water into neighbouring countries.

Taking in consideration the above-mentioned arguments – it is necessary to manage the transformation of the agricultural and water distribution sector and systems in Tajikistan. It is necessary to apply better water distribution schemes and technologies. It is also necessary to make the agricultural sector more water efficient.

5. Conclusion

Tajikistan is a country significantly affected by climate change. This chapter aimed to identify the direct threats to the socio-economic well being related to climate change in six selected districts, prognosed how the im-

pacts of climate change develop, assessed the costs/benefits of climate change in the horizon of ten to twenty years (till 2030 and 2040).

Six main climate related threats to socio-economic wellbeing of households were identified in the qualitative part of the study and the literature review: lack of irrigation water, insufficient quality of drinking water, climate related land degradation and decrease in crop yields, climate related increase in emergencies, climate related increase in pests, climate related impact on human and animal health. The potentially positive impact of climate change implies prolongation of vegetation period, which can enable three harvest per year contingent upon sufficient watering and limited soil degradation.

Climate- related threats may be substantially worsened or mitigated by human activities. The increasing demand for water and inefficiency of water usage currently aggravate the negative effects of climate change on water resources. Human related land degradation is because inefficient land use, overgrazing of pastures and forests, cutting forests, improper use of fertilisers, non-existent crop rotation, lack of winter watering, lack of modern agricultural and water-use technologies, etc. is likely to exacerbate the climate related land degradation. Deterioration of infrastructure, population growth (leading to more houses in endangered areas), deteriorating or non-existent system of warning exacerbate the climate related risks of emergencies.

This study concentrated on climate threats related to water resources and agricultural production in Tajikistan as a whole. The future water stress was analysed in ten- and twenty-years time spans. The quantitative twenty-year analysis of complex risk of water stress for optimistic, median and pessimistic scenarios predicted high and extremely high risk in selected regions like Muminabad, Kuhistoni Mastchoh and Konibodom, while the risks in many other regions were considered medium. The risk of seasonal variability, meaning that dry months are expected to become even drier and wet months even wetter, predicted high levels of risk in all the regions except Muminabad, where the risk is extremely high. This also implies higher risk of drought and extreme rains. The regions most affected by the lack of water supply are predicted to be Hisor, Faizobod and Shahrtuz. Kuhistoni Mastchoh is the least affected area.

While prediction of water stress provided rather clear picture, the prediction of agricultural production was less clear. The analysis of existing trends suggested increasing production despite climate change. The qualitative analysis implies, that these trends largely corresponded to overall massification and intensification of production following the period of civ-

il war, and that local farming communities were able to adapt to climate change to some extent. However, the limits of adaptation on the local level seem to be reached. The future predictions according to most of the scenarios predict stagnation or slight increase of crop yields. However, this growth of crop yields could hardly compensate for the population growth. Moreover, these growths do not reach the biologically possible limits of production. The main limiting factors related to climate change are water resources and land degradation. Adaptation is necessary.
This study concentrated on the period till 2040. The models of climate change and its effects suggest that the largest negative effects will occur after 2040.

o General recommendations for climate change adaptation in Tajikistan from the perspective of costs and feasibility

One of the aims of this chapter was to suggest cost-effective climate change measures in target districts. However, the effective measures are largely contingent upon the current governmental policies, cultural prerequisites, and overall formal and informal institutions effective in the country. Some of these factors cause that the effective measures might not be feasible. Second, some factors that are effective in the short run may prove ineffective in the long run. The time scope of the measures should also be considered. Third, the long-term sustainability of the majority of CC measures is predicated on local capacity building. Though capacity building does not deal with the CC directly, it may be considered as one of the most important powers that will ensure the continuation of the CC measures after the external donor help is extinguished and may substantially reduce the costs of CC measures when enacted as some of the work can be done by locals. Apart from CC measures, local capacity building will ensure the transmission of know-how from the old generation to the new one. Some conclusions on the local capacity building are presented in the section Education, Coordination and Counselling. The particular suggestions are also scattered across the various suggested CC approaches. The following table summarises the main aims of the local capacity building independent from the particular area.
The second type of CC adaptation measures is related to the infrastructure projects aimed directly at a particular CC problem and location. These measures are often the cross-border between the general development assistance and the CC adaptation assistance as most of the direct and indirect results will serve both the purpose of improving infrastructure and CC adaptation. These projects were intensively discussed in Deliverable

four. A cost-benefit analysis was provided for the projects where the data were available.

The third type of CC measures assumes the provision of CC-adapted floral and animal species, which will be more high temperature- and drought-resistant and will provide higher yields for both agriculture, forestry, and, possibly, fishery when applicable. This genetic material is especially necessary not only due to the CC adaptation but also in order to increase yields in agriculture, which will be most necessary given the intense population growth.

The fourth types of recommendations include some of the systemic measures, which, at first sight, are not aimed at CC adaptation but will make the other measures more effective and in some cases, even feasible. Three types of measures were identified. First, land fragmentation does not allow full economies of scale, efficient water use, the adaptation of new agrarian technologies, and CC-proof practices. Moreover, the land fragmentation makes local capacity building more time and resource-consuming. In addition, much of the fragmented agricultural land was given to the people with little education in agriculture, which decreased the efficiency of land use.

Second, the regulation of pasture use, though not directly aimed at CC adaptation, will help to reduce land degradation and improve the water catchment capacity of the higher altitude territories, which will be manifested in the larger availability of drinking and irrigation water.

Third, suggested intensification and professionalisation of agriculture will help to both increase the yields and decrease the pressure on education and capacity building. The downside of this approach is a lower number of people employed in agriculture, who will need to find jobs elsewhere. Thus, it can be enacted only jointly with the development of food processing or other industries, which will be able to employ the newly unemployed people.

Industrialization is the fourth suggested systemic measure. Industrialization will help to improve CC adaptation as, if combined with the intensification of agrarian production and regulation of pasture use, it will put less pressure on the agricultural land and enable the population to benefit from modern technologies which will mitigate the effect of increasing temperatures and other climate-related effects.

Questions

1. What do you think about the possible impact of climate change on agricultural production in Tajikistan?
2. Can you identify the main threats affecting agricultural production development in Tajikistan?
3. Agricultural production activities in Tajikistan are heterogenous. Are you able to identify those agricultural production activities suffering/taking advantage because of both possible negative and positive features related to climate change development/progress?
4. Are you able to propose any suitable strategy to solve the climate change impact on agricultural activities?

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Meat production (fresh and frozen meat)

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Problem description

Food security, climate change and biodiversity are part of the cardinal challenges of the sustainable development of humanity. In particular, livestock production and the increasing demand for meat, eggs, milk and dairy products have led to the emergence of various environmental problems that pose a significant threat to food security. The different forms that agricultural production takes have a different impact on the relationship between supply and demand and seem to be a key factor in effectively solving these global challenges.
CÁRNICAS FITO, is a large, family-owned, multinational meat industry dedicated to the production and marketing of fresh and frozen meat. Its innovation focuses on obtaining new product formats for new moments of use

Cárnicas fito

1. Description of the business project

INDUSTRIAS CÁRNICAS FITO is a large, multinational family company with more than 60 years of experience dedicated to production and marketing of fresh and frozen meats and processed meat products, mainly pork. Currently, they are located at the top of the leading companies in the processed meat sector in Spain and they have a growing presence in the rest of the world.

Its declared objective is to remain among the 10 largest national producers with a proposal to citizens of healthy, nutritious and appetising food. For this, the quality of their products and food safety are the fundamental pillars in a policy of total consumer orientation.
The mission of INDUSTRIAS CÁRNICAS FITO is
To contribute to the good nutrition, health and well-being of all people, taking part in the different stages of their lives, offering products of the highest quality that reconcile tradition, nutritional sciences and technological innovation to create value for the Company, all of our employees, our clients and suppliers and generate, at the same time, a difference for society.
Their vision is:
To be a company recognized among the leading national companies in the production of meat and food products and with a solid international projection that transcends our commitment to excellence, health and sustainable practices in order to perpetuate consumer confidence in our products and each of our brands.
They have about 1350 employees, a turnover of about 290 million euros (2021), more than 500 product references and they have produced more than 90 million kilograms in 2021. They market through three commercial brands. All these brands are registered throughout the European Union, Russia, China and South America, since it markets its products in more than 40 countries.

2. Identification and characterization of the business model

INDUSTRIAS CÁRNICAS FITO divides its business into four areas of activity:

- animal breeding and fattening,
- pig slaughtering and quartering,
- production and marketing of fresh and frozen meat, and
- production and marketing of meat products.

• **Breeding and fattening area**. The firm vocation and will to always offer the highest quality have allowed this to be guaranteed in its products, from its farms to the consumer. INDUSTRIAS CÁRNICAS FITO has twenty farms, both white and Iberian pigs, where the final quality of its products

is controlled from the origin. The quality criterion requires that their farms are located no more than 30 kilometres from their own slaughterhouse to ensure that the pigs arrive in the best conditions. The genetics in the animals bred by FITO is the result of extensive research and experience, aimed at achieving a very homogeneous animal with a large amount of infiltrated fat, based on a completely natural diet, based on a low-calorie diet, mainly composed of reals and legumes. The supply of Iberian pigs comes from farms that comply with Animal Welfare regulations or free range in the Dehesa for acorn-fed products and for white pigs they meet health and quality standards through genetics and optimal feeding for animals.

• **Slaughter area and quartering**. It is an area of 13,000 m^2. It has the ISO 9000 and IFS Quality Certificates, being approved for countries as demanding as China, Korea, Philippines, Japan, Singapore, South Africa, Customs Union, Vietnam, etc.· The slaughterhouse has a slaughter capacity of 600,000 pigs per year and has 75 employees for its development. The cutting room has a cutting capacity of 500,000 pigs per year, in which 125 employees work, for the ham production lines, shoulder line, bacon line, and steak line. Here we find the buffer warehouse for the fresh product and there is also the frozen product warehouse with a capacity of 2,400,000 kilos.

• **Production and marketing of meat products**. The 43,000 m^2 production plant has a production capacity of 16 million kilograms. It comprises the sausage dryers, ham dryers, the intelligent logistics platform, the distribution network, and its own commercial delegations, with a staff of 360 employees for this plant.

With this structure, INDUSTRIAS CÁRNICAS FITO generates a production volume of 90 million kilos that has consolidated it at a national level thanks to its multinational nature, which is reflected in how it has been able to expand with its quality guarantee to European countries such as Denmark. , Poland, United Kingdom, Belgium, Holland, France, Portugal, Ukraine and Russia, and non-Europeans such as Lebanon, Jordan, Cuba, Venezuela, Chile, Guatemala, Gambia, Japan and Hong Kong.

3. Company Value Network

The INDUSTRI AS CÁRNIC FITO chain is fundamentally based on pig farming as the main raw material, the transformation, distribution and sale of

both fresh and frozen meat products and their preparation, thus achieving complete vertical integration of its activities, from the origin of the raw material to the final product.

The raw materials (pork, chicken, turkey and beef) are obtained from third-party suppliers, except for 33% of the pork that is obtained from its own or integrated farms. For the rest of the raw materials, the selection of suppliers, whether national or international, is carried out under strict control, with a technical sheet of requirements demanded by FITO and that have approval for sale in the European Union.

These raw materials are transformed into a fresh product, a frozen product and an elaborated product, with 99% of its own production, which is all meat products and 1% is foreign (sale of cheese). In the transformation it also needs auxiliary and packaging materials that it buys from third parties based on quality/price.

For the storage of the product, they have intelligent logistics platforms controlled by computers, perfecting the preparation of orders and distribution of products, as well as computerised FIFO control.

For the distribution of their products, they have their own sales forces for the national market and outsiders for the international market, selecting them as specialists in meat distribution due to their size, commercial resources and solvency.

The sales channels used by the company are for domestic consumption through traditional food or modern distribution, which account for 68% of sales, and through the on-trade food sector (hotels and restaurants) including 32 % of total sales.

The national market accounts for 70%, with sales throughout the national territory, while in the international market it sells 30% of its production, mainly in countries of the European Union and in other countries such as Japan, Venezuela, Cuba, Lebanon, Jordan, Guatemala, and Hong Kong.

Its main clients are of all types existing within the food market, traditional stores, supermarkets, hotels, catering, free and organised restaurants. Some of their clients are IKEA, SalvaMás, Alcampo or Telepizza as clear examples of the diversification they have in the type of their clients.

The potential consumers that it would like to reach are those final consumers with religious restrictions, such as Muslims who do not consume pork, in order to offer them a wide variety of the non-pork products that the company has.

The communication strategy that the company has developed has been through the Web and social networks for widespread dissemination, use of “Trade marketing” techniques at the point of sale, techniques with Pub-

lic Relations, attendance at food fairs for customers and "Mass-mench" in radio for consumers. The last strategy carried out is through national television through a collaboration with a cooking program.
The support it offers its customers is direct and personalised, through the website they have an exclusive area for customers and they also carry out training for prescribers for butchers and cooks.
INDUSTRIAS CÁRNICAS FITO , through its Social Help Committee, has internally three declared commitments that are

- the maintenance of the environment of its surroundings,
- the incorporation of workers from the surroundings and
- the involvement with the economy of the surroundings.

Also externally, they collaborate with NGOs, such as the Banco de Alimentos and Cáritas, and also deliver merchandise free of charge to regional soup kitchens.
In short, INDUSTRIAS CÁRNICAS FITO is a guarantee of health and food safety, as reflected in its commercial slogan "With FITO you know what you eat" and which it defines with three acronyms: GTP (Total Guarantee of the Processes). This method extends to its farms, slaughterhouse, cutting room, production process, distribution and, finally, to the distribution of the finished product.
Quality as the maximum premise of all its products and innovation from all its departments have led to a diversification of products responding to the needs of consumers such as V-range products, all without neglecting traditional processed products such as whole cooked ham made gluten-free, lactose-free, low in fat and cholesterol, with a very low salt content and rich in essential nutrients.

4. Corporate culture

The corporate culture of INDUSTRIAS CÁRNICAS FITO is fundamentally based on two values:

- business sustainability, since without it nothing would make sense, and
- seeking personal and professional development for all its employees.

Employees respond with a vocation for compliance out of pride in belonging to the company and customers respond with credibility, since the company has experienced a growth in sales of 38% in the last 3 years.
Decision-making is carried out, depending on its importance, by the direction of the department, or by interdepartmental assessment, with the General Director making the decisions. To develop its business strategy, regular meetings are held by the staff of each department, as well as by the interdepartmental committees and the management committees, which communicate their decisions through internal emails. For the management of errors, each management area responds to the consequence of objectives set and approved by the General Management.

5. Organisational setup

As it is a large multinational company, its organisational structure is complex, with numerous departments (figure 8), the management is represented by the General Director who coordinates the following departments: logistics, finance, human resources, marketing, information technology, production, supply, administration and commercial, this being the most developed area of the company. The departments that the company would most like to expand are R+D+i, marketing and commercial, since these are the ones in charge of carrying out the innovation activities.
The company's human resources are made up of 1530 employees, with 80% corresponding to the production department, 10% to the commercial department and the remaining 10% divided into the rest of the departments that make up the company. It has a workforce between the ages of 25 and 58 and a very unbalanced distribution by sex, with the representation of men being much higher at around 80% than that of women, who represent 20% of the workforce, with the 95% of Spanish nationality.
Regarding the variables that it considers when hiring, the human resources department has a scale of values that it applies to the adaptability of the person with the rest of the colleagues, the will, that is, the spirit of work that they show the candidate, the experience in the performance of the functions depending on the position and the development potential that the candidate shows. The selection and hiring of candidates is usually carried out by their own job bank or by employment agencies.
For the training of its employees, the company has programs piloted by the human resources department, both special for each position and gen-

eral. It also has programs planned and contracted to third parties such as occupational safety, labour legislation, emotional intelligence, etc.

6. Company strategy

INDUSTRIAS CÁRNICAS FITO has been distinguished by the quality and versatility of its products, with a continuous concern for food, health and the consumer in all its aspects. The total guarantee of its processes GTP produces a 100% integration from the origin of the value chain. As a differentiation seal, they have the Jamón Serrano denomination protected since 1999 as a Guaranteed Traditional Specialty (TSG) by the European Union Regulation 509/2006.
External certifying companies such as Calicer or Lgai Technological Center standardise the production processes with the external certifications of IFS (International Featured Standards) and BRC (British Retail Consortium). In this way FITO obtains its products with the maximum guarantees of health, nutrition and gastronomy.
The company's growth strategy is based on improving adaptability to current consumption with new product formulations, increasing the number of establishments with a presence of its products in the national market, opening sales in new countries, expanding customers in the on-trade channel, improving technologies, thus increasing product efficiency, optimising delivery times so that there is less stock at the point of sale and, above all, permanent adaptation to the market, constantly innovating with some 15 new products by year.

7. The role of innovation in the company

The R+D+i of INDUSTRIAS CÁRNIC AS FITO is the result of the knowledge and mastery of each and every one of the production processes as a company dedicated to the production of processed meat for more than half a century. The innovations that have been carried out or are in the process of being launched are mainly based on detecting market needs (type "Pull"), thereby developing, for example, new formats for new moments of use. To find out what their customers demand and for them to learn

about the new products or commercial formats, they attend fairs such as Alimentaria at a national level and others at an international level in Paris, Anuga (Cologne/Germany) and Shanghai.

Product innovation has been growing, incorporating new products, especially V range, so that with the different processing of raw materials the final product can be used for a decisive moment of use, in this case we would be dealing with innovations of the " Push" based on the research of the product itself.

Innovation in processes has occurred both in the treatment and in the maceration of meats, the driving force behind these changes being the Production Department in the internal engineering division.

In marketing, the innovations produced are applied to new processes in the reception of orders, with the use of computer programs that, connected to the intelligent warehouse, perfectly organise the preparation of orders and distribution of products.

In terms of innovation in Corporate Social Responsibility, INDUSTRIAS CÁRNICAS FITO has focused its efforts on offering a quality product from its origin, and to this end it has made improvements in the feeding of pigs on its farms and has established more demanding quality criteria for its suppliers of meat raw materials. In terms of the environment, they have made investments aimed at substituting the sources of energy resources. With regard to occupational health, they work on processes aimed at improving the occupational safety of workers. The support to the nearby community is carried out by favouring the approach to jobs and compatible schedules to improve the work/family relationship.

The company is closely linked to the environment with production and the commitment to purchase raw materials from the area. In the production plant they have a store inside the company with insignificant margins to lower the price of their employees' shopping basket, they also sign agreements with other companies such as gas stations, insurance companies, so that FITO workers obtain commercial advantages.

All innovation activities are financed with the company's own profits, so after the continued growth of the company in recent years and in its constant search for the development of new products and ideas in line with market trends, it has allocated two million euros for research, machinery and infrastructure during the current financial year, with plans to repeat this figure in 2015.

8. Future prospects

The company's vision is to continue to be a recognized brand for providing varied foods, with proven healthy, nutritious values and produced in an environmentally sustainable manner. The diversification of the business goes through the adaptation of new products and the opening of new international markets. In vertical integration they seek to increase the production of raw materials and develop new production lines for fresh products.

9. Keys to success

INDUSTRIAS CÁRNICAS FITO is a large family company with well-prepared, competitive products, relevant management know-how and years of presence and diversity in both national and international markets.
The success of INDUSTRIAS CÁRNIC AS FITO has been achieved thanks to the permanent review of all processes, commercial flexibility and the adaptation of the management teams to the real needs of the market. All this added to the agility in decision making, the versatility of its production, knowing how to select quality raw materials and the formation of an effective management team, are the differentiating elements compared to other companies in the sector.
What the company has learned, becoming a clear case of business success, is that correct management must be carried out from the planning, organisation, execution and measurement of all the variables and above all "believe in what the client creates and crystallises in business terms, your idea".
The growth experienced in recent years shows that the business is sustainable in the short and long term, as long as the maintenance of product quality is preserved, the evolution of the market is known, said evolution is contrasted with the client and the consumer the solution to their demand.

Questions for undergraduate students

- Do you think sustainability is a major challenge in meat production? Why?
- Do you think this company has sustainability at the core of its business model? Why?
- How do you think sustainability could be improved in this company? Refer your answer to published work that could underpin your answer.

Questions for postgraduate students

- Develop a SWOT analysis of the company regarding all the aspects concerning sustainability in the meat sector.
- Propose strategies to increase sustainability in this company.
- How would you face sustainability in each of the departments of this company?
- Which department should be the leader of the process? Why?

Byproducts from fruits and vegetables

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Problem description

By-products are, and can be managed as such, those residues that are used as substitutes for commercial products and/or raw materials and that are recoverable without the need to undergo treatment operations. The conditions for a substance or object resulting from a production process (whose objective is not the production of this substance or object) to be considered as a by-product and not as a waste, are the following:

- That there is certainty that the substance or object will be used later,
- That the substance or object can be used directly without having to undergo further processing other than normal industrial practice,
- That the substance or object is produced as an integral part of a production process, and
- That the subsequent use meets all relevant requirements relating to the products as well as the protection of human health and the environment, without the substance producing general adverse impacts on human health or the environment.

One of the aspects that can define the sustainability of a development is its environmental impact. The use of waste brings with it the reduction of the environmental impact, and/or the cost of waste treatment, while economically benefiting the organisation by adding value to by-products and waste.
FUNCTIONAL FACTORY is a small company dedicated to obtaining fruit and vegetable extracts purified in their own natural antioxidants that will be Bioactive elements that can be added as ingredients to functional foods. Their research focuses on obtaining products, which allows them to obtain bioactive ingredients from extracts.

Functional factory

1. Description of the business project

FUNCTIONAL FACTORY is a technology-based company specialising in functional food, that is, food with beneficial ingredients for health. These inactive ingredients are obtained through the extracts of fresh fruits and vegetables or their by-products, purified in their own natural antioxidants. The company's objective is to transform fruit and vegetable extracts into compounds, mostly antioxidants, that fight ageing, and that become part of functional foods and beverages, dietary supplements, cosmetics or as natural preservatives.

The FUNCTIONAL FACTORY project bases its production mainly on pomegranate by-products, but also on grapes, artichokes and lemons. That is, it works from a raw material from the land, at a relatively cheap cost, from which it is managing to enhance products that are working as anti-inflammatories and even help intestinal transit.

Since its beginning, its objective has been the production and commercialization of natural compounds, with a high degree of purification, for functional food and cosmetics. This is now the main activity of this firm that now emphasises R+D+i, looking for its gap in the market.

FUNCTIONAL FACTORY products are classified, depending on the categories according to the function that ingredients are going to develop, in different areas of bioactive ingredients, being able to distinguish the following products with high added value:

- Functional ingredients for food: They increase the added value of products beyond their nutritional profile, providing them with beneficial effects for the health of their customers.
- Cosmetics: Provides products with all the strength of natural antioxidants and their extensive benefits.
- Dietary supplements: The advantages of using its high-purity extracts are taken advantage of, thus reducing formulation costs for its customers.
- Food preservative: Where the advantages of including natural preservatives that favour the marketing of food or fourth-range products are discovered. The natural bioactivity of its extracts hinders the appearance of oxidative, microbial or fungal processes.

2. Enterprise Value Network

The value chain of FUNCTIONAL FACTORY is fundamentally based on the purchase of raw materials, subsequent transformation into vegetable extracts and the commercialization of these products whose fundamental base is pomegranate, grape and lemon and their by-products, as well as extracts at the request of the client.

Regarding the purchase of raw materials, whether they are fresh fruits and vegetables or by-products, they are made from third-party suppliers. They also buy food grade ethanol as they combine aqueous and hydroalcoholic extractions with purification techniques.

The functions for which they are chosen are the quality of the raw materials, where they carry out an evaluation of the degree of purity and health status before the purchase and depending on whether the market price is competitive.

To obtain bioactive compounds, the extraction processes are designed to obtain compounds of high purity, which can be incorporated into food and are non-allergenic. In the case of fruit and vegetable extracts, they are also products that are perfectly soluble in water.

The Quality Department prepares the analysis certificates that accompany each shipment of its products. Parameters are determined following Pharmacopoeia-based methods, as well as spectrophotometric and chromatographic analyses.

Likewise, measurements of the antioxidant capacity are carried out by the OR AC and TE AC methods. FUNCTIONAL FACTORY takes care of all the details, so the calibration of the equipment is done using scientific standards. All this is done in the production plant.

The distribution of the products, for those that use 25 kg drums, is carried out by the company itself, using direct sales as the main sales channel to other companies that are 98% national and 2% international (specifically to France). Its main customers are manufacturers of natural supplements looking for high-quality extracts and high performance. The clients that they would like to reach are those companies in the cosmetics industry where the company thinks it has a lot of potential.

The communication tools used by the company are the website, attendance at industry fairs where customers are, and through advertisements in specialised magazines.

FUNCTIONAL FACTORY also seeks to publicise its company through school visits to its facilities. In the laboratory, with the help of the children and the scientists, they carry out experiments to make a hand cream with

fruit, build a food pyramid, learn how scientists protect themselves when they are carrying out their experiments, how to use a pipette and other laboratory instruments and get to know the “thinking room” one of the most interesting parts of a laboratory, since it is where the great ideas of scientists come from.
In short, FUNCTIONAL FACTORY is a technology-based company that, through the use of innovative techniques, manages to extract a series of natural extracts from fresh fruits and vegetables or their by-products that will constitute high-quality, high-performance bioactive ingredients. , whose final consumers are concerned about their health through food supplements or cosmetic products that help them improve their quality of life.

3. Corporate culture

The corporate culture of FUNCTIONAL FACTORY is based, on the one hand, on the innovation of its techniques to produce high-quality products that are constituted as bioactive ingredients that increase the value of the final product by providing improvements for health.
And, on the other hand, this culture is based on versatility, since workers have to be people with transversal skills so that great things can be achieved with a small team. In this way the workers are aware of this culture and respond satisfactorily, since due to this flexibility they feel more committed to the company.
Decisions and strategies are made or developed by the Board of Directors, with the Director/Manager making the final decisions. For its communication, as it is a micro-enterprise, the work meetings are daily and the decisions are transmitted verbally or by email.
In case of detecting an error in whatever area, they have established a procedure according to the standards that are established for the quality system regulations, proceeding to open a non-conformity and the subsequent taking of corrective and preventive measures depending on the magnitude of the error made and/or the affected area.

4. Organisational setup

The organisational structure of the company is very simple, as it is a very small micro-enterprise. The departments that the company has are: Production, Quality, R+D+i, Sales and Marketing. They have contracted external services for computer maintenance and the accounting and financial department.

The company is made up of three workers who share the work of the different departments, two of whom are men and one woman whose qualifications are to be in possession of second and third cycle university studies. The variables that it considers when hiring are training, experience in the sector and the ability to work independently and multi-skilled, with job portals being the means by which it hires. The specific training is carried out in the company itself with familiarisation courses and later retraining courses are carried out when new tasks are created.

5. Company strategy

The strong point of FUNCTIONAL FACTORY is the greatest experience in elaborating active principles with important properties and a higher degree of purity than those that exist in the market. It has also opened its facilities to companies —such as another of the services—that lack an R+D+i department so that they can use the machinery and resources for their business.

Precisely, the FUNCTIONAL FACTORY production plant is "very flexible", as indicated by its Director, since by varying the parameters of the industrial processes, a wide range of products can be obtained. At the moment it is producing, on request, an organic aloe vera extract for a Valencian cosmetics company. They point that personalised treatment with customers and responding to their demands is also a differentiating aspect.

Quality is also a differentiating element of FUNCTIONAL FACTORY. The company is located in the Spanish Levant, an area rich in the cultivation of fruits and vegetables characteristic of the Mediterranean area, where they understand that quality begins from the principle, so they ensure the traceability of the raw material.

They also comply with HACCP standards and are currently working on the implementation of GMPs and the UNE-EN ISO 9002:1994 standard for quality systems in production, installation and after-sales service.

The company's growth strategy is based on expanding its current product portfolio and increasing distribution possibilities in Japan, the United States and South America.

6. The role of innovation in the company

The R&D&i policy establishes a series of stages for the achievement of scientific evidence. In this way, the FUNCTIONAL FACTORY R&D department

uses a wide variety of certified equipment and techniques to guarantee the in vitro bioactivity of its products. Its researchers work in collaboration with prestigious scientific institutions to establish the in vivo bioactivity of the extracts. The R&D Department of FUNCTIONAL FACTORY develops new innovative and proven quality products.
The company attends various leading fairs in international nutraceutical products such as VitaFoods and Health Ingredients and at a national level it attends Alimentaria, which is the most important fair in the food sector in Spain.
The innovation that FUNCTIONAL FACTORY has carried out is in processes, improving the extraction processes of the compounds. The source of financing for this innovation has been the company itself. The competition has not reacted to this innovation, so the company has been able to improve profit margins.

7. Future prospects

The future objective of the company is to see itself as a stable company with sustained and diversified sales, becoming an international reference in pomegranate extract. To do this, it wants to position itself in current markets and open new markets and new products, especially in the area of cosmetics, where they have a lot of potential to offer.

8. Keys to succeed

FUNCTIONAL FACTORY is a technology-based micro-enterprise fundamentally dedicated to the production and commercialization of natural compounds with a high degree of purification, for functional food and cosmetics; being the main activity of this firm that now emphasises research, development and innovation, R+D+i, to gain a foothold in the market.
The success of FUNCTIONAL FACTORY is based on the investment that has been made in research, specialisation and even location; because they work with raw materials such as pomegranates that are found in local producers in areas bordering the company. As differentiating elements, they highlight the production of a clearly superior product and the personalised treatment it gives its customers.
The main lesson is, on the one hand, not taking the market into account when establishing innovation strategies. And, on the other hand, the "spin-off" company model takes a long time to start up and needs to adapt to the real needs of the market.

The sustainability of the business must be based on continuous and gradual changes, especially with the expansion of markets since they have fewer sales than production capacity.

Questions for undergraduate students

- Do you think creating a business whose core activity is taking advantage of by-products can help to enhance sustainability? Why?
- Do you think this company has sustainability at the core of its business model? Why?
- How do you think sustainability could be improved in this company? Refer your answer to published work that could underpin your answer.

Questions for postgraduate students

- Develop a SWOT analysis of the company regarding all the aspects concerning sustainability in the fruit and vegetable sector.
- Which is the average percentage of waste produced in the fruit and vegetable sector? Which would be the minimum quantity of raw materials for running a profitable business processing by-products from the fruit and vegetable sector?
- Propose strategies to increase sustainability in this company.
- How would you face sustainability in each of the departments of this company?
- Which department should be the leader of the process? Why?

Social sustainability in the milk industry

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Problem description

Social Sustainability seeks to promote relationships between individuals and the collective use of what is common, combining economic growth and respect for the environment with social welfare, promoting the maintenance and creation of employment, protecting the safety and health of people, ensuring the reduction of poverty and inequalities, and avoiding situations of social exclusion.

In general terms, sustainability refers to the ability to meet the needs of the present without compromising the ability of new generations to meet theirs in the future. The concept emphasizes the search for balance between respect for the environment, economic growth and social welfare.

For its part, social sustainability puts the focus of what is sustainable on the vital development of specific social groups. In this way, it seeks to strengthen the cohesion and stability of populations. The concept is applied to social sectors or populations in a situation of disadvantage with respect to the others, or that are unprotected in some way. Hence, its central objective is the responsible management of resources, which means guaranteeing that human activity is carried out in a way that does not destroy the environment of the communities where it is carried out. In this way, the long-term permanence of these human communities, their lifestyle and their culture can be promoted.

EL LECHERO MÁGICO is a small family business dedicated to the production of organic dairy products. Its fundamental innovation focuses on the company concept, which puts social commitment and the environment before business profit, this being only a vehicle to reach an end

1. Description of the business project

EL LECHERO MÁGICO is a company dedicated to the production of organic dairy products. The company, fundamentally dedicated to the production of organic yogurt, kefir and cheese from sheep, goat and cow milk, is located in a sparsely populated rural enclave, and small organic livestock companies have proliferated around it as the final destination of their products is EL LECHERO MÁGICO.

The specificity of the product and its sustainable approach have made EL CANTERODE LETUR one of the most important organic dairy companies in Spain.

The scarce economic activity in the area had caused both the decrease in the population and its ageing. EL LECHERO MÁGICO project and the industrial activity that has been generated around it, has fostered, as it intended, local development. The company's commitment to social benefit and fair trade is a reality that it has continued to uphold from its inception to the present day.

The objective of the company is to obtain quality artisan and ecological products. Innovation in its products has been a basic pillar in the development of the company, but this innovation has not been based on the use of new techniques or on obtaining new products (although they have also developed them), but on a return to tradition, to the production of quality, healthy products that respect the environment and are compatible with animal welfare.

The activity of EL LECHERO MÁGICO is part of a global vision. The company is part of a close environment and a broader environment constituted by nature and the living beings that develop in it. The company pursues that its activity is consistent with this unit and that it collaborates, as far as possible, to improve it.

The company's mission is to produce healthy and natural foods that benefit the well-being of people while respecting that of animals, and thus contribute to the local development of the immediate environment and to spread the ideas of healthy eating and an environment with which establish a sustainable relationship.

2. Identification and characterization of the business model

EL LECHERO MÁGICO is a small family business, established as a public limited company. 65% of its capital belongs to the founder's family and the remaining 35% to 12 partners.

The company was founded by a group of friends led by a philosopher who went to live in the village with his family due to his wife's job as a teacher and who bought a cow to supply the family with milk. The surplus milk was soon required by the residents of the town, who appreciated the quality of the product. In view of his good results, he decided to raise more cows and dedicate himself to selling the products obtained. He soon realized that the activity could improve the living conditions of his neighbours, and the development in the area. The words that he wrote in a letter to his friends perfectly summarize his motivations and the initial objective of the company:

"What am I trying to do? Create a small agricultural and livestock company that transforms its basic product (milk) into cheese. The main objective of this small company is not to make money. The good profitability of this company is an unavoidable condition for its maintenance and development, but it is not the main objective. It is to create life and work, so that the health, both of land and animals, and of the people who work on it, and of those who consume its products, is favoured."

It had a rough start, due to a lack of consumer awareness of organic farming and a lack of experience in the sector. One of the main difficulties, due to the limited implementation of organic farming in Spain, was the difficulty of obtaining certified food: cereals and feed for animal, certified organic milk, etc. The market was also unwilling to pay higher prices for products they did not know about. The losses were considerable, and only the tenacity put in by those who worked there and the selfless contribution of those who put up the money, could keep the company standing.

In 1993, the founder fell ill and left the management to a partner of this company, who, together with the founder's wife, managed to stabilize the company and reduce losses until almost disappear. His contribution was very important in a very difficult time. At this time the company began to make yogurt and buy organic goat's milk from farmers in the area. These farmers began to produce with ecological procedures after committing with them to acquire all the milk they produced at a higher price than the conventional one. In this way, the company has managed to be the first producer of organic goat's milk yogurt in Spain.

Starting in 1999, the founder's son, took over the company, processes were automated, markets were developed, and the company began to market a large part of its products through a big supermarket company, whose retail establishments of food are a benchmark of quality in Spain.

The growth of the company has been 25% per year since 1999. This growth has caused the facilities to remain small to absorb market demand, and it

has been necessary to carry out two expansions, the first in2001 and the last one that is being finished in 2020. The necessary investment has been made with the company's own funds and subsidies from the regional government.

EL LECHERO MÁGICO's product portfolio, all of which are organic, is organized into the following lines:

- Milk: Skimmed and pasteurized milk is marketed, milked daily from cows, goats and sheep in 1 litter glass containers.
- Yogurt: Using organic cow, goat and sheep milk, the company manufactures a wide range of yogurts in different formats and with different recipes.
  - Natural and skimmed cow, goat and sheep yogurt in a 420-gram glass container.
  - Ecobifidus goat and cow yogurt, natural and skimmed, in a 125-gram glass container. They are presented in packages of two containers.
  - Greek cow and goat yogurt in a glass container of 125 gr., in packages of two containers.
- Cheese
  - Fresh cow cheese. Light unfermented cheese, marketed in a 230 gr tub. recyclable and reusable.
  - Soft cow cheese with a smooth texture and a deep aroma. It comes in 270 gr. pieces, vacuum packed in a wooden box.
  - Cow type cheese It is characterized by being tender, light and creamy, with a very fine milky flavour, since part of the fat is lost in its production process. It comes in pieces of 300 and 900 gr.
  - Raw milk cow's cheese. Recommended for cheese lovers. It has between 60 and 240 days of healing. It comes in wedges of 275 gr.
  - Combined fresh goat and sheep cheese. Light unfermented cheese, marketed in a 230 gr tub. recyclable and reusable.
  - Pasteurized sheep cheese. It is a semi-cured cheese (between 45 and 120 days), with a mild and quite creamy flavour. It comes in a 300 gr format.
  - Raw milk sheep cheese. With a cure between 60 and 240 days. It comes in a 900 gr format and in 275 gr wedges.
  - Old sheep cheese. Cheese cured for more than 6 months. Presented in a black cardboard container that contains 4 wedges of 230 gr.
  - Raw milk goat cheese. Cheese aimed at the "gourmet" consumer. It comes in a 900 gr format and in 275 gr wedges.

    - Pasteurized goat cheese. With the special flavour and aroma provided by goat's milk. It comes in formats of 300 and 900 gr vacuum packed.
    - Old goat cheese. Cheese cured for more than 6 months. Presented in a nice black cardboard container that contains 4 wedges of 230 gr.
    - Flavoured goat cheeses with thyme, rosemary and Pedro Ximénez sweet wine. It comes in pieces of 300 gr. vacuum packed and in cardboard boxes.

- Kefir: Kefir is fermented milk similar to yogurt but produced by a different ferment, a mixture of bacteria and yeasts. It has beneficial qualities for health, such as strengthening defences against infections and making other products more assimilable. The company produces both cow's milk and goat's milk kefir, natural and skimmed, in different containers, the natural one in containers of 420 gr and 2x125 gr and skimmed in a 420 gr container.
- Smoothies: Made from skimmed cow's milk, they are low in cholesterol. There are coffee and cocoa flavours in litre glass containers, and cinnamon and lemon, vanilla, walnut and honey and royal jelly flavours in 250 ml glass containers.
- Desserts:
    - Cheese flan, rice pudding and custard, in glass containers of 175 gr.
    - Custard made from soy milk, which is made with and without chocolate. They are suitable for those consumers who cannot take dairy. They are presented in packs of 2 units of 125 gr.

The company has a main brand, EL LECHERO MÁGICO, and a second brand, LECHES SAGRADAS, intended to produce goat yogurts in cardboard format. Both are registered.
The company's target market is fundamentally national (97% of sales) and only 3% goes to international markets.
EL LECHERO MÁGICO has received a good number of distinctions and recognitions.

3. Enterprise Value Network

The value chain of EL LECHERO MÁGICO is based on the production and subsequent marketing of dairy products. To do this, the company, located in a rural environment, needs a continuous supply of organic goat, cow and sheep milk, which it obtains from nearby farms that were created

thanks to the financing provided by EL LECHERO MÁGICO and which have grown in his shadow. The company, in turn, owns one of the producing companies, a dairy farm.

The company also needs other raw materials to make its products, especially in the case of desserts. These are obtained from nearby companies that are also organic. The ferments are obtained from specialized laboratories, chosen according to price and quality offered.

As previously mentioned, the company has about 60 different products, almost all of which are made in the company's own facilities.

The distribution of the products is done from the company, through a commercial, who performs direct management with customers.

The marketing channels used by the company are conventional retail establishments (65% of sales), and specialized stores of organic products (35%), targeting in each of these cases, a different organic consumer profile.

The consumer of specialized organic stores is a convinced organic consumer, with a lifestyle that is aware of the environment and concerned about health, who is willing to pay more for these products, because food is very important to him. The consumer of specialized stores is a more gourmet consumer, of medium-high income, who does not attach too much importance to price in his purchase decision and who values the organoleptic quality and presentation of the products.

The company also uses direct sales. It has a small store in the company's facilities and uses online sales with cash on delivery and free shipping costs for purchases over 35 euros. The turnover percentage represented by direct sales is only 3%.

In the foreign market, they make 3% of their sales, a percentage that is still very low, but which they hope to increase in the coming years. These sales are made to certain retail establishments that contact the company's commercial department directly.

In the coming years they hope to further diversify their products, especially yogurt, and offer it with different formulations and in new packaging formats. In addition, they hope to reach a greater number of consumers.

For its communication strategies, the company has a marketing expert, who is carrying out the communication tasks and defining the information and the means to be used. They are also present on social networks through Facebook, where they have a nearby page with frequently updated content.

The company has made some occasional collaborations with universities and collaborates in numerous cooperation projects, to which it allocates 12% of its profits.

EL LECHERO MÁGICO has pursued local development since its inception with a socially responsible business model, guided by respect for and preservation of the environment, animal welfare, quality employment, responsible management of human resources, commitment to disadvantaged communities or social sectors and ultimately, the commitment in capital letters for a better society.
Since the founding of EL LECHERO MÁGICO, the company's social commitment has been a central objective. This objective is being developed in the immediate environment through the relationship with the region where the company is located. But the company also believes that humanity is one, and there are many places in the world where people are subjected to extremely harsh and unfair living conditions. For this reason, for many years, EL LECHERO MÁGICO has dedicated 12% of its profits to collaborate and promote international development projects.
The business model of EL LECHERO MÁGICO is based on an innovative concept in management: business profit as a collateral and necessary factor for the continuity of business activity that will favour sustainable local development.
Local development is pursued through a business initiative that produces ecological products, respectful of the environment from local ecological raw materials that are compatible with animal welfare. The company's products will therefore improve people's current and future quality of life.

4. Corporate culture

The corporate culture of EL LECHERO MÁGICO was defined in the founding charter which has been maintained until today. The company's objective is to create life and work to promote the health of the land, animals, workers and consumers. Profitability is only a condition for the maintenance and development of the company.
Workers and suppliers respond appropriately to this management model, of which they are fully aware since they work or supply products to the company, since they are direct beneficiaries of the model.
The general lines of activity are defined by the General Director. He transmits to the heads of each department and the quality manager the decisions that concern them, orally and in writing. Regular meetings are not held, since it is a small company, in which vertical communication occurs smoothly in both directions. All the workers are residents of the village, a population that has about 700 inhabitants, so the level of knowledge among all is high.

Regarding management mistakes, if they are procedural errors, these procedures are improved, but if the errors are caused by a breach of standards, sanctions must be imposed, although due to the aforementioned trust, it is sometimes difficult.

5. Organizational setup

Being a small family business, the organizational structure of the company is very simple. The departments that the company has are:

- Quality, on which Production, Sales, Administration, Maintenance and Marketing depend. All these departments report to the Director General. They have contracted external services for computer maintenance.
- The human resources of the company are 25 direct employees and 12 more in livestock. Almost all of them are women between 30 and 45 years old. This is especially notable in the Production Department where only women work. In the company they consider that they carry out organizational tasks better and are more careful in matters of hygiene.
- The Administration Department is led by a woman with a Law degree and an MBA, while the Quality Department is led by a man with extensive experience in the sector. The Marketing Department is managed by a marketing professional.

The origin of the workers is local, although they are now considering hiring university-educated and experienced personnel who, although not from the town, are willing to reside there.

6. Company strategy

EL LECHERO MÁGICO is a company that stands out from the competition from a strategic point of view due to its social commitment. Almost all organic product companies have it, but in the case of EL LECHERO MÁGICO it is especially noteworthy. At a production level, it also differs from its competitors, as it is the only organic dairy company that produces all three types of milk: cow, sheep and goat, thus achieving a much wider range of products.
The company is certified with the Ecological Agriculture seal, which implies that it produces and markets its products following specific standards. It also has the IFS and BRC standards implemented.

It also has a Distinction of Equal Opportunities for women and men in the company. This plan tries to guarantee these principles within the company with the participation of male and female workers in the areas of equal pay, reconciliation of work and family life, prevention of workplace harassment based on sex and action protocol, reservation of positions of work for young women, with family responsibilities and in a situation of risk of social exclusion, collaboration with the women's centre and social services, adaptation of risk prevention to physiological gender differences and commitment to non-sexism in the communications of the business.
The company's growth strategy is based on the one hand, on the development of new products, both in new formulations and in new formats, trying to replace glass with PET packaging; On the other hand, the company wants to enter new markets, especially internationally. In the national market, they aim to increase the number of retail chain establishments in which it is present.

7. The role of innovation in the company

The company concept of the founder is the truly innovative feature of the company. Putting social commitment before business benefit and making this just a vehicle to reach an end, is an innovative concept that, in the case of EL LECHERO MÁGICO, has been successfully applied.
In its beginnings, the ecological product was very little developed, the offer was very scarce (this was more pronounced when dealing with livestock products) and it was a great innovation for the consumer. Even today there are not many companies that make this type of product, but EL LECHERO MÁGICO also surprises with new formats and formulations to try to satisfy an increasingly demanding consumer: Kefir, goat yogurt and refreshing drinks based on of kefir are their latest innovations.
The company has also innovated in processes, renewing its machinery and automating all its processes.
The company is also innovative in its Corporate Social Responsibility actions, with initiatives in the environment, occupational health and support for local communities.
The company attends various fairs, such as Biocultura, with the dual objective of showing its products to customers and establishing relationships that allow it to obtain new ideas to enable them to continue innovating in the future.
The tasks of innovation are carried out by the Quality and Marketing Departments together with the General Management, but one of the com-

pany's objectives is to create an R&D department that reports directly to the Management.

8. Future prospects

The company aims to be more recognized by consumers and grow both in current markets and in new markets. The diversification of its distributors at a national level and the agreements with distributors in other countries are important challenges that the company intends to face in the near future.
On the other hand, the company also wants to continue innovating in products, with new formulations, especially in the case of yogurts that in the conventional offer are found in countless formats while in organic they are very limited. The progressive abandonment of glass, replacing it with PET is another challenge.

9. Keys to success

EL LECHERO MÁGICO is a family business dedicated to the production of organic dairy products, which offers its products to consumers who are respectful of the environment and concerned about their health and the influence that food has on it.
The success of EL LECHERO MÁGICO has been based on the development of a differentiated product of high quality aimed at an ecological consumer. However, the real success of the company is having managed to ensure that the business philosophy of its founder has remained intact to the present day, despite having achieved a notable business volume.
Managing the company while staying true to the principles of sustainability and respect for people, offering products that contribute to improving the health of the earth, animals, workers, consumers and society in general, is the essential step to guarantee the success in the future.
Within the framework of this management model, the company must innovate by proposing improvements in products that are adapted to the tastes of consumers, entering new markets and improving distribution strategies in current ones.

Questions for undergraduate students

- Social sustainability is about identifying and managing business impacts, both positive and negative, on people. Identify and analyse both for this case.
- Do you think this company has sustainability at the core of its business model? Why?
- How do you think sustainability could be improved in this company? Refer your answer to published work that could underpin your answer.

Questions for postgraduate students

- Develop a SWOT analysis of the company regarding all the aspects concerning social sustainability and its impact in business profitability.
- Social sustainability can be interpreted as a condition and process within the community that fulfils the basic human needs in addition to the principles of social justice and equity, homogeneity and cohesion, integration, diversity, sense of place, social amenity, and social security for the present generation, while guaranteeing them for the future generations. Natural resources should be preserved and environmental sustainability should be supported by this process. According to this, develop sustainability key elements in this company. Who goes first: business model or social development?
- How would you face sustainability in each of the departments of this company?
- Which department should be the leader of the process? Why?

SUSTAINABILITY OF THE FOOD SECTOR

Sustainability of the brewing industry in the Czech Republic

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Problem description

First, we can ask why it makes sense to evaluate sustainability in Czechia just for the brewing (beer) industry. The answer is straightforward; better, we can say the answers are clear. We can identify three reasons:

Reason no. 1: Czechia is the second biggest producer of beer per capita

Of course, the Czech Republic is a small country; the largest beer producers in the world are China, the United States, Brazil and Mexico, and the largest producer in Europe is Germany; Germany is number five in the world. We can see these data in Table No. 1.

Table No. 1: Five biggest producers of beer in the world

Position	State	total production in 1 000 hl	total population (mil)	production per capita l
1	China	341 110	1262.6	27
2	United States	211 166	282.2	75
3	Brazil	151 900	174.8	87
4	Mexico	126 900	98.9	128
5	Germany	87 027	82.2	106

Source: BarthHaas report (2022) and World Bank (2022)

But we cannot decide whether the beer sector is so important for China or the United States in the national economy or in the total beverage industry. For this measurement, we can use the indicator of beer production per capita. It seems that of these five countries, this figure is highest in the case

of Mexico. Perhaps it is surprising that it is not Germany. But the reason is mainly that the United States is a large net beer importer from Mexico. Many original U.S. beer brands are produced under licence in Mexico. Mexico and the United States (and Canada) are members of NAFTA, a free trade area. This means that there are no tariffs or non-tariff barriers to bilateral trade when Mexico exports some goods to the United States. The reason is probably that Mexico has a positive competitive economic advantage compared to the United States in beer production, such as lower labor costs. Conversely, we can be sure that labor costs in Germany cannot be low, but Germany is a very traditional beer country, and the prestige of German beer in general is certainly the highest of all five countries.
Let us focus on the traditional (and smaller) beer countries, this information could be seen in Table No. 2.

Table No. 2: 20 biggest producers of beer per capita

Position	State	total production in 1 000 hl	total population (mil)	production per capita l
1	Belgium	23 400	11.6	202
2	Czechia	20 122	10.7	188
3	Ireland	7 100	5	142
4	Mexico	126 900	98.9	128
5	Netherlands	22 130	17.5	126
6	Austria	9 562	9	106
7	Germany	87 027	82.2	106
8	Poland	38 420	37.8	102
9	Estonia	1 291	1.3	99
10	Denmark	5 700	5.9	97
11	Lithuania	2 540	2.8	91
12	Romania	16 750	19.1	88
13	Croatia	2 965	3.9	76
14	Spain	34 738	47.3	73
15	Bulgaria	4 600	6.9	67
16	Hungary	5 378	9.7	55
17	United Kingdom	32 358	67.3	48
18	Sweden	4 750	10.4	46
19	Slovakia	2 100	5.4	39
20	Latvia	702	1.9	37

Source: BarthHaas report (2022) and World Bank (2022)

For these “beer” countries, beer is a really important segment of the national economy and of the beverage industry in general. First and foremost is Belgium, because Belgium is the largest relative exporter of beer. According to the Brewers of Europe, Belgium exported a total of 17,869 thousand hectoliters of beer in 2020, which means that exports accounted for 76% of production. Belgium has a very good production portfolio for export. Belgium exports mainly beer styles such as Belgian (abbey) beer and spontaneously fermented beer (lambic, gueuze, etc.). These beer styles are very good for stocking compared to lager. As lager gets older, the quality of lager decreases more and more. In the case of Belgian beer (abbey beer) and spontaneously fermented beer, storage can improve the quality (taste) of the beer. And export is usually time-consuming.
Let us focus on the Czech Republic. Relative export in the case of the Czech Republic is “only” 25%, because the country produces and exports mainly lager and pilsner (bottom-fermented beers).

Reason no. 2: Czechia has very specific technology for beer production

The American Brewers Association organises what is probably the largest beer tasting competition in the world. Almost every year this organisation produces the Brewers Association Beer Style Guidelines, the latest one is from 2022, and in these guidelines, there are exactly 159 beer styles (Brewers Association, 2022). This means that beer is the most heterogeneous alcoholic beverage in the whole world. It is an even more heterogeneous group of beverages than wine. And Czech beer has quite different characteristics from other lagers, as we can see in Table 1.

Table no 1.: Long-term monitoring of basic markers of Czech lager beers and their comparison with those of foreign lager beers

	Czech beer (lagers)				Foreign beer (lagers)			
	1999	**2002**	**2007**	**2012**	**1999**	**2002**	**2007**	**2012**
Difference in attenuation (%)	4.8	5.3	2.7	5.7	0.2	0.1	1.8	1.5
Color (EBC units)	12.0	10.7	12.4	12.2	7.1	7.5	8.9	8.0
Bitterness (EBC units)	30.2	26.5	28.9	30.2	23.3	23.3	26	20.6
pH	4.51	4.54	4.48	-	4.33	4.27	4.4	-
Total polyphenols (mg/l)	153	149	133	179	122	116	104	146

Source: Olšovská a kol., 2014

Thus, from Table No. 3 it is clear that Czech lager is a major phenomenon in the context of the beer industry. The main difference lies in the chrema-

tistic color and bitterness. The color units (EBC) in the period for Czech beer were in the range from 10.7 to 12.4, for foreign lagers from 7.1 to 8.9. This is true, because if we imagine the most famous global beer brand Heineken (or Stella Artois), it is really lighter than the best-selling Czech lager, which is currently Kozel (Velkopopovický Kozel). Compared to global lager, Czech lager is usually made using not only Czech (Pilsner) malt, but also a certain amount of caramel malt.

The biggest difference between Czech lager and foreign lagers is probably their characteristic bitterness. Historically, Czech lager has been more bitter than foreign lagers. In the period mentioned above the lowest bitterness value for foreign lagers was 20.6 EBC, and the highest was 26 EBC, which is only slightly less than the lowest bitterness value for Czech lagers, which was 26.5 EBC in 2002. The reason for this was that in the privatization era after communism in the 1990s, the new foreign owners (mostly global beer companies) wanted to harmonize the taste of Czech lager with that of foreign lagers (global lagers). The reason was to simplify the standards (characteristics) in their companies and, of course, to save the cost of the rather expensive Czech hops. The highest bitterness for Czech lagers was 30.2 in 1999 and 2012.

The difference between Czech lager and foreign lager can be seen very clearly in Figure no 1.

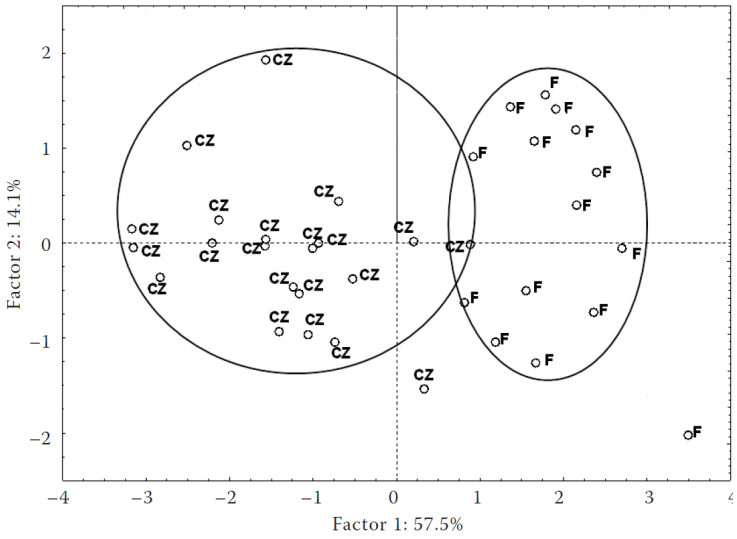

Figure no 1. Factor analysis of analytical parameters of Czech (CZ) and foreign (F) beers

Source: Olšovská a kol., 2014

A total of 20 beers are protected by Protected Geographical Indications (PGI) in the European Union and Czech beer is one of them. It is interesting that it is the only beer that has the protection for the whole member country. It was registered on 14/10/2004.
Due to the current high pressure to be sustainable, which is mainly related to energy, the Regulation on the Protection of Czech Beer PGI strictly protects the traditional way of its production. The regulation states, "The mashing process itself is a one- to three-mash decoction process; the infusion mashing process is not used." Infusion mashing is used for all top-fermented beers and for global lagers, and this production method during boiling saves a lot of energy compared to decoction brewing.
Let us explain what the infusion procedure and the decoction procedure or the single, double, and triple decoction procedure are all about. In the figures 2. to 5. we can check these processes.

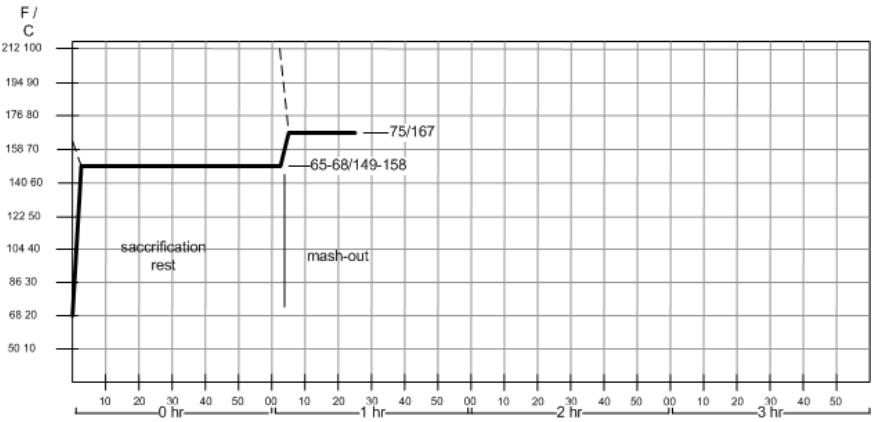

Figure 2. Mash diagram single infusion

Braukaiser.com, 2022

On the vertical axis is the temperature (°C, respectively °F) of the mash. The variable on the horizontal axis is the time (minutes, respectively hours). During **infusion**, the entire mash is heated together, initially very rapidly from 20 °C to 65 - 68°C and after an hour to 75 °C. Thus, the mash never boils, and the entire brewing process takes no longer than 90 minutes.
In contrast, decoction brewing is much more difficult, the mash is divided into two parts once (single decoction), twice (double decoction) and three times. One part is always heated to boiling (100 °C, 212 °F). Most importantly, the decoction process is longer; triple decoction can take up

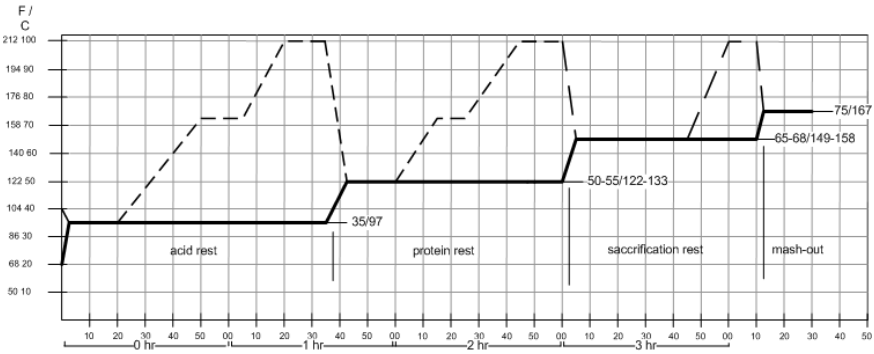

Figure 2. Mash diagram single infusion

Braukaiser.com, 2022

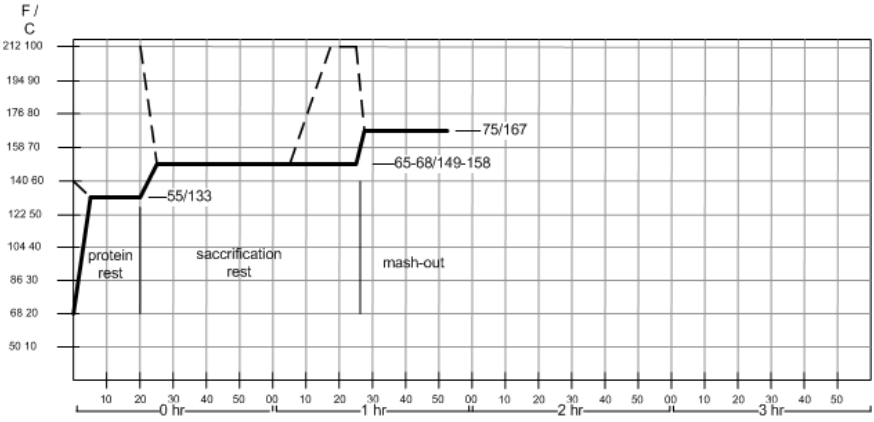

Figure 4. Mash diagram single decoction

Braukaiser.com, 2022

to 210 minutes (4.5 hours). The process duration for each technology can be seen in Table 2.

The duration of the brewing process is described in Table no 4, it does not include the hopping process. This means that the unhopped beer is boiled at a temperature of 100 °C (212 °F) for another 90 minutes with hops or with hop extract. In total, therefore, the brewing time including hopping can be 6 hours (in the case of the triple decoction process).

Czech breweries mainly use the double decoction process (VŠCHT, 2022). The triple decoction process is used only for very special beers in micro-

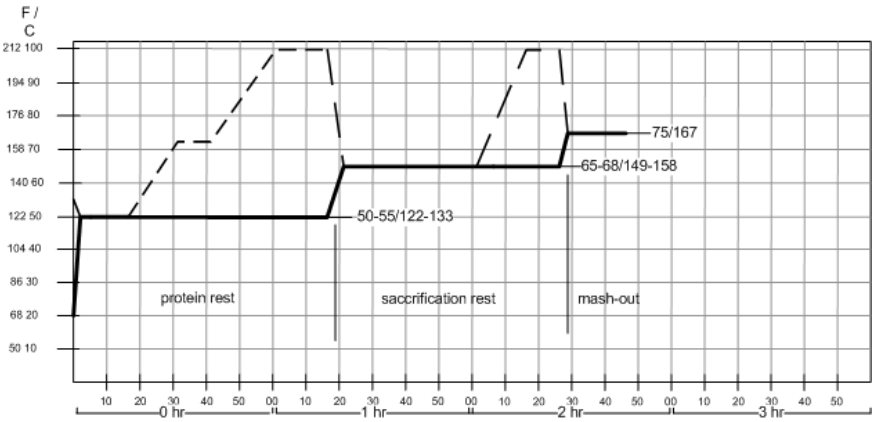

Figure 5. Mash diagram double decoction

Braukaiser.com, 2022

Table no 4: Comparison of infusion and decoction technology

Brewing technology	Period (minutes)	Boiling temperature (100 °C, 212 °F)
Infusion	85	No
Sigle decoction	115	Yes
Double decoction	165	Yes
Triple decoction	270	Yes

Source: Own calculations

breweries and industrial breweries. Among microbreweries, Libertas microbrewery in Úvaly (Libertas Brewery, 2022) or Záhora microbrewery in Kněžičky (Zahora Brewery, 2022) use triple decoction for some of their products. Among industrial breweries, this technology is used by the brewery in Rakovník for the Rakovar brand (Tradiční pivovar v Rakovníku, 2022) or by the number one on the Czech beer market, Plzeňské Pivovary, and its Pilsner Urquell brand (Plzeňský Prazdroj, 2022), probably the best-known Czech brand.

So, the result of this paragraph is that there is no possibility (in the EU) to put pressure on Czech breweries (using Protected Geographical Indications) to save energy in the brewing process by changing the technology.

Reason no. 3: Sustainability of energy in beer sector

According to The Guardian, 0.2 kWh of energy is consumed for one bottle of beer (Reflex, 2022). It is a pity that in the newspaper it is not written what is the size of "one bottle", but we can assume that it is 0.33l, so in Czech language it means a small beer. It means that the same energy is consumed for 3.5 hours on a TV with 1 meter diagonal.

It is sure that there is a negative correlation with the amount of the total production of beer and spending of the energy per unit. Dolenský (2014) in his bachelor thesis "Economics of Homebrewing" calculated that for brewing and cooling lager for brew capacity 23 l are the costs 168,18 CZE for the year 2014 (Dolenský, 2014). The price for 1kWh in the beginning of the year 2014 was 0.97 (Kurzycz, 2022), so it means that for the whole batch the energy spending is 173 kWh. Per litre it is 7.54 and per 0.33l it is 2,51kWh. So it means that homebrewing compared to commercial brewing is really not sustainable. The same author in his master thesis calculated in the year 2017 energy costs per 5.5 hl batch 2 178 CZK for top fermented beer (like Weizen or ale) (Dolenský, 2017), for bottom fermentation the energy spent is approximately three times higher, so it means 6 534 CZK per batch. For one bottle of beer it means 0,369 CZK. In the year 2017 the price of electric energy was 0,79 CZK/kWh (Kurzycz, 2022). So it means that the energy spent per one bottle is 0.5 CZK.

It is certain that there is a negative correlation with the amount of total production of beer and the expenditure on energy per unit. Dolenský (2014) in his bachelor thesis "Economics of Homebrewing" calculated that for brewing and cooling lager beer at a capacity of 23 l the cost was 168.18 CZE for the year 2014 (Dolenský, 2014). The price for 1 kWh at the beginning of 2014 was 0.97 (Kurzycz, 2022), which means that the energy cost for the whole batch is 173 kWh. Per litre it is 7.54 and per 0.33l it is 2,51kWh. The same author calculated energy costs per 5.5 hl batch of top-fermented beer (such as wheat or ale) and for bottom fermentation in his master's thesis in 2017 (Dolenský, 2017). In 2017, the price of electrical energy was 0.79 CZK/kWh (Kurzycz, 2022). Batch of top fermentation (5.5 hl) would require energy consumption of CZK 2,178. The energy cost is about three times higher, i.e., CZK 6,534 per batch of bottom fermented beer. For a bottle (0.33 l) of lager beer energy costs were derived to be CZK 0.369 or CZK 0.5 for a 0.5-liter bottle. So, this means that home brewing is not sustainable compared to commercial brewing.

Sustainability of water in beer sector

The sector of alcohol production we can divide into three main sub sectors:

i. Spiritus production (distillation)
ii. Wine production
iii. Beer production

Since alcohol production is a part of the food industry, it is necessary to exert high pressure on hygiene. The beer industry has a disadvantage compared to the wine and spirits industry. The alcohol concentration in spirits and partly in wine is toxic for almost all microorganisms, especially for bacteria. In beer, the alcohol concentration is lower, usually 4%-5%. This means that most microorganisms can survive in this alcohol concentration. This has only one consequence: for all breweries, hygiene is the top priority in the production process. If the brewery equipment is not sufficiently disinfected, it usually does not mean that the beer can have negative effects on human health. It usually means that an excess of bacteria in the brewery has a very negative effect on the taste of the beer, because the bacteria produce an unfriendly (ugly) metabolic product that the consumer can feel later in the beer.
So it means that wastewater disposal and water use are really high priorities in the brewery.

Models

We can try to make an accurate analysis of what influences water consumption in breweries. So we can try to find an answer to this research question (hypothesis):

i. Is there any relation between usage ratio of water and time?
ii. Is there any relation between usage ratio of water and weather?
iii. Is there any relation between usage ratio of water and price of beer?

It is very difficult to get long term data about consumption of water in breweries, but we got it from two industrial breweries. One of them has annual production approximately 700 000 hl, the second has approximately the annual production 2 000 000 hl. We have monthly data from January 2013 to September 2021, so it means n = 105. This value is very nice, because the testing criteria will not be so strict. Our disponible vari-

able is the water usage ratio of water for production beer (the rate) for both breweries. So, they are endogenous variables for models.

So,

S means water usage ratio to production beer in smaller brewery,

B means water usage ratio to produce beer in bigger breweries.

The explanatory (exogenous) variables are:

Ti means time (time vector)

Te means monthly average temperature (°C)

R means rain (precipitation, mm/m^2)

WPBaLL means wholesale price in barrel of light lager beer (CZK/100l)

WPBaL means wholesale price barrel of lager beer (CZK/100l)

RPBoLL means retail price bottle light lager (CZK/0.5l)

RPBoL means retail price bottle lager (CZK/0.5l)

First, we can check the descriptive statistics of the variables. This can be seen in Table no 5.

Table no 5: Descriptive statistics

Variable	Mean	Median	Minimum	Maximum	Std. Dev.	C.V.	Skewness	Ex. kurtosis
S	4.5747	4.5306	3.6364	6.0905	0.50048	0.10940	0.61697	0.45399
B	3.7310	3.7459	2.8040	4.5947	0.29395	0.078786	-0.036936	0.59937
Ti	53.000	53.000	1.0000	105.00	30.455	0.57462	0.00000	-1.2002
Te	12.273	12.200	-2.1000	24.500	7.2215	0.58839	0.044026	-1.2695
R	37.504	27.400	1.1000	139.30	29.917	0.79771	1.3084	1.3950
VPBaLL	2034.3	2064.2	1890.5	2156.2	75.474	0.037100	-0.38682	-1.2763
VPBaL	2883.7	2848.7	2670.7	3215.8	184.31	0.063913	0.46773	-1.3421
RPBoLL	11.228	11.320	10.250	12.160	0.51215	0.045613	-0.11747	-1.1556
RPBoL	20.670	20.820	17.170	23.120	1.2263	0.059328	-0.78472	0.24230

Source: CZSO, selected breweries, Czech Hydrometeorological Institute, calculation in Gretl

We can see that the interval for the water consumption ratio for smaller breweries is 3.6364 to 6.0905 and for larger breweries is 2.804 to 4.5947. Just a note: the best ratio in the Czech Republic has the brewery in the town of Nošovice, member of the global beer group Asahi from Japan. In 2021, the value was 2.4 (Plzeňský Prazdroj, 2022). But this brewery in Nošovice has a very big advantage. It is a very modern brewery; it was founded in 1970. It is the only large industrial brewery that was founded in the communist era in the Czech Republic and has survived until today. Our two anonymous breweries are older. The smaller brewery was founded in 1898, the larger one in 1871.

The first thing we should do is create a correlation matrix. The correlation matrix shows the pair correlation between the variables. Let us look at table number 4.

Table no 4.: Correlation matrix

S	B	Ti	Te	R	VPBaLL	VPBaL	RPBoLL	RPBoL	
1	0,313	0,335	-0,227	-0,061	0,3329	0,3521	0,3215	-0,071	S
	1	0,309	-0,123	0,0117	0,2095	0,3496	0,2665	-0,278	B
		1	0,0709	-0,006	0,9371	0,9465	0,8301	-0,282	Ti
			1	0,6346	-0,0662	-0,023	-0,0133	-0,131	Te
				1	-0,1205	-0,01	-0,037	-0,239	R
					1	0,8954	0,835	-0,119	VPBaLL
						1	0,7653	-0,406	VPBaL
							1	0,0233	RPBoLL
								1	RPBoL

Source: Own calculation

In the correlation matrix we can observe multicollinearity. We can assume that there are strong pair correlations between the prices.
The value |0.8| was chosen as the criterion for high pair correlation (or multicollinearity). From the correlation matrix (Table No. 4), it can be seen that there is no high positive pair correlation between RPBoL (retail price bottle lager) and Ti (time vector). This is very unusual, even if the pair correlation is negative. There is a fairly strong correlation between all other prices (WPBaLL, WPBaL and RPBoLL) and time. This means that there is multicollinearity since they are all explanatory variables. It is clear that among the prices in each equation, we can choose only one type of price, and in the correlation matrix we can see that WPBaL (the wholesale price of lager) is the best because it has the strongest influence on both endogenous variables among all prices. (0.3521 and 0.3496, respectively).

Assumption

i. Time decreases the water ratio; the brewery is changing the technology to be environment-friendly.
ii. Temperature increases the water ratio; a higher temperature is a better environment for bacteria.
iii. Rain (precipitation) increases the water ratio; a wet environment is better for bacteria.
iv. The price of beer decreases the water ratio; water costs are part of total costs.

Results

Model 1 means that the dependent variable is the water use ratio in the smaller brewery and Model 2 means that the dependent variable is the water use ratio in the larger brewery.

Model 1: Smaller brewery

Model 1: OLS, using observations 2013:01-2021:09 (T = 105)
Dependent variable: S
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	**Std. Error**	**t-ratio**	**p-value**	
const	4.19197	1.99665	2.099	0.0383	**
Ti	0.00534515	0.00464340	1.151	0.2524	
Te	−0.0246172	0.00812844	−3.029	0.0031	***
R	0.00278769	0.00215695	1.292	0.1992	
VPBaL	0.000102993	0.000759519	0.1356	0.8924	

Mean dependent var	4.574674	S.D. dependent var	0.500481
Sum squared resid	21.02721	S.E. of regression	0.458554
R-squared	0.192816	Adjusted R-squared	0.160528
F(4, 100)	8.598350	P-value(F)	5.26e-06
Log-likelihood	−64.56104	Akaike criterion	139.1221
Schwarz criterion	152.3919	Hannan-Quinn	144.4993
rho	−0.050886	Durbin-Watson	2.099936

Source: Own calculation

In the case of the smaller brewery, only the influence of temperature is statistically significant, and the influence is negative. This means that for every 1°C increase in temperature, the water ratio decreases by 0.025.
The big surprise is that time, rain, and prices are not significant. The brewery seems not to change the production technology to environmentally friendly technology. It appears that production is entirely independent of rainfall. The huge surprise is the price. The p-value is 0.8924, it really seems that it is not statistically significant.
An excellent result is a Durbin-Watson value; there is no autocorrelation in the model.
Based on the previous, the model was modified, variables rain and price were omitted from the model, so we kept in the model explanatory variables time and temperature. The results can be seen in model 3.

Model 3: Smaller brewery

Model 3: OLS, using observations 2013:01-2021:09 (T = 105)
Dependent variable: S
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value	
const	4.48197	0.123904	36.17	<0.0001	***
Ti	0.00579777	0.00135391	4.282	<0.0001	***
Te	−0.0174835	0.00595525	−2.936	0.0041	***

Mean dependent var	4.574674	S.D. dependent var	0.500481
Sum squared resid	21.47843	S.E. of regression	0.458882
R-squared	0.175495	Adjusted R-squared	0.159328
F(2, 102)	11.67168	P-value(F)	0.000027
Log-likelihood	−65.67570	Akaike criterion	137.3514
Schwarz criterion	145.3133	Hannan-Quinn	140.5777
rho	−0.061970	Durbin-Watson	2.119804

Source: Own calculation

Model 3 is the final model and describes the smaller brewery. Every month the water ratio gets worse by 0.006. This is not a large value, but it is not in harmony with our assumption.
In harmony with the assumption is the temperature. An increase in temperature of 1°C means a better water ratio of 0.017.
The correlation is very low, only 0.17, but the model as a whole is statistically significant. In the model there is no autocorrelation, the DW value is 2.12.
We can try a very simple simulation - elasticities. The time elasticity is 0.067170207, the temperature elasticity is -0.046906253.

Model 2: Bigger brewery

Model 2: OLS, using observations 2013:01-2021:09 (T = 105)
Dependent variable: B
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	2.03504	1.43795	1.415	0.1601
Ti	−0.00037949	0.00344571	−0.1101	0.9125
Te	−0.00827847	0.00526720	−1.572	0.1192
R	0.00141942	0.000993834	1.428	0.1563
VPBaL	0.000611858	0.000554776	1.103	0.2727

Mean dependent var	3.730968	S.D. dependent var	0.293946
Sum squared resid	7.649638	S.E. of regression	0.276580
R-squared	0.148722	Adjusted R-squared	0.114671
F(4, 100)	7.057995	P-value(F)	0.000048
Log-likelihood	−11.47519	Akaike criterion	32.95038
Schwarz criterion	46.22018	Hannan-Quinn	38.32756
rho	0.065564	Durbin-Watson	1.844499

Source: Own calculation

If we calculate the first version of bigger brewery model, there is no statistical significancy any variable, even time has p-value 0.9125.

Model 4: Bigger brewery

Model 4: OLS, using observations 2013:01-2021:09 (T = 105)
Dependent variable: B
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	**Std. Error**	**t-ratio**	**p-value**	
const	2.12332	0.401045	5.294	<0.0001	***
VPBaL	0.000557498	0.000138352	4.030	0.0001	***
Mean dependent var		3.730968	S.D. dependent var		0.293946
Sum squared resid		7.888071	S.E. of regression		0.276737
R-squared		0.122188	Adjusted R-squared		0.113666
F(1, 103)		16.23744	P-value(F)		0.000107
Log-likelihood		−13.08659	Akaike criterion		30.17317
Schwarz criterion		35.48109	Hannan-Quinn		32.32405
rho		0.057993	Durbin-Watson		1.852759

Source: Own calculation

The final model of the big brewery has statistically significant only one explanatory variable, it is price. Increase of wholesale price barrel of lager beer by 1 000 CZK/hectoliter increases the water ratio by 0.000557498. We can suppose that the reason is that the brewery uses the water from the river, because it is almost free. The correlation is low, value is 0.12. Very nice is DW value 1.85, so there is no autocorrelation in the model.
Very big surprise is price elasticity, the value is 0,430893793, so it means that if the price increases by one percent, the water ratio increases by 0.43 %.

Results

Beer is a traditional production sector, and it is the oldest alcoholic beverage intentionally produced by humans. If we compare it with some other alcoholic beverages, it is less sustainable than, for example, the production of wine or spirits. In the initial production of beer, much more water is used because of the deep sanitation. In breweries it is necessary to always do extremely deep sanitation, this pressure is not as strong in spirits and wine production.
The second consideration is sustainability from an energy point of view. In a brewery, it is necessary to spend a lot of energy during "boiling" and then a lot of energy during "cooling".
But it makes sense, beer is one of the oldest legacies we have. The invention of beer, or rather fermented drink made from grain, is much older than the invention of the wheel.

Questions

1. Explain, for which states is important beer production in their economies. Why?
2. Why is it very difficult on the level of the EU to change the technology for Czech beer production?
3. Explain why smaller breweries have worse water usage ratio than the bigger breweries?
4. Which kinds of beers need more energy for production and why?
5. What is the main difference between infusion and decoction production process? Which technology is more sustainable?

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Case study on bakery and brewery cooperation in the double bread business model

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Problem description

1. Introduction - setting the scenery – food waste and poverty as motivation to act and some facts on the situation in Croatia

Food waste is one of the important determinants in achieving global sustainability. According to FAO (2021) reduction in food waste leads to a number of positive outcomes, i.e. improved food security, reduced pressure on natural resources as well as climate benefits. However, there are still ambiguous findings regarding the scope and effects of food waste on the global economy. FAO has developed the Food Loss Index and Food Waste Index, the latter measuring food waste created at the household, food service and retail levels (FAO 2021).

The UNEP Food Waste Index (2021) estimates that more than 900 million tons of food waste were generated in 2019 alone. The majority came from households, estimated at 61%, while food services and retail amounted to 26% and 13% respectively. Croatia is no exception when it comes to food waste. The Croatian Ministry of Economy and Sustainable Development (2022) estimates that more than 286.379 tons of food waste are produced annually. Around 76% of food waste is produced in households, 14% in food production, 5% in the hospitality industry, 3% in manufacturing and 2% in retail.

On the other hand, it is estimated that between 702 and 828 million people in the world faced hunger in 2021 (FAO, 2021). According to FAO, peo-

ple can experience moderate or severe food insecurity. Moderate food insecurity can be defined as "reduced quality and/or quantity of the food as well as the uncertainty of an individual's ability to obtain food due to a lack of resources". Severe food insecurity is defined as "individuals that have run out of food or have gone a number of days without eating".
In Croatia, there are an estimated 3000 homeless individuals as well as 1000 neglected children. Although these numbers do not seem alarming, the Croatian Bureau of Statistics (2022) states that 19.2% of the Croatian population were at risk of poverty. These individuals are being taken care of by 124 food donation intermediaries - social supermarkets, donated food warehouses and public kitchens.
Therefore, at all levels of a local community, there is an observed necessity for developing and encouraging initiatives to solve these two completely opposite problems. This case study will describe the connection and cooperation of two companies from the bakery and brewing industries which established the Double bread business model as both business and social innovation to alleviate the described issues in the Croatian market. In addition to the bakery and brewery, some other stakeholders are important in achieving the aims of the business model, and their roles will be briefly described as well.

2. Brewing industry and its residues

In 2018 global beer production was nearly 2 billion hectolitres (Conway, 2019) which means that brewing is a large-scale industry of great economic importance in each national economy. Due to the structure and nature of the beer brewing process, production of the large quantities of the final products (i.e. beer) results in the generation of a huge amount of organic waste materials. Therefore, the brewing industry is trying to find new approaches to 'waste' products and make them 'co-products' usable in the food industry (Farcaş et al., 2014) and other industries as well.
As explained by Rachwal et al. (2020), 85% of by-products of the brewing process can be changed into resources for the food production industry and those three main by-products include brewer's spent grain (BSG), residual brewer's spent yeast (BSY) and hot trub (HT). Better utilisation of those by-products can improve environmental and economic performance in the brewing industry. We will outline just some known facts on each of those 3 by-products:
Brewer's spent grain (BSG) is a major part of residues (85%) in beer production in form of barley grain husks which are rich in lignocellulosic bio-

mass, proteins, fibres, lipids, vitamins, amino acids and minerals (for more details see: Kerby & Vriesekoop, 2017; Cooray et al., 2017; Aliyu & Bala, 2011).

Brewer's spent yeast (BSY) amounts to 15% of total residues in the brewing process. As single-cell organisms, yeasts contain proteins, carbohydrates, minerals, vitamins and lipids. BSY is especially rich in polyphenolic compounds and B-group vitamins (mainly B1, B2, B3, B6, and B8) (see Huige, 2016; Podpora et al., 2016).

Hot trub (HT) is a sediment that residues after the wort boiling process it includes colloidal proteins, polyphenols, complex carbohydrates, lipids, minerals, tannins hop residues and malt particles (for more details consult Mathias et al., 2015; Huige, 2016).

All 3 residues of beer production are used in animal breeding and other various branches of the food industry, mainly as a feed additive and food ingredient. Rachwal et al (2020) claim that they can also serve as raw material for the extraction of compounds for food production or can be applied in biotechnological processes in which food industry additives are obtained. However, their usage should be implemented on a larger scale in the near future in order to improve the environmental impact of the brewing industry.

According to data from FINA (2022), Lider (2022), Poslovna (2022) and HGK (2022), the Croatian beer industry comprises 92 companies and generates total revenues of approximately EUR 310 mil. It employs around 1600 workers. And quantities of produced beer amount between 3.5 to 4 hectolitres of beer. The largest company in the industry is "Zagrebacka pivovara" located in Zagreb with EUR 157 mil. in revenues and EUR 39 mil. in profits. The company employs approximately 600 employees.

As a modern brewery and market leader "Zagrebacka pivovara", for many years, deploys numerous initiatives in fields of corporate social responsibility and sustainability regarding all stakeholders starting from the care of employees' well-being, towards contribution to local society towards numerous actions in the field of environment-friendly production. Moreover, in the last couple years, the company is open to new ideas from business partners and the wide public which are oriented on reducing waste, promoting energy efficiency, and implementing more sustainable business processes. As a brewery, as mentioned before, "Zagrebacka pivovara" faces previously mentioned residues as a natural outcome of the beer production process and struggles to find more acceptable solutions to convert as many residues as possible into a usable product for further usage to reduce waste and improve its ecological influence. Therefore,

"Zagrebacka pivovara" accepted and supported the idea of Double Bread as an innovative business model in this sense.

3. Double Bread Business Model – proposed and implemented solution

The Double Bread initiative and the whole business model is designed, proposed, and implemented by "Krostula". It is a small bakery located in Pakostane and operating in Pakostane and Zadar in the southern part of Croatia.

From the very beginning "Krostula" is an artisan bakery which strives to implement the following business ideas (Krostula, 2022):

- long-lasting high-quality bread for all
- no additives and long fermentation with natural organic yeasts
- including local suppliers who share a common vision and strive to produce and distribute high-quality food.

The company is led by a team of younger entrepreneurs who are oriented to innovations in improving the quality of products and processes in various stages of bread production and distribution. Aware on problems of growing poverty and food waste in beer production, the new entrepreneur idea was generated – "Krostula" can intervene to address both problems by introducing a new product and a new business model. The product and the model in called "Double Bread".

Double Bread is a blend of food innovation, better food waste management and philanthropy, therefore we can address it both as a business and as a social innovation. As a product - Double Bread is made from residues from beer production described in the previous chapter. Residues from barley in beer production were treated as waste in breweries. On the other hand, those residues are rich in fibre and protein and can be used as raw material in the production of nutritionally better bread. So, the idea behind Double Bread was to create a premium product, fermented using natural yeast and without any industry additives that are commonly used in the bakery industry. This allowed the bread to have a longer duration, better taste and lower glycaemic index, the traits making it a premium product and a better choice health-wise.

In addition, the proposed business model included a social component. Each loaf of baked bread in the proposed model has to serve an important societal purpose in the sense of poverty reduction. Therefore, for each loaf of bread to consumers throughout the retail network, "Krostula", do-

nates one loaf of bread to food donation intermediaries in Croatia such as social supermarkets or public kitchens who distribute it to people in need on a daily basis.

The implementation of the model is possible only through the mutual agreement of all firms in the supply chain. The brewer "Zagrebacka pivovara" provides the barley residues for free as a donation to "Krostula" resolving one part of the waste within its own production. In such a manner, "Krostula" has reduced production costs because it gets a part of its inputs for free. The bakery sells the product at a lower markup to its customers but also distributes Double bread to standard retail networks via five partnering retail chains. The distributors and retailers who market the bread have also lowered their markup to make the 1 + 1 model sustainable in the long run. The initiative is covered by a partnering media company.

The model is successfully implemented and so far, more than 20.000 pieces of Double Bread were produced and sold to consumers, according to the promise of the Double Bread model, more than 20.000 loaves are donated to social supermarkets, public kitchens or similar organisations that provide services to people in need.

Based on collected data and experience gathered during the implementation of the model, it is expected that production will increase significantly in the future. One of the extremely important aspects of this business model is its transparency. The project web page and regular media out-

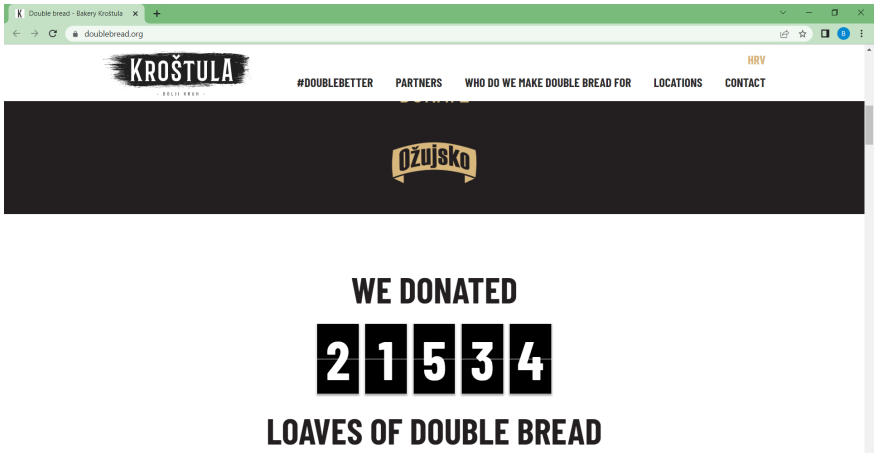

Figure 1: Transparent web communication on donated bread in The Double Bread initiative

Source: www.doublebread.org, accessed on 13th January 2023

lets keep the public and all other stakeholders informed of the number of donated pieces. In Figure 1 the web page at which the exact number of donated loaves of bread is shown.

4. Conclusion

Double Bread business model helps resolve several important sustainability issues. It is designed as a model for the circular economy, helping in food waste reduction while on the other hand providing food for people at risk of poverty or hunger.
What differentiates the model from other similar ventures is the fact that it is also profitable for all firms in the supply chain. It reduces the costs of waste management for the brewer, thus leading to financial gains. The bread itself is sold at a profit to consumers via the traditional retail network, at a lower rate than the industry standard, however, both the bakery and the retailers make a profit on each sold piece. This fact makes the model sustainable in the long run and makes it different when compared to the similar model already present in the market that are mostly philanthropic. In the future, the model could find suitable use in other countries where people have a higher risk of food insecurity.

Questions, discussion and team work

1. Which main groups of stakeholders are involved in the described business model? Briefly explain the role of each stakeholder!
2. Based on the description in the text, draw a scheme of the supply chain for a given business model!
3. Elaborate how this initiative contributes to achieving UN SDGs (United Nations Sustainable Development Goals)! Which SDGs are addressed besides poverty and food waste prevention?
4. What can provoke the interest of the media in this project? Which kind of TV-shows do you see as a potential for promoting this initiative and why?
5. How can customers be motivated to buy more Double breads? Would you address some special target groups in communication to consumers? Which, why and how would you reach those groups?

6. Discuss in teams which benefits should be emphasised in communication with the wide public and develop several ideas for promotional billboards, slogans, and advertisements!
7. How can the bakery or some other participant/stakeholder in this model use digital social networks to promote this initiative?
8. Do SWOT analysis for the given business model and propose some solutions to make this business model more robust and more sustainable in the long run!
9. Are you aware of similar initiatives and business models in your market? Explain them briefly. If you are not aware of such initiatives, explain: can this model be implemented in your market or in some other industries, which stakeholders (companies or institutions) would you involve in it?
10. Research which sustainability issues are addressed by the largest brewery in your market! Refer to primary communication by the brewery! Then refer to available media articles or use other secondary resources to critically overview some of initiatives mentioned in CSR or Sustainability Reports of the company.

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Green and social initiatives in the food manufacturing company Podravka

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Problem description

1. Introduction – Corporate social responsibility and Podravka as a leading regional company in the food sector

The definition of corporate social responsibility (CSR) states that companies must not only pursue their main goal—to maximise profits, but also contribute to the well-being of society through voluntary effort (Barauskaite and Streimikiene 2021). Although the concept of socially responsible business began to develop in the 1950s, it became a global trend at the beginning of the 21st century. Development of the concept of corporate social responsibility at the end of the 20th and beginning of the 21st century, many external factors contributed. The importance of CSR is becoming mandatory for companies to engage in socially responsible activities to support the growth of their business effort (Barauskaite and Streimikiene 2021).

For development to be truly sustainable, a company must integrate care for the environment, economic development, and the well-being of all people, keeping in mind the generations yet to come. According to numerous authors (Waas *et al.* 2011; Boyer *et al.* 2016; Arushanyan *et al.*, 2017, Purvis *et al.*, 2019) one particularly prevalent description of 'sustainability' employs three interconnected 'pillars', 'dimensions', 'components', 'perspectives' or 'aspects' encompassing economic, social, and environmental (or ecological) factors or 'goals' (see Figure 1).

The key motivations for an increasing trend in application of CSR and sustainability principles in contemporary business strategies are (Zhang et al., 2019):

- financial benefits
- branding
- reputation and image
- relationship building
- organisational culture
- strategic business direction

The company Podravka is one of the leading Croatian companies whose products can be found in more than seventy countries on all five continents. It was established in 1947 on the foundations of the former jam and fruit-processing factory - Wolf. The Podravka Group operates through two basic business segments - food and pharmaceuticals. In the South and Eastern Europe (SEE) and Central and Eastern Europe (CEE) market Podravka is well recognized as a food producer via several top food brands, while Belupo as a member of the Podravka Group is known as pharmaceutical producer dominantly in South East Europe.

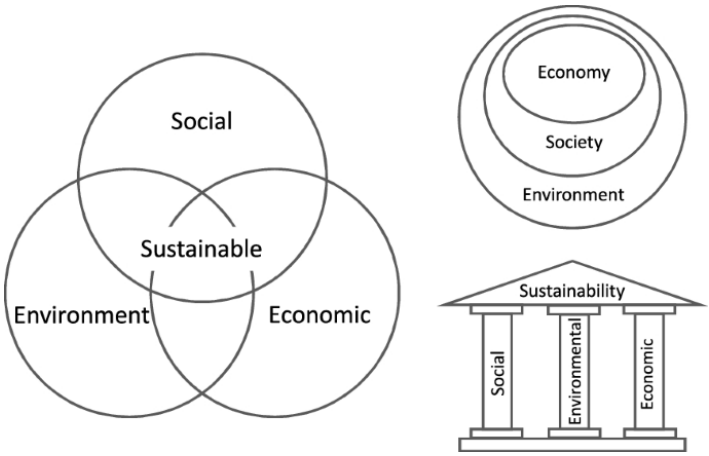

Figure 1. Three pillars of sustainability

Source: Purvis et al. (2019)

Podravka as a food producer expressed its vision as follows: “Making tasty, healthy food through knowledge and heart.” and its stated mission is: “Creating a tastier world. Always with heart.” (see Podravka - About, 2022). The heart is incorporated in the logo and all communication materials of the company.

The main vision develops further into several important directions, the company wants to improve the daily quality of life of all consumers,

customers and employees through innovation and internationalisation. Therefore, one of the company's goals is the application of the norms of socially responsible business and the compliance of the economy with the development goals of the social community and the preservation of the environment for future generations (Podravka – Responsibility, 2022).
In Figure 2 basic business data for Podravka are given. Podravka has more than 6600 employees, and generates income of approximately EUR 615 mil. and profits of around EUR 41 mil. In its portfolio, Podravka has more than 1000 products and operates at more than 70 markets. Top Podravka brands are shown in Figure 3.

Figure 2: Podravka's key indicators for 2021.

Average number of employees	**6650**
Sales income	615,07 mil. euro
Compared to 2020.	+ 2,8 %
EBITDA	78,62 mil. euro
Compared to 2020.	8,3%
Net profit	41,06 mil. euro
Compared to 2020.	24,2 %

Source: Podravka Financial Reports (2022)

Figure 3: Top brands in Podravka's portfolio

Podravka	food brand no.1 in the region of South Eastern Europe ad in one of top food brands in Central and Eastern Europe
Vegeta	unique mix of spices
Dolcela	products for the preparation of desserts
Lino	baby food and cereals
Eva	healthy and tasty fish products
Fant	special seasoning mix
Talianetta	rich choice of pasta
Fini-Mini	practical and nutritional instants soups
Kviki	crispy snacks
Warzywko	key ingredient in the kitchen

Source: Podravka – Brands (2022)

Following trends in contemporary business practices regarding CSR and sustainability principles, in 2015, Podravka formed the Department for Sustainable Development, which is responsible for developing, introduc-

ing, and monitoring sustainability and CSR initiatives and actions. Moreover, the Department prepares an annual non-financial report every year. In the non-financial report of Podravka Group for 2020, an ESG report has been integrated and they stated that socially responsible business is much more than "doing good to feel good" and it is emphasised that Podravka strives to be a responsible and considerate business entity in the environment in which it operates (Podravka - Annual Report for 2021). In the report, Podravka defines and describes modes of operation with positive active participation in the lives of local communities and among their employees with emphasising harmonisation of social, environmental, and economic impact in the society.

Although the company profiled itself as a socially responsible company in almost all aspects of sustainable development, in advance we will focus on examples of good practices carried out in 3 areas of sustainable development: (1) improving energy efficiency, (2) contribution to decreasing of poverty and hunger in the local community and (3) care for well-being and health of consumers. Through these examples, environment, society, and economics, as 3 pillars of sustainability are tackled. In conclusion we will refer to UN SDGs which are addressed by the given examples.

2. Podravka's actions to increase energy efficiency

Sustainable development is one of the main interests of the company Podravka, because through it they want to show and prove their intentions both to the community and to their business associates. The European Union in the European Green Plan has set the goal of making Europe the first climate-neutral continent by 2050.

Through its Environmental Protection Policy Podravka continuously works to reduce the negative impact on the environment. Following idea on climate-neutrality, Podravka made several large investments in the last five years in the field of the green energy transition.

In 2021, a significant quantity of needed **energy was produced from renewable sources**, most of which was obtained from wood chips that serve as biomass for steam production and a significant part of electric energy was produced in the own photovoltaic solar power plants Kalnik and Danica (see Figure 4).

Podravka's **new biomass plant** was released in 2017 in the Danica-Korpivnica zone. This plant today covers most of the heating energy needed for factories located in that production zone. The biomass plant contributed

Figure 4: Podravka's rooftop solar plant

Source: Jutarnji list (2022)

to a significant decrease in the usage of fossil fuels (i.e. gas) in Podravka and reduced the emission of greenhouse gases by 50% (Odgovorno, 2022).

On the rooftop of its Kalnik vegetable processing factory in Varazdin county, Podravka 2020 constructed its **first solar power plant** with a capacity of 350KW. The construction of **the second solar power plant** Podravka – Danica 1 began at the end of 2021 and the plant was released into operation in June 2022. The planned annual production of this plant is 3.2 GWh per year. Thanks to this power plant, 40% of the electricity of the Soup and Vegeta Factory, the Baby Food Factory, and the Meat Products Factory will come from renewable sources. The investment is valued to EUR 1.5 mil. and around 50% is provided from EU funds via the Rural Development Program of the Croatian Ministry of Agriculture under the measure "4.2.2 Use of renewable energy sources". The future goal in enhancing sustainable energy-producing capacities in Podravka is to reach the new 9.9MWh from solar plants and 5 MWh from biomass plants. With this action, almost all heating and the majority of electricity needs would be provided for its factories in Varazdin County and the Danica-Koprivnica zone (compiled according to: Podravka - Annual Report for 2021; Odgovorno, 2022; Jutarnji list, 2022; Montel Energetika.NET, 2023).

Another area in which Podravka is compelled to green transition is **the investments in the vehicle fleet** through the purchase of electric vehicles and vehicles of EURO VI standards with reduced CO_2 emissions. Those in-

vestments resulted in the decrease of emitted CO_2 in 2021 by 2.89% compared to the previous period (Podravka - Annual Report for 2021).
Moreover in 2022, the **energy renovation of the administrative building** was completed, which raised its energy class from level D to level A. This was the first significant investment in building energetic efficiency since 1979. By completing this renovation, energy consumption for heating will decrease by about 82% (Poslovni, 2023).

3. Social responsibility towards the local community

Corporate sustainability is a complex concept and refers to the practice of enhancing ecological, social, and economic goals to meet the needs of both current and future generations (Bansal and Song, 2017). Podravka has been implementing various socially responsible and humanitarian projects for many years. On an annual basis, the company constantly reviews its responsibility as well as the results of its activities in a certain local community. The evaluation is carried by comparing old and new results of such activities.
Podravka carries out local community involvement and development programs in all activities that enable sustainable economic, environmental and social effects. Podravka has enviable results when it comes to social responsibility. For years Podravka Group has been implementing a number of socially responsible initiatives and projects in cooperation with the Croatian Red Cross, various humanitarian associations, cultural and artistic projects, sports clubs, children and youth organisations etc. In 2021, the Podravka Group donated EUR 3 mil., which is 6% more than the year before (Podravka – Annual Report for 2021).
Podravka regularly donates packages of food products to needy families. For instance, in 2020 valuable packages of food products were sufficient for 500 families in material deprivation. Packages consisted: flour, soup, vegetables, tuna, jam, pâté and cold meats and a variety of baby food for families with children. The donation was distributed to users via Red Cross societies of Koprivnica, Križevci and Đurđevac (Klikni, 2023).
At the end of 2020, a devastating earthquake hit Sisak-Moslavina county. Immediately Podravka organised an action to help the victims of the earthquake and delivered ten tons of food products to Topusko, Petrinja and Sisak. The donation contained various food products - canned meat and fish and ready-made canned meals, pasta, Podravka soups, jams, teas, Čokolino and Lino Lada. Podravka also donated products for the preparation of cooked meals for the first weeks in the earthquake-affected areas.

Figure 5: Podravka's food donation to the social supermarket in Osijek
Source: Tportal (2023)

Moreover, Podravka organised food preparation in the field by its own culinary promoters. With food donations, Podravka helped the Croatian Red Cross prepare aid packages for beneficiaries from the areas affected by the earthquake (Jutarnji list, 2023).
In 2022, the company celebrated its 75th anniversary by donating a food value of EUR 100.000. Food was donated to 11 social supermarkets in Osijek, Koprivnica, Belišće, Beli Manastir, Đakovo, Nova Gradiška, Sisak, Vukovar, Rijeka, the social self-service of Caritas of the Zagreb archdiocese and the Croatian network of social self-services from Zagreb (Tportal, 2023). In that way Podravka made a significant contribution to poverty reduction in the local community as donated food is distributed to people in need via mentioned non-profit organisations which are in direct daily contact with materially deprived people in their local communities.

4. Concern for customers' health by introducing innovative products with improved nutritional values

The most famous brand of Podravka's food products is Vegeta. Vegeta is a unique mixture of spices and several kinds of dried vegetables. But in order to improve its product lines and brands, Podravka's research team also designs new products and improves existing ones.
Preserving health and contributing to the change of customers' bad eating habits is the reason why Podravka created its Nutritional Strategy. In this strategy they committed themselves to (Podravka – Nutritional Strategy, 2022) :

- reduce the content of saturated and trans-fatty acids, salt (sodium) and sugar in our products,
- optimise products with nutrients that ensure better health,
- in the development of new products, focus on children, the elderly population, consumers with special nutritional needs, support for the health of the digestive system, support for achieving and maintaining a healthy body mass and a healthy lifestyle,
- provide consumers with accurate and valuable information about our products through packaging and promotional activities,
- to educate and thereby point out the importance of the nutritional value of the meal and the size of the portions.

From the very beginning, Podravka thinks about and cares about the health of its customers. Innovations are based on changes in consumer habits in order to fully satisfy their needs. Podravka continuously monitors and follows the recommendations of the World Health Organization (WHO). In the recommendations for many years, among all, WHO emphasises the need to reduce the daily intake of salt to 5 g. Therefore, for several years, Podravka's research team has been thinking about the health problems that result from excessive intake of table salt, and as a result of a research and development project, they have designed a unique salt mixture with 35% less sodium than traditional table salt (Podravka – Salut, 2023).

Figure 6: Packaging of Salut salt

Source: Podravka - Salut (2023)

The brand name for this innovative, “new generation” salt is Salut. The Salut salt is used like regular table salt and has been on the market since 2019. The brand has been recognized by The International Taste Institute and awarded the prestigious Superior Taste Award medal 3 times (JaTrgovac, 2023).

5. Conclusion

An increasing number of companies promote socially responsible business strategies and everyday practices. In the case of Podravka Group, we recognized and described actions contributing to achieving several UN SDGs. We described its effort to reduce the negative impact on the environment by significant investments in green energy transition and, thus, the realisation of CSR 7 - Affordable and clean energy. Then we described the activities of Podravka in support of the realisation of CSR 1 - No poverty and CSR 2 - Zero hunger, where Podravka donates food to social supermarkets and other organisations involved in working with people in material deprivation. Finally, we described how Podravka actively works in the field of CSR 3 - Good health and well-being and CSR 12 - Responsible consumption and production through the creation of new innovative products and brands that provide improved nutritional values and contribute to the health of customers. As a such product, we described the innovative salt brand Salut with decreased values of sodium developed by Podravka.

Questions, discussion and team work

1. What is the key motivation for companies to implement CSR and sustainability in their business strategy and everyday operation? Is it pure philanthropy or something else?
2. In Podravka’s case, EU incentives played a significant role in their green transition in energetics. Do a small research and find out which incentives are available to support companies or individuals in green transition. When doing this research - think about improvement of your housing or buying a new vehicle.
3. Investigate who is involved in food donation distribution to people in material deprivation in your country. Do you recognize some

companies and/or organisations who jointly contribute to poverty solving in your country? Describe how they operate and what could be improved in their cooperation.

4. Podravka had developed a new and innovative nutritionally improved product Salut. Give some ideas how to market this product as quickly as possible. What ideas and points would you emphasise in your promotional activities?
5. Explore how local food producing companies develop innovative approaches to achieve CSR 3 at your market! Outline characteristics of product(s) that you found. What is new about it? For one of those products, develop a story as the basis of promotional activities to follow.

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Blockchain chocolate

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Problem description

As the world increasingly looks at using digital technology to accelerate action on issues such as climate change and biodiversity loss, **blockchain** is pushing to the forefront. It is a decentralized, digitally distributed ledger technology (DLT) that helps to verify and trace multistep transactions. While it might be best known as the architecture behind crypto-currencies like Bitcoin, it is finding uses in everything from tracking the sustainability of products to the real-time monitoring of pollution (UNEP, 2022). Some experts even predict that blockchain might be the key to sustainability innovations that can help us fight climate change (Marr, 2023).

A new report from the United Nations Environment Programme (UNEP) and the Social Alpha Foundation (SAF) *Blockchain for Sustainable Energy and Climate in the Global South: Use Cases and Opportunities* (SAF, 2021) explores how the technology can accelerate the transition to clean energy and help combat climate change in developing countries. "*The world needs to almost halve emissions over the next eight years to stay on track for a 1.5°C world, while at the same time expanding access to energy to bring hundreds of millions of people onto the grid. Blockchain technology can play a part by making possible more accurate load monitoring, generation, and distribution in the grid through efficient use of data,*" said Mark Radka, Chief of UNEP's Energy and Climate Branch, referring to data from UNEP's Emissions Gap Report 2021.

Blockchain technology has scaled rapidly in the last several years and is projected to expand to an even larger market across industries and countries, from verifying ownership of digital assets like NFTs to tracking items in a supply chain, its versatility can drive innovation and support business transformation (PWC, 2023).

Innovation in infrastructure services like transportation, energy and water – which account for a significant amount of global emissions – could have a substantial impact on reducing emissions. The core properties of blockchain and other DLT can enable deeper technological integration, standardisation, and the possibility of new business models. Their potential for integration with other important digital technologies like the internet of things (IoT) and artificial intelligence could have profound implications for traditional infrastructure services (OECD, 2023).

A closer look reveals that not all blockchain protocols are the same and may have different purposes and varying levels of environmental impact. A key component of these protocols is the consensus mechanism, which is the defined approach to validate transactions and prevent malicious activity. Each consensus mechanism has advantages and disadvantages regarding decentralization, security and scalability, and adjustments to these trade-offs can unlock opportunities to make the respective blockchain more sustainable (PWC, 2023).

The core competencies of blockchain technology – transparency, data auditability, privacy, value transfer, and process efficiency and automation – can be leveraged to drive the systemic changes needed to deliver sustainable infrastructure. The properties of decentralised trust and immutable records enable real transfer of ownership. While it was only possible to copy data via the internet in the past, blockchain accelerates the move to an "internet of value". This enables intangible or tangible assets like currencies, shares, infrastructure securities, data, or obligations like contracts to be exchanged, without the need for intermediaries, via the trusted ledger (OECD, 2023).

Blockchain has significant potential to support sustainability, and it may prove to be a valuable tool to help companies advance environmental aspects of their ESG (environmental, social and governance) goals (PWC, 2023).

The role of blockchain in the context of sustainable infrastructure is considered to be far beyond enabling efficient data collection, monitoring, reporting and steering services. The technology can potentially also address the key challenges and opportunities in supporting mitigation and adaptation-related activities, especially in the energy, transport and agriculture industries (OECD, 2023).

About the company Lyra Group, S.R.O – lyra chocolate

The Slovak brand LYRA chocolate is the most popular Slovak producer of premium chocolate, and it is often the first in Slovakia to come up with new chocolate innovations. It began its story in 2008, with offering hot chocolate, followed by small individually packed chocolate cubes for private brands. During a decade on the chocolate market, the company has become famous not only in the country but around the world, too. They offer a wide range of product assortment, including chocolate bars, nut spreads, coated products, ZmrzLyra (ice cream), products with alternative sweeteners (substitutes for refined sugar – coconut flower sugar, natural sweetener stevia, cane sugar, coconut sugar, etc.), Bean to Bar production (chocolate made from three ingredients: cocoa mass, coconut flower sugar and powdered milk).

Of course, they own many certifications, such as Bio or Fair trade, as well as the prestigious BRC Global Standard for Food Safety certification, which offers a supplier strong guarantees regarding food safety, traceability and quality.

And in the meantime, they are winning global awards for taste, quality and design. In 2014, as the first Slovak company, they won the Great Taste Awards in the UK, which is the "Oscars in the food world", which brought a lot of positive PR and brand awareness.

Their products are sold in the Czech Republic, Poland, Austria, Hungary, Portugal and France in Europe, and are available in Singapore and the USA as well. South Korea is currently their most dominant partner in terms of exports, selling products on Asiana Airlines, Korean Air, Jeju Air, T'way Air, Air Seoul and in the JDC airport duty free shop (Hubeňáková, 2018).

The co-owner, Karol Stýblo, completed trainings in praline making, the Barry Callebaut chocolate academy in Belgium and training with one of the best chocolatiers in the world, Emmanuel Hamon in France. Today, he is one of only seven producers in the world with the title of **Fino de Aroma Master Chef Chocolatier**. This is due to Fino de Aroma cocoa, the designation awarded by the World Cocoa Organisation and used for only 6% of the world's total cocoa production.

They learned everything in Colombia, from how the seed is prepared, planted, grafted, hand-pollinated, i.e. the entire agricultural process and processing in the factory. There are three categories of producers: those who buy the raw material, then strain it, pour it, and sell it. Then there are the bean-to-bar producers, who buy the beans, bring them over, process

them, make the chocolates, and sell them. Finally, there is the **tree-to-bar category**, where there is only one such producer in Europe – Lyra. They grow the cocoa, oversee the fermentation, which they can direct on the plantation, and they continue to the finished product. The taste of the chocolate is influenced 30% by the quality of the cocoa, 40% by the fermentation, and in the factory in Slovakia they can only influence 30%.
They also invest in **research**. In cooperation with four universities (in addition to the SUA in Nitra, there are two in Colombia and one in South Korea), the chocolate factory is involved in complex clinical trials focused on chocolate with probiotics and its effects on the human body, since up to 90% of diseases of civilisation arise from digestion not working as it should. They have not found any probiotics in Europe that would meet what they declare, which is why they work with South Korea, where they have natural probiotics that can handle the processing in chocolate without harm. In fact, they could sell this chocolate already, but they want to know the effects of what they are selling (Huďová, 2017).
In 2022, the company joined forces with Colombian chocolate manufacturer **Luker Chocolate (CasaLuker SA)**, a Colombian family-owned B4B chocolate ingredients manufacturer with more than 110 years of experience in chocolate production at its place of origin, exporting its chocolate ingredients and finished products to 40+ countries worldwide, with own cocoa plantations and research centre or direct relations with Colombian farmers and farmers' associations.
This merger brought together Luker Chocolate's expertise in processing cocoa at the point of origin, along with LYRA's creative experience in the production of premium quality chocolate confectionery. Luker acquired a majority stake to support the brand's innovative capabilities and premium market position, while accelerating its own international growth and strengthening its capabilities to meet the needs of the European chocolate market.
With this partnership, LYRA became the only Slovak chocolate producer to fully integrate research, direct sourcing, cocoa processing and chocolate production at the point of origin. The brand continues its current growth plan, with the management team retaining an ownership stake in the business and continuing to run the operation (Cebrová, 2022).
The Pontis Foundation awards companies from all over Slovakia for their responsible business and corporate philanthropy each year. LYRA won the **Via Bona Slovakia 2019** award in the People's Choice Award category, decided by the readers of the newspaper SME, who voted for the most inspiring example of responsible business in an online poll (Nadácia Pontis, 2020).

Corporate Social Responsibility (CSR) is the basis of the company's sustainability, for them, a balance in the business. It is about the ethical standards that the company wants and tries to follow. Their code of ethics, published on their website, includes pillars such as honesty, trust, fairness, solidarity and social feeling, responsibility and quality products and services (Hubeňáková, 2018).

Their responsible business approach is defined as follows:

"At LYRA Chocolate / LYRA GROUP, all employees work with respect for the environment. Environmental laws and compliance with them are a must. We contribute to conservation by using energy-saving and environmentally friendly technologies. We do not waste energy and we dispose of waste in an environmentally friendly manner.

The company's activities are complemented by educational activities, which include visits to secondary schools. The cooperation gives students an insight into the world of chocolate and its production. In this way, they share their experiences and teach at the same time. Organising events for the public gives people the opportunity to see the whole process of chocolate production.

Social and solidarity support is mainly in the form of donations to organisations helping people with intellectual disabilities. The company tries to provide everything under its own roof, but they are so enthusiastic about the concept of supporting local people in Colombia that they take not only cocoa, but also cocoa mass and butter from them. In this way, they support local farmers and provide them with employment opportunities," (LYRA, 2023b).

Specifically, the chocolate manufacturer decided to eliminate plastics in production and shipping. Packaging material consists of paper and recyclable materials. The transport boxes, chocolate wrappers, tubes and the carton tapes as well are made of paper. They are still working on an alternative to stretch film, which they also plan to replace year with an eco-friendly option. All of the company's waste is recycled properly. It also contributes to environmental protection by using energy-saving and environmentally friendly technologies. Energy is not wasted and waste is disposed of in an environmentally friendly way (Hrabovská Francelová, 2020).

The company cooperates closely with the secondary vocational school Hotel Academy of Ľudovít Winter in Piešťany, where they teach students how to work with chocolate, they organize the Junior Chocolatier competition and participate at the Sweet Festival (Huďová, 2017).

The company also invests in social projects, they carry out many activities in in Slovakia and in Colombia as well, within their **LYRA Cares** project. On their website, they state the following:

Figure 1: LYRA Cares project

Source: LYRA (2023a)

"We care about everything we leave behind us. We value the nature which bears cocoa trees, the farmers who grow them, but also their children and our interns who will take over our craft one day. That is why we strive to be responsible and fair in every way possible. To put it simply, LYRA Cares," (LYRA, 2023a).

LYRA Cares came about after seeing the documentary Shady Chocolate (2012) and working with the organisation People in Peril (Človek v ohrození). They felt the need to do fair trade, but directly with the people concerned. It is a part of the work to which a fixed percentage of the turnover is dedicated.

"*Colombia is famous for coca cultivation and cocaine. However, the local farmers are not drug dealers, they simply grow what they grow to survive. Under a government programme, 500 hectares of land in the* ***Necoclí*** *area have been turned into cocoa plantations. There are three schools here, which we support by paying for breakfast for the children. It's a strong incentive for them to walk a few kilometres through the forest to school every morning*," said the owner in an interview in 2017, describing the situation in Colombia, where he and his colleagues visit regularly

In a project called **Young Necoclí**, they support 782 young people from Colombia who are learning how to be good leaders, how to integrate into a fast-growing society, how to make the most of the potential of their ancestors. This involves providing information, training young people in financial management, leadership, communication, environmental management. This is crucial for a community of young people who have low financial literacy but want to stay in the farming business and want to make the most of it. In many cases, young people cannot calculate and evaluate how much effort and money they will spend to produce their product, nor do they know how much to sell it for. In partnership with Casa Luker, LYRA manages to educate young people to see the sense in staying in their home country (Hubeňáková, 2018; Huďová, 2017; Hrabovská Francelová, 2020).
LYRA has been an official partner of the **Arabeska** gymnastics association in Slovakia, which focuses on children with Down syndrome, for many years. Every year they co-organise concerts and performances, as well as the Special Olympics European Championships in gymnastics, where many employees of the company volunteer to help with the organisation (Hrabovská Francelová, 2020).

The first blockchain chocolate in Slovakia

The company has created the first Blockchain chocolate in Slovakia, which brings transparency to the chocolate production and distribution process, not only in terms of the raw materials used, but also in terms of the products' traceability over time (Nadácia Pontis, 2020).
As the co-owner explained in an interview in 2019, when asked about the reasons why they do not want to rely only on certificates: "*We live in a time of information chaos and people have a hard time finding their way around information. They have a problem to distinguish truth from untruth. For example, there are several certificates available, such as Bio or Fair Trade, but they have had a few scandals and people don't trust them anymore. In my opinion, the future is that people will or will not trust the brand, not the certificate*". In his opinion, manufacturers should show customers that they are doing things transparently and have proof of that. "*That's the point of the GALLERY range of chocolates. We want to show the customer everything that is associated with its production. We plan to go into even more detail, where the customer will see everything about all the ingredients that have been used to make them*" (Heglasová, 2019).

In September 2019, 3IPK hosted the "3IPK Blockchain & Industry 4.0 Forum" event in Bratislava. Here, 3IPK together with DECENT announced the partnership with LYRA.
The cooperation of three companies based in Slovakia brought a unique project in which the final consumer gets step by step to all stages of choc-

Figure 2: Lyra Gallery chocolate bar with a unique QR code showing the timeline and activities related to its production

Source: Lyra (2019)

olate production – from the harvesting of cocoa beans, to the unique chocolate bar they are holding in their hands (LYRA, 2019).

The "farm to table" tracking system is powered by the blockchain platform DCore. Each of LYRA's Gallery chocolate bars has a unique QR code, which customers can scan in order to track all phases of each chocolate's individual production process. Maria Capova, the CEO of 3IPK expressed: "*We are very happy 3IPK is a part of Lyra's blockchain chocolate project. The food quality, originality and transparency in production process has become an important factor for more people, in recent years. Thanks to blockchain, all steps in the process can be tracked and customers can find out where exactly their chocolate comes from. We are looking forward to further develop our cooperation with Lyra and to bring more blockchain chocolate bars to the market,*" (3ipk, 2019). "*It is a fundamental right of every person to know where their food comes from. Thanks to the partnership with LYRA, blockchain has once again proven its flexibility and efficiency capabilities, which are also usable by the general public*", expressed Matej Michalko, founder and CEO of DECENT (Biznár, 2019).

The primary role of this unique project is to initiate the tracking of a new range of six specialty **LYRA GALLERY chocolates**, the "tree-to-bar" chocolates, whose unique design for the packaging was created by artist-painter Daniel Bidelnica. With its playfulness and unique choice of colours, this range of chocolates is distinguished from other chocolates not only by its appearance, but also by its unique composition. The uniqueness is that none of the six chocolates contain any lecithin and the sugar content in both the milk and bitter versions does not exceed 30%. The chocolates are made from Fino de Aroma cocoa beans and with only cane sugar. There are two versions available: milk 50% and bitter 70%. Both variants have a pure chocolate taste, the second in line is the nutty variation and the trio is rounded off by nuts with raisins (LYRA, 2019).

The blockchain implementation in LYRA chocolates is composed of several layers. Each GALLERY chocolate produced has a unique QR code. By scanning it, the customer is able to access all the information using their mobile phone. On the screen, they see all 15 production steps associated with the particular chocolate bar, through the origin and harvesting of the cocoa beans, fermentation, drying, conching and packaging – the complete journey to Slovakia or what processes the chocolate has undergone directly in the manufacturing plant in Ivanka pri Nitre. Each piece of information (time and place of each production step) is recorded.

The role of blockchain technology is to ensure and immutably write down on a timeline all the activities associated with the production of the choc-

olate. The blockchain works by recording data in blocks that are interconnected by threads, which cannot be changed on a timeline. They want the customer to know everything about their chocolate (Hrabovská Francelová, 2020).

"*The origin of food and its dual quality are important topics right now, and we have solved this in our company with blockchain chocolate,*" explains Stýblo, why as a manufacturer they decided to use this technology, when using blockchain technology can also be something of a burden. If anything went wrong during the production of goods, the company would be unable to modify records from the production process.

The paradox of this chocolate range is that, despite incorporating new technology into their packaging, they cost less than other chocolates from the brand. The cost reduction is due to automated production, which does not bring anything extra to the consumer. They made their products traceable anyway, as they are covered by BRC certification, which certifies food safety, so they did not have to make any additional investment within that (Heglasová, 2019).

Questions and tasks for student

- Do you think sustainability is a major challenge in chocolate manufacturing? Why?
- What are the advantages and disadvantages using blockchain technology in the food sector from the manufacturer and consumer point of view?
- How do you think sustainability could be improved in LYRA? Propose strategies.
- Develop a SWOT analysis of LYRA regarding all the sustainability aspects.
- Compare the sustainability initiatives applied in LYRA with a chosen chocolate manufacturer from your own country. What differences can you identify?

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Global sustainability: chocolate of peace and love

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Problem description

Are fair-trade products really more sustainable? People tend to equal "fair-trade" to "green" but is this really true? And furthermore and more important, is this idea linked to sustainability if consumption of this product is made thousands of kilometres away from the place where it is produced?

The recent rise of the "ethical" consumer has not only created a new market for greener products. It has also developed a potential market for new labels that intend to guarantee that they certify these new products have been meant to show that those products have been evaluated.

However, this can lead to confusion or even worse to some tricks if we assume that any product with a sticker including words such as "earth" or "fair" must be good for the environment and good for local workers in a distant developing country.

It is also interesting focusing on products that are officially "fair-trade certified." This sort of certification tends to be linked to labour standards more than environmental standards. So, they suggest that workers in these countries get better job conditions and wages producing these goods than for producing products without these "fair" labels.

The question is if certification "fair trade" must also guarantee a meet a set of environmental standards that is required for local products and how travel emissions can be compensated.

CHOCOLATES OF PEACE AND LOVE is a microenterprise dedicated to the production of artisan chocolates with the best quality organic ingredients and produced and elaborated under the principles of Fair Trade. They have innovated in product formulations and sustainability, as it was the

first artisan company in Spain to introduce certified chocolates with organic and Fair Trade raw materials to the market.

1. Description of the business project

CHOCOLATES OF PEACE AND LOVE is a micro-enterprise dedicated to the production of artisan chocolates with the best quality organic and Fair Trade ingredients, and with the passion of creating responsible chocolates that have a positive impact on our environment and on the planet.
They consider themselves producers of delicious, handmade and surprising chocolates, in which quality is fundamental and, therefore, they put all their efforts and know-how into making what they hope will be the best chocolates that their customers have ever tasted. But they also care about the people who make it possible and the conditions in which they make it, which is why they emphasize the use of organic and Fair Trade raw materials, such as cocoa and cane sugar, and also consumer local, mainly Extra Virgin olive oil and Marcona almonds.
The objective of the company is, ultimately, to create different and innovative chocolates from the best raw materials, to be able to offer a natural, healthy product with a fair origin, and always enjoying the work.
The mission of the company is the search for the highest quality in the manufacture of chocolates, through the constant search for the best quality raw materials to make a delicious, healthy and wholesome chocolate; but, at the same time, with social traceability based on both the use of raw materials from Organic Agriculture and Fair Trade, as well as a workforce that generates sustainable local development and that allows equal opportunities in access to work between men and women in a fairly isolated region.
It is a microenterprise where all the employees are women.

2. Identification and characterization of the business model

The company CHOCOLATES OF PEACE AND LOVE was founded in 1997 by its currentowner, with the initial objective of manufacturing cakes and chocolates for the local market. As she says: “I had always liked the world

of cooking, gastronomy, and I was very clear that I wanted to work on my own. So I trained in pastry and chocolate and worked in chocolate workshops in France and Belgium. And, although from time to time I leave Spain to continue training, most of the year I am working in our workshop".
The transformation of the initial pastry-chocolate shop into the current chocolate workshop was gradually forged. Initially, Fair Trade raw materials were used and, little by little, the innovative idea of making only certified organic and Fair Trade chocolates was born. Its tenacity allowed in 2013 to obtain the Fair Trade Certificate "Fairtrade", being currently the only company in Spain that produces artisan chocolates with this seal. Her clear vocation with the world of chocolate is striking, since there was no family tradition in the confectionery sector since they were dedicated to the manufacture of furniture, and the clear commitment from the beginning with its social traceability.
The evolution of the company has been based both on new product lines and on new markets. When it comes to launching new products, they have been innovative because they have known how to find the market niche according to their business idea. In this way, CHOCOLATES OF PEACE AND LOVE has established itself as a creative space where to innovate with chocolate and make it a jewel that brings pleasure to the senses and the heart of people. To achieve this, they have been specializing in medium-high range organic and Fair Trade chocolates. This commitment to clearly differentiated products due to their social traceability has allowed them to have an annual increase of 30% in their sales volume since they were set up and to go from a local market to a regional market (mainly Zaragoza) and , on a smaller scale, national (Barcelona and Madrid). The company wants to evolve and be able to serve the international market and, especially, European markets such as Germany, France and Sweden.
In CHOCOLATES OF PEACE AND LOVE they manufacture with a triple objective so that the chocolates are:

Quality

The selection of the highest quality products is part of their philosophy, so to produce chocolates they select cocoas based on their purity, their character and their characteristics and qualities. The selected cocoa has different origins and they work it according to their needs, adding a little cocoa butter and little sugar. In addition, they have replaced the fats with which they usually work in sweets (butter, margarine or vegetable oils) with Extra Virgin Olive Oil and instead of refined white sugar they use brown sugar, panela, honey or natural stevia.

To ensure that consumers trust this quality, they make all their products in their facilities, including candied or dehydrated fruits, pralines and dried fruit pastes. That care and respect for the elaboration of their chocolates is expected to be noticed by the consumer in its flavour.

Delicious

As they love chocolate, and since they started in this business, they try to continue learning every day and thus be able to offer a totally different and innovative chocolate. For this reason, its tablets are designed so that they hardly have to be bitten and thus the chocolate can melt in the mouth, without chewing it, to be able to enjoy it appreciating all its qualities and flavour. They make traditional flavours such as chocolate with almonds, with coffee, with cream or with orange, but also newer flavours: spices, ginger, herbs, caramelized sunflower seeds, olive oil and many others, using the best raw materials and, which is also very important for them, a lot of love.

Healthy

They consider that to achieve this, an important part of their work is the constant search for the best raw materials, that is, the ideal ingredients for their products. They look for quality raw materials to make a delicious chocolate but, at the same time, they look for raw materials from Fair Trade and Organic farming and certified with the minimum content of allergens because they want to make a healthy chocolate, so they are free of gluten, egg, soy, fish and derivatives, mustard and derivatives, crustaceans and derivatives, molluscs and derivatives. , sulphites, peanuts and derivatives, sesame seeds and derivatives, celery and derivatives. Nor do they work with latex in their premises. They are also free of genetically modified organisms (“GMO Free”), and they are suitable for lacto-vegetarian diets. However, although some of its chocolates are also lactose-free, all of them contain or may contain milk protein and nuts.
The products of CHOCOLATES OF PEACE AND LOVE are divided into

BIO and Fair Trade chocolate bars (Certified by FLO-Fairtrade and by the Committee for Organic Agriculture)

They contain ingredients that enhance the flavour of cocoa and that, at the same time, give it texture, flavour, contrast and innovation. They are presented in tablets of 100 gr. Its barely 5 mm thickness makes the chocolate melt in the mouth without the need to chew it, thus allowing the

chocolate to express itself and release all its aromas and nuances. Various flavours are made that change according to the year. Nowadays, they offer the following:

- BIO White Chocolate Tablet.
- 73% BIO Dark Chocolate Tablet – Origin Ecuador.
- BIO Dark Chocolate Tablet with Extra Virgin Olive Oil and Salt.
- BIO Dark Chocolate Bar with Ginger, Citrus and Mint.
- BIO White Chocolate Tablet with Yogurt and Raspberries.
- BIO Milk Chocolate Bar (minimum 39% cocoa).
- BIO Milk Chocolate Bar (minimum 39% cocoa) with effervescent Lemon
- Crunchy BIO Milk Chocolate Bar with Bourbon Vanilla.
- BIO Milk Chocolate Bar (minimum 38% cocoa) and caramelized sunflower seeds.
- BIO Dark Chocolate Tablet (minimum 73% cocoa) with Spices.
- BIO Dark Chocolate bar with candied orange peel.
- Personalized chocolate bar

Seasonal

- nougat

They are made for Christmas. They are ecological and Fair Trade (Certified by FLO -Fairtrade and by the Committee for Organic Agriculture). They are presented in tablets of 200 gr. The flavours on offer are:

- Artisan BIO chocolate nougat with Crunchy Praline
- BIO Artisan Nougat – 73% Chocolate Truffle and Extra Virgin Olive Oil.
- BIO Artisan Nougat – 100% Arabica Coffee Truffle.
- Artisan nougat BIO Chocolate with Spices.
- Organic white chocolate artisan nougat – White Truffle.
- BIO artisan almond, orange and saffron nougat.

Its trademark is CHOCOLATES OF PEACE AND LOVE and it is registered in Spain.

3. Enterprise Value Network

The value chain of CHOCOLATES OF PEACE AND LOVE is based on the selection of the highest quality raw materials, so for the production of choc-

olates they select cocoa based on its purity, its character and its characteristics and qualities. The selected cocoa has different origins and they work it according to their needs, adding a little cocoa butter and little sugar. All the raw materials with which they work are totally sustainable natural products, for which their production must be respectful of people and the environment. They believe that the best chocolates can (and should) be produced in a totally sustainable way. That is why they ensure that their raw materials meet these three requirements:

Being raw material of local production (Km. 0)

By buying directly from the producer, they avoid the pollution caused by transport. They work and live in a rural area, therefore they have at their disposal a wide variety of raw materials that are grown or produced there certified by Organic Agriculture. In this sense, the honey, the Extra Virgin Olive Oil, the Marcona almonds, the fruits, the saffron, etc. that they use are cultivated by small producers near their facilities.

Being a Fair Trade raw material

With this they ensure a salary and decent living conditions for the farmers who grow cocoa, sugar, coffee, quinoa or the spices with which they make their products. They come from small plantations in Africa, Asia or Latin America and are certified as Fair Trade and Organic Farming products by FLO -Fairtrade. The Fairtrade seal guarantees that the human rights of all the people who have worked on it have been respected throughout the path that the product has travelled, from the moment it is grown until it reaches the consumer.

Being raw material from Organic Farming, free of pesticides and chemical fertilizers, without genetically modified organisms ("GMO Free")

Most of its suppliers share its principles of socially equitable and environmentally friendly practices. Thus, they work with small producers, ethical banking, ethical insurance and electricity from renewable energies.
However, for cocoa and sugar they seek to increase their social traceability, so they are trying to work directly with the producer and try to eliminate intermediaries.
The transformation of their products is carried out using traditional methods, following the recipes designed by them, in a small workshop where the entire production process of their chocolates is carried out, as well as their packaging.

Waste management is practically non-existent and, for those that are generated, the selective collection containers of the town of are used.
The company has been able to identify a market niche that allows them to be leaders in the chocolate sector in terms of making organic and Fair Trade chocolates. Their products can be found in organic, Fair Trade and gourmet stores.
The company's target market is fundamentally regional with 70% of sales in the region, dividing the remaining 30% in all Spain. (97% of sales).
The sales channels used by the company are its own distribution to retail stores (48%), external distributors that are mainly organic products (30%), sales in their own store (20% and the online store -line (2%).
The target customers are all chocolate consumers of any age, but specifically those who are looking for different and/or surprising flavours, with a gastronomic culture for gourmet products or who are committed to organic and/or Fair Trade consumption.
The company's communication strategy has been based on product demonstrations in retail stores, school visits to its facilities, and its web and social media presence.
The support to the intermediary and customer service is carried out mainly through a special web channel designed for them where they are offered information on new products, recipes and any topic that is of interest to their business relationship.
The company has a special collaboration with suppliers of Fair Trade raw materials to help them promote these products among potential customers.
For this, they collaborate with the Fair Trade Associations in events organized by them in which CHOCOLATES OF PEACE AND LOVE makes known its experience in the use of Fair Trade products.
They also carry out an important informative work among schoolchildren through candy making workshops. Among them, it is worth highlighting for their social commitment the collaborations with associations of the Intellectually Disabled in carrying outchocolate and nougat making workshops.
CHOCOLATES OF PEACE AND LOVE belongs to the Spanish Network of the United Nations Global Compact (Global Compact), which is an international initiative that promotes the implementation of 10 Universally Accepted Principles in the areas of Human Rights.
Human Resources, Labour Standards, the Environment and the Fight against Corruption in the activities and business strategy of companies. It is a practical framework for developing, implementing and disseminating corporate sustainability policies and practices, offering its signatories a

wide range of resources and management tools to help them implement sustainable business models.
The company CHOCOLATES OF PEACE AND LOVE is aware of corporate social responsibility fundamentally through its three social commitments:

With disadvantaged producers of raw materials

For this they are committed to making their products with raw materials from Fair Trade. This guarantees a decent salary and an improvement in working conditions for producers in impoverished areas of the countries of the South, which are also the areas where most of the cocoa, cane sugar and many other raw materials. The company makes its chocolates with these raw materials. The FLO-Fairtrade Seal (www.sellocomerciojusto.org) ensures the obtaining of quality raw materials, with the guarantee that the rights of people and also the environment have been respected.

With equal opportunities between women and men

The Women's Institute has recognized it as a "Collaborating Company for Equal Opportunities between Women and Men". They are a small company that is committed to creating quality employment for women and thus reconciling family and work life.

With the Earth and the environment

Their commitment is reflected in the fact that all the raw materials they work with are organic and many of them are also locally produced. They also work to reduce their packaging to a minimum, using recycled or originating paper from sustainable forests, with the minimum use of inks and minimizing disposable material. Most of its suppliers share its principles and also use renewable energies and practices that are socially equitable and respectful of the environment. They also take care in the utensils they use when working: lead-free and PTFE-free kitchenware, and biodegradable and phosphate-free cleaning products. Finally, all their chocolates are certified by the Committee for Organic Agriculture and are also suitable for the Lactovegetarian Diet and are free of Genetically Modified Organisms ("GMO Free").
In short, the business activity of CHOCOLATES OF PEACE AND LOVE is based on making the best artisan chocolates with the best, most sustainable (ecological) and most supportive (Fair Trade) raw materials that satisfy a very specific market niche such as consumers of organic and/or Fair Trade products but, without giving up, to reach the rest of chocolate con-

sumers, preferably those with a gastronomic culture who are looking for gourmet products. For this, they constantly innovate in their chocolates, especially in flavours, through their creativity in order to turn chocolate into a jewel that delights the senses and, with its triple social commitment, also reaches the hearts of people.

4. Corporate culture

The corporate culture of CHOCOLATES OF PEACE AND LOVE is based on achieving good quality chocolate through the passion put into its craft production with excellent raw materials, which must be respectful of people and the environment. That implies, through the mixture of organic Fair Trade ingredients, local production and passion in its preparation, putting a grain of sand to improve things. This culture was defined by its founder from the beginning and has always been present in the company and they have remained faithful to it. The workers are fully aware of this culture since they joined the company, as well as the suppliers and clients who work with it.

Its commitment to quality, people and the land is openly manifested in its triple social commitment outlined above when defining its corporate social responsibility. Quality is essential since they put all their effort and know-how into making what they hope will be the best chocolates that their customers have ever tasted.

It actively participates in talks at the regional level to disseminate its corporate culture, fundamentally in relation to organic raw materials and Fair Trade. They also plan to share their experience at the next National Congress on Corporate Social Responsibility to be held in Zaragoza in February 2015.

Global decision-making is carried out by the owner of the company and communication is developed in an unscheduled way to the workers.

5. Organizational setup

Being a microenterprise, the organizational structure is very simple, and responsibilities are divided into production and administration. It has outsourced certain administrative issues and the website. The commitment to the employment of rural women is very important since the 7 people who work in the company are young women from the region.

The management is exercised by the founder of the company who coordinates all activities but also actively collaborates in them. In the production and logistics department, there are three women on staff and basic training in food handling is required. Three women work in the administration department, one of them dedicated to direct sales in stores and the other two to communication and sales to their customers. They would like to expand with the creation of a quality control department.
The variables that are considered when hiring are personal knowledge or references and, above all, commitment to the company's philosophy.
They have their own training programs given by the owner of the company so that the workers improve their techniques in the elaboration of their products.

6. Company strategy

CHOCOLATES OF PEACE AND LOVE seeks to distinguish itself from the competition through an artisan production of chocolates but made with organic and Fair Trade raw materials. They are also constantly innovating in the development of different flavours in order to surprise consumers and make them aware of their new chocolate proposals. To this end, all its chocolates are certified by Fair Trade and by the Committee for Organic Agriculture. They also have other certifications such as 100% Pure Cocoa Butter, Aragon Food Crafts, Collaborating Entity in Equal Opportunities between Women and Men, Forest Stewardship Council (FSC), We use only Green Kilowatts, VAT Fiscal Footprint: Spain and IS : Spain.
The company's growth strategy is based on the search for new products to offer (fundamentally combining flavours that surprise consumers and developing new products such as figures and chocolate Easter eggs), expanding to international markets (France, Germany and Sweden), in increasing online commerce and in controlling the supply of raw materials to do it directly to the producer.

7. The role of innovation in the company

Innovation has always played a key role in the development of CHOCOLATES OF PEACE AND LOVE, but they have all been "Pull" type, that is, based on the detection of market needs.

The types of innovation in the product have focused fundamentally on being the first artisan company in Spain to introduce certified chocolates with organic and Fair Trade raw materials on the market. In addition, each year they innovate in flavours to annually attract the curiosity of consumers towards their chocolates.
Also very important is the innovation in corporate social responsibility of the company, which has been a pillar of its corporate culture and which has been reflected in its social commitments with disadvantaged producers of raw materials, with equal opportunities between men and women and with the Earth and the environment.
Innovation activities are usually promoted by the owner of the company, although for product innovation she has the collaboration of a French master chocolatier who was World Pastry Champion. At the moment, the company does not collaborate with any research center to advise it on innovation, although they would like to, as they could help them solve some technical problems, such as, for example, how to combine artisan production with the increase in the average life of the chocolate.

8. Future prospects

The company's vision is to become a socially responsible business model that favours development in an isolated rural environment, through the artisan production of chocolates based on organic and Fair Trade raw materials.
CHOCOLATES OF PEACE AND LOVE commitment to sustainability is an important part of the company's *raison d'etre*, as it combines the four legs of sustainability:

- economic because it is capable of growing in a market as mature as the of the chocolates;
- environmental because all its actions are respectful of the environment;
- social because it has a clear social commitment both with its nearby community creating female rural employment and with the communities where its raw materials are produced;
- and cultural because it does not lose sight of its roots in its local culture in many of its activities.

9. Keys to success

CHOCOLATES OF PEACE AND LOVE is a micro-enterprise fundamentally dedicated to the production of artisan chocolates, which has been able to innovate in a market as mature as that of chocolates by committing to social traceability through the use of organic raw materials and Fair Trade. The success of CHOCOLATES OF PEACE AND LOVE has been based on identifying a market niche of consumers who are aware of the environment and social responsibility with cocoa producers and are capable of constantly innovating their products. The commitment of all the workers in the corporate culture of the company with their work and their dedication has been key to its success. The main differentiation of the company from its competitors has been its social traceability, which is manifested in its three social commitments with disadvantaged producers of raw materials, with equal opportunities between women and men, and with the Earth and the environment.

Recommendations to be able to continue with its success would be to maintain the quality of its artisan elaborations and its faith in the use of ecological raw materials and Fair Trade to elaborate new products. However, they should be more attentive in being able to innovate with the help of R+D+i centers in the search for production techniques compatible with artisanal elaboration that allows them to improve the commercialization of their products.

Questions for undergraduate students

- What do you think is more important for sustainability: to focus on local production or to develop fair trade strategies? Justify your answer
- Do you think this company has sustainability at the core of its business model? Why?
- How do you think sustainability could be improved in this company? Refer your answer to published work that could underpin your answer.

Questions for postgraduate students

- Develop a SWOT analysis of the company regarding all the aspects concerning social sustainability and its impact in business profitability.
- Fair trade is trade between companies in developed countries and producers in developing countries in which fair prices are paid to the producers. According to this, develop sustainability key elements in this company. To what extent do you think Who goes first: business model or social development?
- One 2015 study concluded that producer benefits were close to zero because there was an oversupply of certification, and only a fraction of produce classified as fair trade was actually sold on fair trade markets, just enough to recoup the costs of certification.[de Janvry, Alain; McIntosh, Craig; Sadoulet, Elisabeth (July 2015). "Fair Trade and Free Entry: Can a Disequilibrium Market Serve as a Development Tool?". The Review of Economics and Statistics. 97 (3): 567–73. doi:10.1162/REST_a_00512].

A study published by the Journal of Economic Perspectives however suggests that Fair Trade does achieve many of its intended goals, although on a comparatively modest scale relative to the size of national economies.[Dragusanu, Raluca; Giovannucci, Daniele; Nunn, Nathan (2014). "The Economics of Fair Trade". Journal of Economic Perspectives. 28 (3): 217–236. doi:10.1257/jep.28.3.217]

Some research indicates that the implementation of certain fair trade standards can cause greater inequalities in some markets where these rigid rules are inappropriate for the specific market.[Booth, P.; Whetstone, L. (2007). "Half a Cheer for Fair Trade". Economic Affairs. 27 (2): 29–36. doi:10.1111/j.1468-0270.2007.00727.x]

In the fair trade debate there are complaints of failure to enforce the fair trade standards, with producers, cooperatives, importers, and packers profiting by evading them. One proposed alternative to fair trade is direct trade, which eliminates the overhead of the fair trade certification and allows suppliers to receive higher prices much closer to the retail value of the end product. Some suppliers use relationships started in a fair trade system to autonomously springboard into direct sales relationships they negotiate themselves, whereas other direct trade systems are supplier-initiated for social responsibility reasons similar to a fair trade systems. Propose a model to ensure that Fair Trade can help to develop areas avoiding mentioned problem

Sustainable development strategy of Lorenz Group in the salty snacks market

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Problem description[1]

Global energy-related CO2 emissions grew by 0.9% or 321 Mt in 2022, reaching a new high of over 36.8 Gt. Following two years of exceptional oscillations in energy use and emissions, caused in part by the Covid-19 pandemic, last year's growth was much slower than 2021's rebound of more than 6%. Emissions from energy combustion increased by 423 Mt, while emissions from industrial processes decreased by 102 Mt. In a year marked by energy price shocks, rising inflation, and disruptions to traditional fuel trade flows, global growth in emissions was lower than feared, despite gas-to-coal switching in many countries. Increased deployment of clean energy technologies such as renewables, electric vehicles, and heat pumps helped prevent an additional 550 Mt in CO2 emissions. Industrial production curtailment, particularly in China and Europe, also averted additional emissions. Specific challenges in 2022 contributed to the growth in emissions. Of the 321 Mt CO2 increase, 60 Mt CO2 can be attributed to cooling and heating demand in extreme weather and another 55 Mt CO2 to nuclear power plants being offline. CO2 growth in 2022 was well below global GDP growth of 3.2%, reverting to a decade-long trend of decoupling emissions and economic growth that was broken by 2021's sharp rebound in emissions. Improvements in the CO2 intensity of energy use were slightly slower than the past decade's average. Emissions from natural gas fell by 1.6% or 118 Mt, following continued tightening of supply exacerbated by Russia's invasion of Ukraine. Reductions in emissions

[1] Source: International Energy Agency report 2022.

from gas were particularly pronounced in Europe (-13.5%). The Asia Pacific region also saw unprecedented reductions (-1.8%). Increased emissions from coal more than offset reductions from natural gas. Amid a wave of gas-to-coal switching during the global energy crisis, CO2 emissions from coal grew by 1.6% or 243 Mt, far exceeding the last decade's average growth rate, and reaching a new all-time high of almost 15.5 Gt. Emissions from oil grew even more than emissions from coal, rising by 2.5% or 268 Mt to 11.2 Gt. Around half of the increase came from aviation, as air travel continued to rebound from pandemic lows, nearing 80% of 2019 levels. Tempering this increase, electric vehicles continued to gain momentum in 2022, with over 10 million cars sold, exceeding 14% of global car sales. The biggest sectoral increase in emissions in 2022 came from electricity and heat generation, whose emissions were up by 1.8% or 261 Mt. In particular, global emissions from coal-fired electricity and heat generation grew by 224 Mt or 2.1%, led by emerging economies in Asia. A strong expansion of renewables limited the rebound in coal power emissions. Renewables met 90% of last year's global growth in electricity generation. Solar PV and wind generation each increased by around 275 TWh, a new annual record. Emissions from industry declined by 1.7% to 9.2 Gt last year. While several regions saw manufacturing curtailments, the global decline was largely driven by a 161 Mt CO2 decrease in China's industry emissions, reflecting a 10% decline in cement production and a 2% decline in steel making. China's emissions were relatively flat in 2022, declining by 23 Mt or 0.2%. Growing emissions from combustion were offset by declines from industrial processes. Weaker economic growth, declining construction activity, and strict Covid-19 measures led to reductions in industrial and transport emissions. Power sector emissions growth slowed compared with the average of the past decade but still reached 2.6%. The European Union saw a 2.5% or 70 Mt reduction in CO2 emissions despite oil and gas market disruptions, hydro shortfalls due to drought, and numerous nuclear plants going offline. Buildings sector emissions fell markedly, helped by a mild winter. Although power sector emissions increased by 3.4%, coal use was not as high as anticipated. For the first time, electricity generation from wind and solar PV combined exceeded that of gas or nuclear. US emissions grew by 0.8% or 36 Mt. The buildings sector saw the highest emissions growth, driven by extreme temperatures. The main emissions reductions came from electricity and heat generation, thanks to unprecedented increases in solar PV and wind, as well as coal-to-gas switching. While many other countries reduced their natural gas use, the United States saw an increase of 89 Mt in CO2 emissions from gas, as it was called upon to

meet peak electricity demand during summer heat waves. Emissions from Asia's emerging market and developing economies, excluding China, grew more than those from any other region in 2022, increasing by 4.2% or 206 Mt CO2. Over half of the region's increase in emissions came from coal-fired power generation.

Organization description

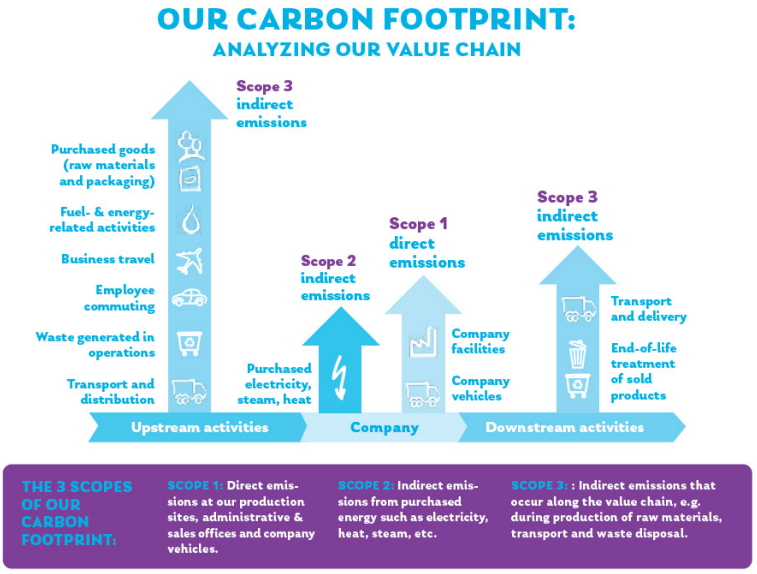
130 years and still going. It started small, with the family making tasty snacks from dough (like pretzel sticks), potatoes (like chips) or nuts. Lorenz has always been thinking in the long-term perspective and working for coming generations. Today, Lorenz is still an independent family business and has long been one of the leading producers in the European snack market. With chips (Crunchips, Naturals, Pom Sticks) and flips (Monster Munch, Curly, Peppies, Pommels), pretzel sticks (Saltletts) and nuts (NicNac's), people all over the world enjoy relaxed and special moments with friends and family. Brands and products contribute to the pleasure in their lives. To ensure that they succeed in this today and tomorrow, Lorenz takes responsibility for the high quality of their products as well as for sustainable and economic development. That means always improving the environmental and social impact of the business activities and the nutritional qualities of products. The handover of the company management in 2019 was a generational change for Lorenz in every respect. With Moritz Bahlsen, the fourth generation in the family took over the company management back then. At the same time, Lorenz entered a new stage of the company's development, and with it a new era that has its own challenges. Lorenz realigned themselfs along their values and placed joy of life and responsibility for sustainable development at the center of their work. This is what their new logo also stands for. For all these reasons, Lorenz committed to the United Nations Global Compact, guided by its ten universal principles and working on implementing the Sustainable Development Goals (SDGs).
Actually, Lorenz really only has one thing in mind: JOY OF LIFE. Because people need joy in their lives. It's in the company's nature. And snacking is simply part of it. Yet, Lorenz believes this also means that they must take on RESPONSIBILITY. To make sure that carefree joyfulness will also be possible in the future. As a family business, the snack producer thinks in the long-term and operates sustainably. They don't act on the basis of

quarterly results, but consider what will be important for the generations to come. That's why they make a sustainable commitment to the environment, to society and to the company every single day. And they are determined to improve the environmental and social impact of their actions as well as the nutritional properties of the products. With snacks that are always genuine, high quality and simply good. To bring their resolution to life, they asked themselves in which areas can they make the most difference for a more sustainable future. Lorenz aligned these areas with their corporate values. And Lorenz also examined which areas are most important for society, including consumers, employees and partners. On this basis, they have prioritized seven action fields, which summarize under the two clear areas: People & Planet. If the joy of life is motivation, then people must be at the center of everything they do. Because they produce snacks, their goals focus primarily on consumer health and nutrition. However, respect for human rights and transparent, fair supply chains come before enjoyment. And wherever possible, they support people in need. Their activities and initiatives are focused on these goals. If people are at the center, then it follows that environmental protection is also there. Because as humans we also need a safe, healthy environment and nature that surrounds us. However, they do need a lot of resources and raw materials for products. This is precisely where they see particular ecological responsibility. From cultivation to production, from transport to consumption, they work to use raw material, water, energy, other material or land as sparingly and efficiently as possible and to promote the circular economy.

Everything Lorenz does in seven action fields is important and makes a great contribution to the sustainable development of Lorenz and their partners. The company works on climate goals or for transparent and fair supply chains is an example for this. However, two areas are particularly important. As a manufacturer of savory snacks, Lorenz can make the biggest difference to their consumers and the environment in the areas of packaging and in consumer health and nutrition. And that's why they focus on this. Lorenz works on making their snacks healthier. without changing their character. This starts with the raw materials that they use, continues with their manufacturing processes, and extends to the transparency provided about ingredients and contents. Because their snacks are food, there are also high legal demands on the packaging of snacks. Alternative, environmentally friendly solutions are still rare up to this day. That's why they work on reducing the use of materials, especially plastic, and on improving recyclability.

For the coming years and decades, Lorenz set goals for their most important action fields. They set these based on the requirements that not only their stakeholders but that they place on themselves. In doing so, Lorenz took industry standards as well as their own potential analyses into account. All goals apply to the entire group and all locations. In order to achieve them, they work in an international and interdisciplinary network across all business units. Every employee contributes to this – on both a small and a large scale. Lorenz set the following goals:

1. Packaging:
   - By 2025, we want to reduce our use of plastic in our primary packaging (single product pack) by 15% compared to 2019.
   - By the end of 2022, 90% of our primary packaging will be recyclable (100% by 2025).
   - By the end of 2021, we will source exclusively FSC®- certified paper materials.
2. Consumer health and nutrition:
   - By 2025, we aim to reduce salt content across our entire product range by 15% compared to 2019.
   - New products must already contain 15% less salt than the average for existing products of the brand.



3. Climate and resources:
   - By 2045, we will achieve net zero emissions along the value chain.
   - By 2030, we will reduce our Scope 1 und Scope 2 emissions by 50% compared to 2019.
   - By 2030, we will become climate neutral in Scope 1 and Scope 2 (via climate pro- tection projects).
4. Human rights and responsible sourcing:
   - By the end of 2022, all our production sites will be audited according to the SMETA format.
   - We implement our Code of Conduct in our company and with our suppliers.

Questions / Tasks for undergraduate students

- How sustainable development goals can contribute to the salty snacks business like Lorenz?
- What are the pros and cons of Lorenz sustainable development strategy?
- What other fields or directions might be taken into sustainability strategy for Lorenz?
- Do you think that a sustainable development strategy should have an impact on the financial result of the company?
- Do you think that actions taken by Lorenz can solve the issues which are observed in Europe?

Questions / Tasks for postgraduate students

- What are the sustainable development goals that are taken into account by Lorenz?
- Is there any risk in your opinion that Lorenz sustainable strategy could be perceived as green washing by consumers? How should Lorenz communicate sustainable goals to consumers?
- Prepare two new fields or action areas that can be implemented in Lorenz and put sustainability into a higher level as a result.

– Do you think that family businesses can more easily achieve sustainable development growth compared to big corporations? Justify your opinion with market examples.
– Do you think that a sustainable development strategy should have an impact on the financial result of the company?
– Do you think that actions taken by Lorenz can solve the issues which are observed in Europe?

SUSTAINABILITY OF THE PUBLIC SECTOR

Sustainable cities and communities

Jana Gálová
University of Agriculture in Nitra

Problem description

The world is developing at an unprecedented scale. As many of us live in cities, ensuring a sustainable urban environment is vital. Cities are the engines of Europe's economy and are increasingly recognised as key players in Europe's transition towards a low-carbon economy (EEA, 2023).
Based on the findings of the World Bank (2023a), over the next 20 years, urban population in developing countries will double to 4 billion, while the urbanized land area will triple. On the one hand, rapid growth helps create new opportunities, but on the other hand, it has also brought serious social, economic, and environmental challenges. Urban and rural communities around the world increasingly feel the urge to tackle these challenges and increase their resilience to poverty and inequality, social exclusion, as well as climate change and disaster risks. Building sustainable cities and communities is essential for achieving the **Sustainable Development Goals (SDGs)** by 2030, and eliminating extreme poverty and boosting shared prosperity at the local, regional, and national levels.
The SDGs are a universal call to action to end poverty, protect the planet and improve the lives and prospects of everyone, everywhere. The 17 Goals were adopted by all UN Member States in 2015, as part of the 2030 Agenda for Sustainable Development which set out a plan to achieve the Goals (UN, 2023b). While progress is being made, but not yet at the speed or scale required.
The United Nations (UN, 2023a) states that the **Goal 11** is about **making cities inclusive, safe, resilient and sustainable**. Today, more than half the world's population live in cities. By 2050, an estimated 7 out of 10 people will likely live in urban areas. Cities are drivers of economic growth and contribute more than 80% of global GDP. However, they also account for

more than 70% of global greenhouse gas emissions. If well-planned and managed, urban development can be sustainable and can generate inclusive prosperity. Some interesting facts and figures:

- In 2019, ambient air pollution from traffic, industry, power generation, waste burning and residential fuel combustion resulted in 4.2 million deaths.
- Over 6,000 cities in 117 countries are now monitoring air quality.
- In 2021, 99% of the world's urban population lived in areas that exceeded the new air quality guidelines set by the World Health Organization (WHO).
- Between 2015 and 2030, annual passenger traffic globally is projected to increase by 50%, and the number of cars on the road is likely to double.
- According to 2020 data from 1,510 cities around the world, only about 37% of urban areas are served by public transport.
- In 2022, an average of 82% of municipal solid waste globally was being collected and 55% was being managed in controlled facilities.

Building sustainable communities will be critical to eliminating poverty and boosting shared prosperity (World Bank, 2023a). Specifically, the concept of **Sustainable Cities and Communities** of the World Bank's Urban, Disaster Risk Management, Resilience and Land Global Practice (GPURL) includes four key dimensions:

1. Sustainable communities are environmentally sustainable in terms of cleanliness and efficiency;
2. They are resilient to social, economic, and natural shocks (which are increasing in intensity and frequency due to climate change);
3. They are inclusive communities, bringing all dimensions of society and all groups of people into their activities;
4. They are competitive communities that can stay productive and generate jobs for members of the community.

According to the World Bank (2023b), in Europe and Central Asia, more than two-thirds of the population resides in urban areas. Consequently, the range of challenges posed by climate change, economic transformation and demographic shifts in the region is formidable, with governments and city mayors facing increasing pressure to find sustainable solutions.
The **Sustainable Cities Initiative (SCI)** is a multi-year program designed to support cities and governmental programs at the national level in pursuing an agenda that enhances the sustainability of cities across Europe and

Central Asia (ECA). SCI aims to optimize the economic, financial, social, and environmental sustainability goals of cities. SCI is organized around 4 core activities, collectively called the **Applied Knowledge Framework**: orientation, awareness, and exposure workshops; development and implementation of local diagnostic tools; policy reforms and investment strategies; and project financing, technical assistance and implementation support. This approach is also applied across 10 sustainable development modules or themes:

1. Historic city conservation and regeneration;
2. Energy efficiency and climate change;
3. Brownfield development;
4. Municipal finance;
5. Solid waste management;
6. Water and wastewater;
7. Urban transport;
8. Social inclusion.

Since there is a global effort to try and act more sustainably to protect the environment and create a safe planet to live on for generations to come, developing sustainable cities is something every country can get involved in (Marsh, 2022). As it is expected that by 2050, 66% of the global population will reside in urban areas (Toli & Mutagh, 2020), it'll be crucial for urban planners to take sustainable actions and create cities that support sustainable infrastructure.

While there is no single environmental solution that can be applied to all cities across the world, because their issues, needs and opportunities are different, a big issue that needs to be tackled everywhere is where cities obtain their energy, and how they use it (BBC, 2023). This means the main ways cities can become greener are to:

- Reduce the amount of energy and resources used through improving the efficiency of systems (e.g. transport, and changing citizens' behaviours);
- Reuse and recycle waste energy and materials;
- Obtain energy from cleaner sources.

The EU has a key role in promoting sustainable urban development (EEA, 2023). But cities (local authorities in general) have their own governance setting and therefore, are best placed to take local action to tackle environmental challenges, whilst ensuring a good quality of life for their citizens. Traditionally, they are crucial in improving waste and water man-

agement, public transport and efficiently using land by implementing integrated urban planning. Today, they also take centre stage on climate change adaptation and ecosystems preservation and restoration.

Urban environmental sustainability encourages revitalisation and transition of urban areas and cities to improve liveability, promote innovation and reduce environmental impacts while maximising economic and social co-benefits.

Urban systems are inherently complex. With the ample support of urban stakeholders, the EEA developed a conceptual model and selected six observation and analysis lenses to assess the role of cities in urban transitions towards environmental sustainability, within the broad European Green Deal framework and the EU Urban Agenda. Based on the stakeholders-led assessment process, several outputs have been co-created (see Figure 1).

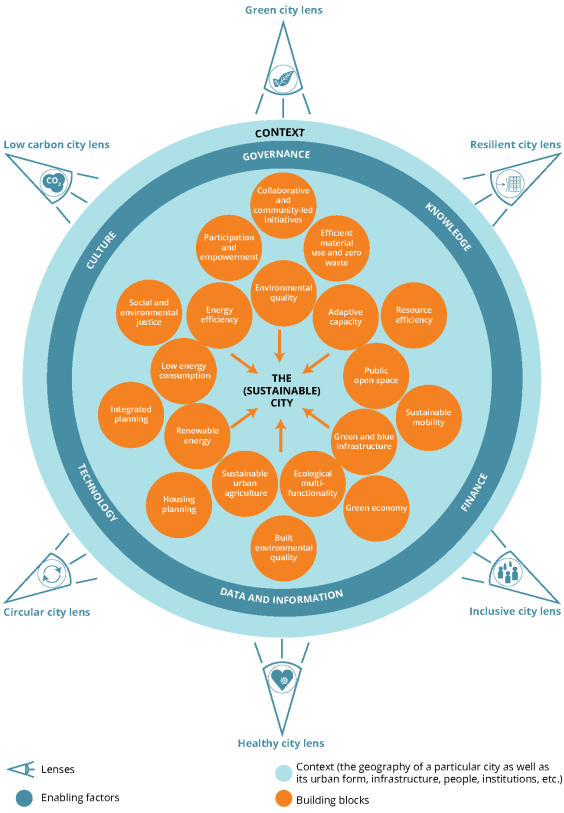


Figure 1: Conceptual framework for urban environmental sustainability

Source: EEA – European Environment Agency (2021), p. 20.

Society benefits from everyone working together to achieve sustainability. While there is no cut-and-dry answer on being more sustainable, the measures listed above are some of the most important features of sustainable cities and society, and are great places to start. It will be crucial for more cities worldwide to adopt these practices to create a safer, more liveable environment for everyone to enjoy (Marsh, 2022).

Sustainable Nitra

Nitra is a small, big city in south-western Slovakia, spread over seven green hills and combines ancient history with nature. The Nitra river flows through the city centre. Nitra is the cradle of history – seat of the diocese since 1000 years, a paradise for archaeologists, the mother of Slovak cities. It lies on two important European cultural routes, the St. Jacob's route and Cyril and Methodius route. The dominant feature of the town – Nitra Castle attracts many visitors every year, Nitra Calvary is a pilgrimage place and also a place of active leisure, genius loci of the oldest monastery in Slovakia – the Zobor Monastery directly in the bosom of nature is also unique. The Slovak Agricultural Museum is one of its kind in Slovakia with a number of exhibits from traditional agricultural production, with a steam railway and demonstrations of traditional works and crafts. It is part of the largest Slovak exhibition centre – Agrokomplex. The city also includes a small airport, where international competitions in gliding take place every year (Green Destinations, 2022a).

The city of Nitra through its Tourist Information Centre Nitra (TIC Nitra, 2022) participated in an international competition and was included in the *2022 Green Destinations – Top 100 Stories* award list (see Figure 2). Every year, the Green Destinations competition presents stories and best practices of destinations from around the world that are dedicated to sustainable tourism. The tourism sector, which has been facing challenging times in recent years, is creating a network of destination management organizations and offering long-term sustainable solutions through these examples.

Green Destinations (2023) is a global organization created in the Netherlands to support sustainable destinations, their businesses and their communities. Its core programs, the GD Awards and Certification Program for destinations, the Good Travel Program for businesses and the Top 100 Sustainability Stories are the main pillars of a country-wide stewardship

approach that they have developed and piloted. They developed a support program including over 40 assessment and reporting tools, including training courses. The aim of the organization is to promote a sustainable way of life in tourist destinations focused on ecology, climate change, innovation, recycling, community involvement and tourism sustainability.

Figure 2: Certificate of the 2022 Green Destinations – Top 100 Stories award for Nitra

Source: TIC Nitra (2022)

Nitra joined the competition of Green Destinations with the slogan "Let's inspire together!" in the Functional Communities category, in accordance with the Tourism Development Strategy in the city of Nitra for the years 2021-2031. The application was two-stage: within the first one, it was necessary to pass a sustainability test evaluated by international experts. Destinations that passed the first round described within the second stage an example of good practice of their destination. For Nitra, it was about the connection of different communities living in the city, the opening of self-government to citizens, the involvement of the public, and the focus on sustainability topics (TIC Nitra, 2022).

Nitra, as one of the oldest Slovak cities, significantly shaped the national identity of Slovakia. It was and still is an important agricultural centre thanks to the Slovak University of Agriculture (SUA) and the unique Agrokomplex exhibition centre. The old (settlement of the city from prehistoric times, numerous historical monuments, cultural heritage of St. Cyril and Methodius) intersects here with the new (industrial park with the largest Jaguar Land Rover car factory, modern functionalist architecture). Today, due to ongoing changes, the identity of the city has transformed into a modern industrial city.

The main problem/issue solved with the good practice was identified as the fact that the new industrial reality created the need to find a modern identity, combining respect for the past and tradition with the modern industrial city. A return to the roots through the support of traditional crafts, demonstrations of handcrafts, promotion of honey making and honey products, sensitive access to natural resources, discovering new possibilities for cultural leisure in public spaces and their transformation, as well as the education for sustainability, were the main ideas.

As for the implementation of the good practice, since 2020, several strategic documents for social services, sustainable mobility, climate and air protection, tourism, culture and the creative industries, as well as plans for planting and maintaining greenery in the city, have been prepared and subsequently approved. The Manual of Public Spaces and the new Urban Plan enabled a careful analysis of the current situation (with the participation of many institutions, actors of city life and the public), naming problems and creating action plans to eliminate them. The particular strategies have been approved gradually and are now being implemented.

The destination management organisation (DMO) was networking with local producers, revitalizing the regional brand, and developing marketing strategies to promote it (e.g. with events such as World Tourism Day, Honey Festival in the Botanical Garden, Dobrotrh in the City Market). Together, they have created a network of sales outlets for these products and revived them with interesting events in non-traditional places. Several workshops were held, which brought to the fore the development of a new brand and new communication strategy for visitors to the city and region. New public places were promoted (such as the Botanical Garden of the SUA in Nitra), artists supported and activities and events revived and transformed, focusing on traditions and increasing cultural awareness.

Among the key success factors that helped tackle the issues was the fact that all this has been achieved through proper cooperation and open dialogue between inhabitants, experts and public authorities. There were

many discussions, meetings and workshops between experts and the public, with new systems of communication introduced. The first contact point of the Community Centre for Work and Knowledge Mobility in Nitra (COMIN) has been established at the Municipal Office in Nitra, which provides counselling (not only) to foreigners. An important factor was also the active involvement and volunteering of the mayor of the city in several activities (and with employees of the Municipal Office).

There were plenty of lessons learned when facing challenges while implementing the good practice, starting from the everyday perception of the surroundings which can be changed into something unique with just a small intervention. In fact, the pandemic period enabled for people to return to nature, brought more free time and the desire to do something for their surroundings. Opening up to the public and making things and changes participatory meant a shift towards a better perception of the city by its inhabitants and thus by visitors. The core vision remains: to present Nitra as an open European city with respect for its past.

The main qualitative and quantitative results, achievements and recognitions of the good practice include (Green Destinations, 2022a, 2022b):

Together with the *Čistá Nitra* (Clean Nitra) initiative and volunteers, the 7 hills of the city were cleaned;

- Participating in the national volunteer project *Naše mesto* (Our city) through the Pontis Foundation and cleaning the Archaeological site and surroundings under the Zobor Monastery;
- 200 new trees were planted in the last 2 years; with many more being added thanks to the *Zelené mesto* (Green city) initiative *Zasaď strom v meste!* (Plant a tree in the city!) – a responsive web application that allows to participate in planting greenery in the city in a simple, modern way. Using the web or smartphone, everyone can mark the place where they would like to plant a tree. The app is also an aid in choosing locations for replacement plantings and also serves as one of the channels for informing about the planting of new trees.
- Activities to support hiking and cycling (revitalization of the gazebo in Zoborské vrchy, addition of playground elements, renovation of the educational footpath Zoborské vrchy with 6 information boards, renovation of the educational footpath Hradisko Zobor, info board under Zobor, free bike tours with a guide);
- During the pandemic, 6 virtual realities were created, with a virtual educational game app for children and families *Cesty mladého*

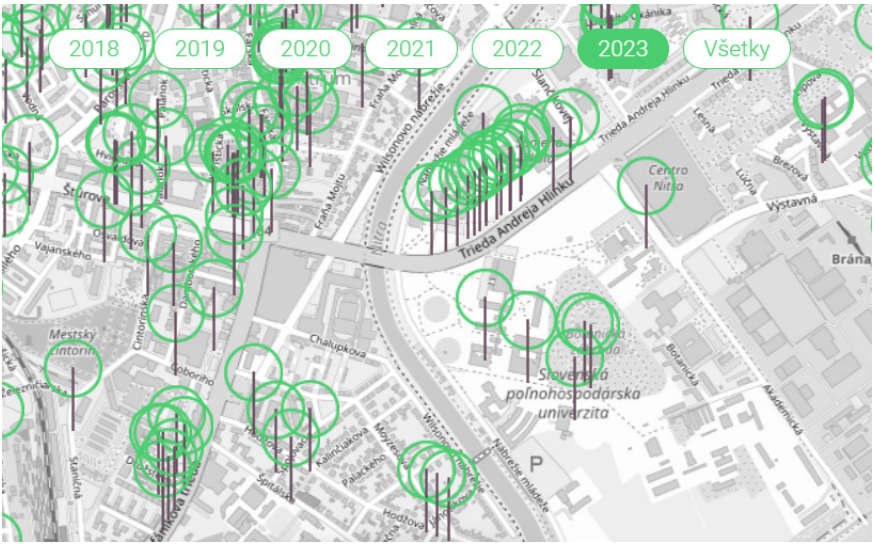


Figure 3: Map of trees planted within the Zelené mesto (Green city) initiative

Source: Zelené mesto (2023)

Corgoňa (Paths of young Corgoň) in Slovak, English and Nitra dialect, responsive website *Mesto v meste* (City in the city) with historical photos of the city, mobile app of *Nitra na 7 pahorkoch* (Nitra on 7 hills);

- The number of Ponitrie brand holders has increased from 17 to 38 members of primary producers and service providers;
- Events and workshops to support ecology, environmental protection, sustainability (Sustainable Nitra project) with the involvement of about 200 volunteers;
- Supporting the development of tourism, a via ferrata under the Pyramid hill was built;
- Formal and informal partnerships were established with 59 stakeholders in the public, non-public and business sector;
- The city has successfully implemented the CAF (Common Assessment Framework) model as its effective user, making the city more open and improved ranking by 3 places in the transparency assessment;
- Nitra became the first Slovak info point on the Cyril and Methodius Road;
- In 2021, it received the title Enviromesto in the field of air protection;

– Support of 15.5 mil. EUR was received for establishing a *Creative Centre Nitra* which creates a space for the development of creative talent, supports entrepreneurship in the field of CCI and brings a multi-genre programme for the general public;
– In 2022, the city received an EU support of 6.7 mil. EUR for green projects such as the restoration of the city park and the castle hill, revitalization of the inner blocks of housing estates on Štúrova street and the elementary school campus on Škultétyho;
– Through the *Menim moje mesto* (I'm Changing My City) support program, several public benefit activities and creative ideas of citizens were supported.

The *Udržateľná Nitra* (Sustainable Nitra) project is highlighted on the website of the TIC Nitra (see Figure 4). It includes a useful and practical circular map of the city of Nitra, which shows places that help create less waste. The map was prepared thanks to the cooperation of the Institute of Circular Economy and Human Progress. The current list and information about establishments include zero-waste stores (which offer local and organic food products, packaging-free goods, buying by weight or measure), honey making and stores, eco-friendly refill shops, and second-hand stores (with sustainable or upcycled fashion). The map also includes sustainable services such as libraries, bookstores, co-working centres, charities, as well as rental of cars, bicycles, scooters and other sports equipment. As part of the circular economy, sustainable services are also added, such

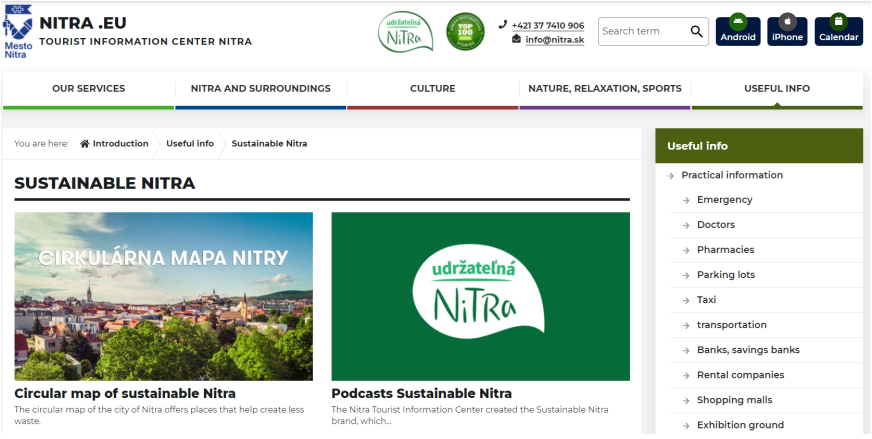


Figure 4: Screenshot of the website of the TIC Nitra

Source: TIC Nitra (2023)

as electronics and textile/shoe repair shops, tailoring, with ecological initiatives such as recycling centres, community gardens and composters or collection yards and points for cooking oil and other waste.

Questions and tasks for students

- What sustainability aspects are the key challenges in establishing sustainable cities and communities? Why?
- Select one of the 10 sustainable development modules or themes within the Applied Knowledge Framework of the SCI and apply it to a chosen city/town. What areas does it lack in?
- Read more about the Conceptual framework for urban environmental sustainability. Select one of the lenses, then assess and analyse a chosen city/town based on those criteria.
- Have your home city/town/village already introduced some sustainability initiatives? If yes, in what areas? Propose strategies to increase sustainability in your city/town/village and region.
- Compare the sustainability initiatives applied in the city of Nitra with the place you live at or a chosen city/town/village. What activities could Nitra be inspired by?

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Tram train is a new form of public transportation in Szeged Area (Hungary) to protect environment

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Problem description

1 Introduction

Indeed, there is a large number of people moving between Szeged (about 160,000 inhabitants, the third largest city in Hungary) and Hódmezővásárhely (about 45,000 inhabitants) on weekdays, and public transport to and from Szeged was represented by buses and trains so far. A lot of people use cars as well. The distance between the two bus stations is about 26 km and the journey is scheduled to take between 30 and 37 minutes (depending on the number of stops), but due to traffic jams on the roads most buses are delayed. Cars use the same time to catch destination, they cannot run faster. One of the biggest problem is huge number of vehicles on the roads so big emission. Diesel powered trains of MÁV-START also run between the two cities, but they have a low frequency (approximately hourly) and a maximum speed of 80 km/h. This situation causes environmental problems, which is not sustainable in the future.

2 Background

Tram-trains combine the tram's flexibility, and ability to penetrate city centre streets, with a train's greater speed, allowing quick and easy travel from suburban stations directly into the heart of towns and cities. A conventional train travelling into a city typically transports passengers from their local railway station to the city's railway terminus. Because large

numbers of trains are all heading for the same place, these railway stations can become very congested, with knock on effects for punctuality and reliability. Furthermore, on arrival at the station, passengers usually have to make an additional journey to reach their desired destination.
A tram-train allows passengers to board at their local station and continue their journey beyond the major city railway station, directly into the city streets, as the vehicle switches seamlessly from railway track to urban tramline. Passengers can alight at various tram stops along the way, meaning that no single place is overly congested and passengers can get off closer to the place they actually want to get to, whether that is the office, the shops or the cinema. Tram-trains can accelerate more rapidly than many heavier conventional trains which means frequent stops can be made whilst keeping end-to-end journey times attractive.
Essentially, tram-trains offer a direct service from near home to the traveller's real destination in the city centre, be it for work, leisure or shopping. Tram-trains also offer the potential for savings. They can make use of existing stations, railway tracks and tramlines, improving accessibility for passengers by connecting these assets up, rather than requiring the construction of expensive new infrastructure.
In operation, tram-trains have lower costs per kilometre compared to heavy rail. They are lighter than conventional trains, meaning less wear and tear on the track, and they can use diesel or electric power, thereby reducing energy costs (as well as noise and pollution) when in electric mode. With improved performance, particularly in braking, they may also offer the opportunity to simplify or eliminate signalling on some sections of the routes they use, again generating savings as well as enabling enhanced frequencies and protect environment.
The comfort and convenience offered to passengers (encouraging modal shift and higher revenues), combined with lower operating costs can also help keep fares affordable.
This system is brand new in Hungary. Construction of it is paid by European Commission (100%), so it is a pilot project for Hungary .

3 Discussion questions and tasks for students

MÁV-START started a passenger service on a new train-tram system in southern Hungary, connecting the cities of Szeged and Hódmezővásárhely by using the Szeged - Békéscsaba railway line as a train between them and

Figure 1: Tram train uses standard city tram tracks
Source: picture by author, 2021

in Szeged and Hódmezővásárhely working as a tramway, using the local tram lines. (Figure 1)
Tram trains run between towns around the clock on weekends at night in each hour the same time, and frequency of them design according to number of passenger flow on workdays maximum 4 times an hour.
The Class 406 Citylinks are three-car bi-directional low-floor vehicles with a 1,435 mm track gauge, a 100 km/h maximum design speed and a Bo' 2' 2' Bo' axle arrangement, which can run on the tram lines in Szeged and Hódmezővásárhely at 600 V DC with overhead power supply and on the non-electrified railway line connecting the two cities in diesel mode. In the electric mode, they have a maximum power of 4 x 145 kW and in the diesel mode, these trains are powered by two 390 kW Power Packs, mounted on the roof of the end cars. The maximum speed is 50 km/h in tram operation and 80-100 km/h in rail operation. The wheels have a diameter of 720 mm when new (640 mm when worn) and a minimum curve radius of 22 m. Vehicle weight is 71 t, length 37,200 mm, maximum width 2,650 mm and a height of 3,800 mm. There are four double-leaf entrance doors on each sidewall, with automatic sliding steps, the boarding height is 300 mm and 550 mm. The Citylinks are air-conditioned and equipped with CCTV and WiFi, have 92 seats (16 of which are folding) and space for up to 216 standing passengers (4 persons per m^2) and also offer two multi-purpose areas that can accommodate two wheelchairs or four prams.

Figure 2: Tram train Citylinks is made in Spain

Source: picture by author, 2021

Task for students

- Choose departure and arrival stops which are the same on the route of a) tram train and bus, b) tram train and train, c) tram train directly, d) by car. Compare the length of travel times.
- Check and compare fares, costs of journeys.
- How do you think about emission using different modes of transportation?
- Express your creative ideas how to develop tram train network in your region?

4 Further reading

The tram train still operates in relatively few places in Europe, there are examples to be followed in Germany and the United Kingdom. Based on the experience of the first tram train project in Hungary, the planning and preparation work of additional lines has already begun.
Szeged applied for and won support for the tram-train system connecting Szeged with Makó in parallel with the Hódmezővásárhely line. According to the completed preliminary plans, this will be a joint development with the construction of the southern Tisza bridge, which together with the

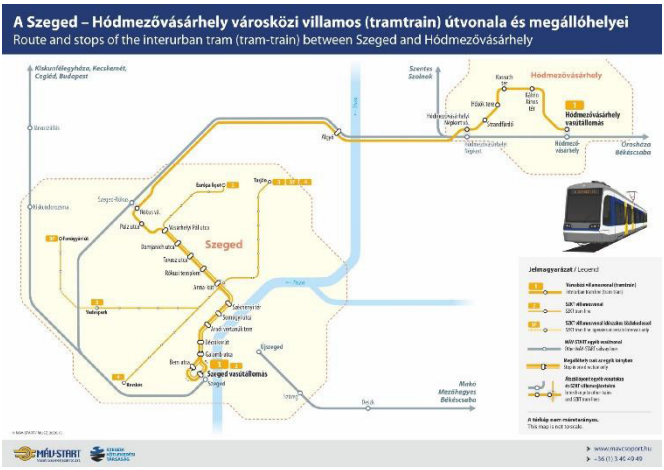

Figure 3: Tram train route

Source: https://szkt.hu/vasutvillamos-tram-train , 2022

Bertalan bridge would complete the Szeged boulevard. Since the Tisza bridge in Szeged was not rebuilt in II. after the Second World War, it is therefore planned to carry the railway over the new bridge, connecting the Békéscsaba – Kétégyháza – Mezőhegyes – Újszeged railway line, which had been cut off since 1946 and ended in Újszeged, with the main station of Szeged.

The impact on the environment is becoming more and more important in our lives. It is advisable to develop and use modes of transport that reduce the load on roads and improve the utilization of railway tracks. The length of the travel time is important for passengers, therefore connecting local and intercity transport solutions, so that travel without transfers can only be competitive. In addition to the time factor, emissions are an additional benefit in the long term. Passengers prefer this solution if the price of the tickets remains competitive compared to the cost of driving or the combined ticket price of the combined use of traditional modes of transport. It is natural that public transport cannot fully provide the comfort of private cars, but with modern vehicles it can be approached, and a different kind of comfort appears in tram train vehicles.

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Geothermal district heating in Szeged: Providing heating service in a sustainable way

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Problem description

1 Introduction

The Southern Great Plain region has the most favourable geothermal potential in Hungary. Taking advantage of this, a large-scale development started in Szeged in 2019, with an investment of around €70 million to set up a geothermal heating system in all parts of Szeged by 2023. The use of geothermal energy is one of the best ways to reduce energy costs and environmental pollution.

According to the Act on District Heating Services, the territorially competent local government is obliged to ensure the supply of district heating to the facilities provided with district heating services, which means that the organisation and provision of district heating is a mandatory municipal task, which the City of Szeged carries out through the district heating service company owned by the municipality (Szegedi Távfűtő Kft.; in short: Szetáv Kft. or SZETÁV).

Prior to the switch to geothermal energy, the city had a gas district heating system supplying around 28,000 homes and almost 500 institutions (nearly half of the city's housing stock). The combustion of 25-30 million cubic metres of gas per year released 50-60 thousand tonnes of carbon dioxide into the air, making SZETÁV the biggest air polluter in Szeged.

The modernisation of district heating and its re-foundation and partial conversion to geothermal energy is therefore an important condition for greening the city and making it climate-friendly. Thanks to the geothermal heating system upgrades that have been launched in the city, the com-

pany's gas consumption and thus its carbon dioxide emissions could be halved, with the potential for significant energy cost savings.
By the end of the development series, the nine geothermal systems will supply 96 percent of the district-heated homes and institutions in Szeged with green district heating, making the resulting geothermal district heating system the largest geothermal district heating system in continental Europe.
The construction and development of a geothermal heating system is an eco-innovation, as the heating system that is developed contributes to sustainable development. These developments will offer a form of district heating that creates business opportunities and benefits to the environment by preventing and reducing environmental impacts and optimising energy use by reducing the use of fossil energy and combining it with renewable energy.
The resulting district heating system based on geothermal energy can therefore be considered a green or sustainable service, as it minimises its environmental impact throughout its life cycle, in line with the current state of technology and science.

2 Background of the Szeged model of geothermal heat utilisation

The utilisation of thermal water is not a new activity in Szeged. Water exploration in Szeged started in the 1880s. The city's famous thermal spring, the Anna well, was drilled in 1927, at a depth of 944 m, and brings water to the surface at a temperature of 58 °C. The water was introduced into the steam bath on 2 December 1927, reducing its coal consumption by a third. Once the well was put into operation, there was no need to produce hot water with a steam boiler.
The 2000 m deep thermal well at the Faculty of Medicine of the University of Szeged was drilled in 1965, and two years later the first utilisation system was completed. The thermal water was used to heat the university's medical, educational and other buildings and to produce hot water for domestic use. In 1980, the first thermal well was drilled in Szeged for domestic use.
The project currently under completion is a direct precursor of the large-scale geothermal project in Szeged that started in 2013, when the con-

struction of a geothermal heating system capable of heating the University of Szeged building systems (clinics, faculty buildings, dormitories) and certain municipal buildings (medical clinic, municipal swimming pool, sports hall, municipal library) was initiated. Within the framework of the project, the thermal system was constructed in 2013-2014 for 36 institutions of the City of Szeged, the University of Szeged and the Biological Research Centre of the Hungarian Academy of Sciences in Szeged, including two extraction wells and 4 injection wells.
Most recently, a two-year project from 2017 to 2018, with funding of around €5.5 million, explored the potential of geothermal energy in Szeged. The research aimed to increase efficiency and reduce the environmental impact of investments.
After such a history, the construction of the largest geothermal system in continental Europe started in Szeged in 2019, resulting in the second largest heating system of its kind in Europe, after the system in Reykjavík, Iceland.

3 Brief overview of the Szeged model of geothermal heat utilisation

The improvements will supply geothermal energy to SZETÁV's heating plants. The projects will create new extraction and injection wells in the Északi, Tarján, Rókus, Belváros, Felsőváros, Makkosháza and Odessza districts, 1 700-2 000 m deep, which will produce thermal water with an average yield of 80 m^3/h and a temperature of 90°C.
The water extracted from the nine production wells is not fed into the district heating or domestic hot water networks, but is used through the heat exchangers of the heating plants and then returned to the deep aquifer through 18 injection wells. As a result of the projects, the district heating company will replace nearly 15 million m^3 of burnt natural gas per year with 350,000 GJ of geothermal energy, reducing the emissions of the SZETÁV by 25,000 tonnes of CO^2 per year, reducing the greenhouse gas load of the city's air.
As a result of the development, the share of renewable energy in the heating circuits concerned will be about 70%, and 50% for the entire district heating in Szeged, improving air quality and security of supply.
It should be made clear that, even with the use of 95 degree water from the deep to the surface, gas cannot be abandoned for district heating.

Water from the depths can be used to provide district heating down to minus 6-7 degrees Celsius, but if the temperature is lower than this, gas must be used to supplement it. According to SZETÁV statistics, no colder temperatures are recorded on 150 out of 200 days of the heating season, so gas is not needed at this time.

The essence of the project is that the district heating company in Szeged will use thermal water to replace part of the gas used for heating, which will significantly reduce the company's carbon emissions. In addition to the direct environmental impacts, it is important to highlight that the use of geothermal energy is estimated to be 15-20% cheaper than fossil energy, which could be up to 30-50% cheaper than conventional gas-based services. The investment was originally calculated to return on investment in ten years, but this calculation has been significantly over-estimated by high gas prices, shortening the payback period.

The project has involved drilling thermal wells and running pipelines from the wells to thermal centres, which were previously heated by gas boilers, where the thermal water, at around 90 degrees Celsius, is fed into a heat exchanger and piped through existing pipe networks to the houses and apartments for heating and hot water for use. The thermal water is therefore not transported to the homes, only its thermal energy is used, and it is then discharged to the injection wells, also part of the project, from which the 40-50°C water, which has already lost much of its heat, is returned to the ground.

Buildings to be heated with thermal water can be linked to so-called thermal circuits. A thermal circuit comprises thermal wells (one extraction well and two injection wells), consumer heat centres and a network of pipelines connecting them. All of the extracted thermal water will be injected back into the aquifer to ensure the sustainability of the system, which, with proper maintenance, will last up to 80 years.

The geothermal district heating system to be developed will comprise 27 wells, with two injection wells for each extraction well. When the system is fully developed, nine wells will be used to extract water for heat production and eighteen will be used to inject the water previously extracted. The system comprises the extraction wells and their two associated injection wells, the network of thermal pipelines connecting the wells to the thermal centres, the mechanical systems (e.g. pumps) and the heat exchangers.

4 Advantages of the geothermal thermal energy utilisation

Geothermal energy is a renewable and environmentally friendly energy source. Generally speaking, there are many advantages of using geothermal heating systems, the most important of which is that they use renewable energy during operation, i.e. they significantly reduce air pollution and greenhouse gas emissions of carbon dioxide. The system is characterised by a high efficiency, i.e. it can produce several times the amount of thermal energy per unit of energy input, which translates into lower operating costs.

It also offers a wide and varied range of uses (e.g. cascading, i.e. multistage energy recovery) and is an environmentally friendly solution that has the potential to shape the future. The fossil energy sources replaced not only reduce the environmental burden but also energy dependency, thus contributing to greater self-determination of municipalities and regions.

However, there are also disadvantages. The development of geothermal systems requires a significant investment, so the initial capital investment for their establishment is substantial. Furthermore, energy, essentially electricity, is needed to operate them, to bring the thermal water to the surface, to exchange and transfer the heat and to inject the extracted water back into the ground. As a result, the return on investment is medium to longer term, over 8 to 12 years, but is highly dependent on initial investment costs, operating costs and the market price of the energy (typically gas) replaced.

Environmental impacts are only expected during the installation of the thermal wells (air pollution, noise). In the case of thermal energy utilisation, emissions are the result of heating with a gas boiler.

Two things are important to note about the benefits. The first is the need for reinjection, and the second is the need for energy efficiency upgrades in heated buildings. The reinjection is important for two reasons: 1) to avoid the depletion of exploitable thermal water resources; 2) to avoid chemical contamination of the surface.

During reinjection, we increase the natural refilling of the system, helping to maintain reservoir pressure and prevent thermal and chemical contamination of the surface. The key to the sustainability of geothermal district heating operation is to inject the used thermal water back into the thermal storage layers. In this respect, the injection wells established in con-

junction with extraction wells play an important role. To ensure that the aquifers are not depleted and that geothermal energy is a truly renewable source of energy, the water must be reinjected after the heat has been transferred.
Each of the nine geothermal systems will be connected to a thermal centre and will be able to meet 40-50% of their annual heat demand. If the buildings were upgraded to make them more energy efficient, this figure could reach 90%. In this context, it is important to note that the system, which will be up and running by 2023, could be further expanded, but the conditions for this are not currently in place.
According to the district heating company, the whole city could be heated geothermally, but at the current temperature of 90 °C, the heating capacity is fully utilised. If they were to expand, buildings would have to use lower temperature heat, which would require major renovation of buildings or use in new buildings designed for lower temperature heating. Another problem with the system currently being rolled out is that 30 percent of the buildings attached to thermal circuits, predominantly panel buildings, are not insulated. As a result, the flats that have undergone the panel programme (insulation and replacement of windows) are overheated, while the rest of the residents feel that their flats are colder.

5 Operating green and looking green

The construction and development of the geothermal heating system in Szeged as an eco-innovation and the environmental benefits of the resulted sustainable district heating service are represented by the reinterpretations of several heating plants of the city in the framework of nature street art.
The CITY METAMORPHOSIS is a nature conservation street art programme of SZETÁV Ltd. and the Mondolo Association for Nature Protection and Sustainability, which aims to reinterpret the heating plants owned by SZETÁV from an environmental point of view. The programme also involved businesses and municipal institutions. So far, five heating plants in Szeged have been given a spectacular new look, environmental education messages and practical solutions reflecting the city's nature conservation problems.
The "Operation Pollination" project raises awareness of the importance of pollinators and the dangers of their depletion (Fig. 1). The "Swallow Nest

Figure 1: Operation Pollination

Source: https://urbanology.hu

Figure 2: Swallow Nest heating plant

Source: https://urbanology.hu

Heating Plant" project aimed to improve the habitat and breeding success of swallows arriving in the city, in addition to transforming the living environment (Fig. 2).

6 Questions and tasks

What tools, measures and ways can a city tackle climate change and reduce its ecological footprint?
What is the role of eco-innovations in cities? Give examples of successful eco-innovations.
How can settlements (cityes and villages) become greener in their operations and provide environmental benefits to their inhabitants and visitors?
Choose cities and compare them in terms of sustainability actions, eco-innovations and sustainable services.
What do you think are the most important factors influencing the future of a settlements? Explain and make conclusions.

7 Further reading

The website of the DARLINGe (Danube Region Leading Geothermal Energy) project, which was carried out within the framework of the Interreg Danube Transnational Programme, provide relevant and useful information on geothermal energy utilisation. https://www.interreg-danube.eu/approved-projects/darlinge

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Figure 2: Swallow Nest heating plant. Source: https://urbanology.hu/wp-content/uploads/2020/06/6-v%C3%A1rosmetamorf%C3%B3zis--fecskef%C3%A9szek-f%C5%B1t%C5%91m%C5%B1-mondolo-szeged--moln%C3%A1r-utca.jpg

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Proactivity and cooperation for the development of trolleybus service in Szeged (Hungary)

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Problem description

1 Introduction

Public transport is a special public service (public good) which is linked to sustainability in many ways. Perhaps the best tool to illustrate this can be

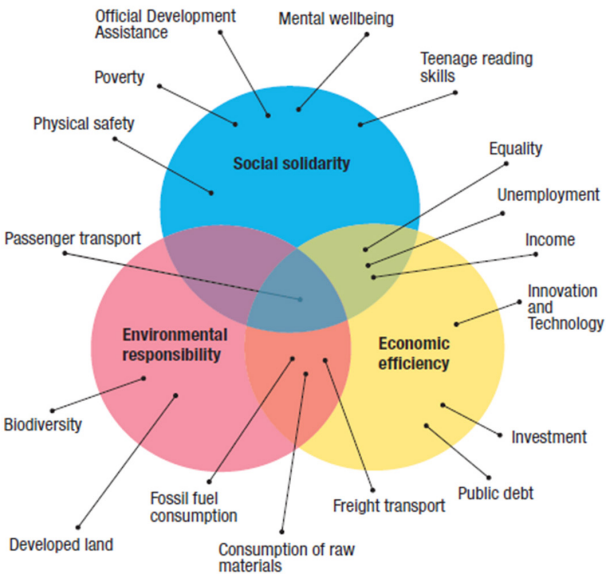

Figure 1. *Factors affecting the sustainability of the social well-being in Switzerland*

Source: SFSO (2013)

found in a report published by the Swiss Federal Statistical Office (2013). This report analyses the possible risks to the sustainability of well-being from the point of view of Swiss society. The figure below (Figure 1.) shows that public transport affects all three pillars of the classic interpretation of sustainability, and is located at their intersection.
In this regard, it is understandable that special attention should be paid to the development and greening of public transport because of its strong embeddedness in the social and ecological environment (Rupprecht Consult, 2019). In the following, we can learn about the characteristics of this special public good, as well as the challenges that the EU has to face in relation to achieving sustainable urban mobility. The case study points out how cooperation and application activity can help the electrification of public transport at the local level, the quality development of the service and the creation of special knowledge networks with partner institutions facing similar problems. This example focuses on the city of Szeged (Hungary) and its trolleybus system.

1.1 Public Transport as a special „public good"

The most important features of public transport can be seen as follows:

- there are no revealed preferences for public goods, including public transport (Holcombe, 1997),
- no market (benchmarking) indicators at hand,
- it is not a pure public good: urban service only locally disposable, not free for all (excludability) and rivalry (crowded vehicles),
- financed not only by public money,
- can be provided by private sector too,
- crowding out effect: due to too expensive public transport investments, there will be no source left for other important tasks,
- long-term thinking and holistic view are necessary,
- the positive effects and synergies develop in the long run,
- due to the above mentioned embeddedness, integrated approach is also inevitable,
- financial profitability emerges long-term or never, but it could induce positive social impacts (urban development, static competitive advantages…)
- no direct (evolutionary) selection on market: often monopoly situation or natural monopoly structure,

– regulatory tool: for instance it could underpin other regulations *e.g.* congestion charge,
– tries to solve several problems at the same time (*e.g.* market failures, urban development issues, „green" challenges).

development of public transport can provide an adequate answer to the challenges of the present and the future in relation with urban living. The most relevant issues are listed below:

– growing urban population,
– settlement structure and increasing number of commuters,
– need for reduction of traffic jams, accidents and air pollution,
– former financing logic (TENs, Trans-European Networks) vs. development of local transport - the latter has so far been neglected (European Commission, 2011),
– an integrated approach is required to solve complex problems (holistic view, follow-up of emerging patterns, impact measurement, etc.),
– negative externalities should be reduced, *e.g.*: by 2050, damages resulting from noise pollution will increase by 20 billion euros, while an increase of 60 billion euros can be forecasted as a result of traffic accidents,
– it should be compatible with EU strategic objectives (Europe 2020).

The European Commission's clear objective is to reach *sustainable urban transport,* which could contribute to freedom of movement, health, road safety, quality of life of present and future generations, environmental efficiency, inclusive economic growth, access to opportunities and services for everyone, including the disadvantaged citizens (elderly, disabled, etc.) The Commission supports research, tries to improve public financial management and promotes the dissemination of good practices, including such urban mobility plans, which are attractive and get people to use the public transport (European Commission 2004, 2011).

2 Background

The first trolleybus in Szeged started its journey on April 29, 1979. In the decades that have passed since then, trolleybus service in the city has developed, sometimes more slowly, sometimes more rapidly, but continuously. Between 1979 and 1994, the Szeged Public Transport Ltd. (SZKT,

est. 1885) provided 6 lines (including a feeder line) with a length of 28.2 km. Over the years, both the number and the length of the lines have increased (Nemes, 2019).
The SZKT develops its sustainable transport network with strong commitment. By shaping partnerships, many projects have been already successfully implemented during the years. Here, you will find details about the most significant ones.

Szeged electric public transport development project (On a new track)

Project purpose: the transport policy of the European Union encourages environmentally friendly public transport in the spirit of sustainable mobility. One of the strategic goals of the city of Szeged is to create attractive, high-quality public transportation, to reduce the use of private cars by making everyday travel faster and more comfortable, and thus to provide a livable environment for the city's residents.
Central European application/Trolley-project (www.trolley-project.eu): Szegedi Public Transport Ltd. received support from a successful application entitled „Trolley-Promote Clean Public Transport" within the framework of the Central Europe support program of the European Union with the leading partnership of the city of Salzburg. The project also involved additional partners: Brno (Czech Republic), Parma (Italy), Eberswalde (Germany), Leipzig (Germany), Gdynia (Poland), Gdnask (Poland) and the Trolleymotion organisation (www.trolleymotion.eu). The aim of the project is to promote and develop trolleybus service as an environmentally friendly means of public transport. In addition to ensuring sustainable development, its outstanding objective is to optimise the energy use of trolleybuses, increase their transport efficiency, and improve their appearance.

EU HORIZON 2020 – 636012 – ELIPTIC

Szeged Public Transport Ltd. together with 33 partner organisations, in addition to the leading partnership of the Bremen Transport Company, successfully applied for the ELIPTIC (Electrification of Public Transport in Cities) project.
The general goal of the project is to develop new concepts and business models, to optimise the existing electrical infrastructure and vehicle fleet with the aim of saving energy and money.
The company submitted its application for two model studies.

1. Making a feasibility study/demonstration test: Replacement of diesel buses with an extended trolleybus network, hybrid trolleybuses.

2. Making a feasibility study/presentation test (demonstration): Multipurpose use of the existing infrastructure for charging hybrid trolleybuses, e-bikes and e-cars (Németh and Dózsa, 2016).

LOW-CARB projekt

The main goal of the project is the planning of urban mobility related to low carbon dioxide emissions and the promotion of public transport with low carbon dioxide emissions.
In accordance with these objectives, the company prepared its route planner, which was also supplemented with CO^2 emission data. By using this, everyone can check the carbon footprint of their trip and can also look for alternatives to travel with a smaller carbon footprint.

Trolley 2.0 Project – Trolley Systems 4 Smart Cities

In the Trolley 2.0 project, a wireless-driving function will be integrated into the experimental trolleybus, which will be made possible by an advanced battery drive. At the same time, the battery packs will be charged on the go („in motion" charging).

Green Bus program

Procurement of environmentally friendly, climate-neutral urban, electric-powered passenger vehicles. By purchasing new trolleybuses, the aim is primarily to provide high-quality, passenger-friendly service to the existing trolleybus lines.
Within the framework of the project, four pcs. full low-floor, uniform design, new, passenger-carrying, battery-powered, self-propelled, solo trolleybuses will be purchased and put into operation.

3 Discussion questions and tasks for students

One of the several efforts that reduces negative environmental effects and boosts urban sustainability and resilience is the development of public transportation. In order to increase energy efficiency, reduce local emissions of dangerous substances and lower noise pollution, public transportation must be electrified (Wołek et al., 2021).
In order to achieve a positive impact and synergies, significant financial resources, special technologies and knowledge are needed. Proactive and

successful application activity, creation of knowledge networks and professional cooperation contribute considerably to realisation of favourable effect, especially when there is a shortage of certain resources.

Task for students

Task No. 1.

– Consult with your groupmates and formulate incentives and suggestions that can be used to educate drivers in order to prefer green public transport instead of their car. Please, argue for your suggestions!

Task No. 2.

– Please, conduct a survey at your own university or residential area (min. 50 people) and explore the ideas, expectations and needs that are expressed in relation to sustainable public transport! Analyse the answers, formulate proposals based on them and present the results.

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Green University – some practical examples in line with the sustainability, the case of the University of Szeged (Hungary)

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Problem description

1 Introduction

As their education, research & development actions and community involvement can result in long-lasting environmental effects and societal change, universities play a key role in tackling global environmental concerns. Universities have many, multiplier effects on society by using best practices in their operations.

According to Ralph and Stubbs (2014) strong policy environments, funding for initiatives, support of leaders and environmental sustainability advocates are crucial in enabling universities to make the transformational changes required to integrate environmental sustainability across all university departments. Educating, raising the awareness of university staff, students or the future generations on the relevance of environmental sustainability is key to a successful green strategy (Leal Filho, 2010; Ralph and Stubbs, 2014).

It is presumed in general that green universities could contribute to the sustainability performance the most in comparison with other public sector institutions. In this context universities can influence or manage sustainability by internal (*e.g.* sustainability strategy, green university projects, pro-environmental initiatives, special curricula and research activities) and external (*i.e.* the third mission of universities) achievements.

Therefore, universities are expected to engage in sustainability both internally (*i.e.*, as an organisation) and externally (as an influential actor in the region). As organisations, universities contribute most to the student's personal attitudes, worldview, values, environmental knowledge and pro-environmental behaviour (Dagiliūtė et al., 2018; IARU, 2019).
The greening of universities is therefore desirable and forward-looking for society as well. The question is how to manage external and internal implementations in order to achieve the greatest possible positive impact.
Reviewing good and best practices then using them as benchmarks can help in this manner. This case study presents the efforts of one of Hungary's greenest universities, the University of Szeged (SZTE), with a focus on the Study and Information Center (TIK). This Center is the most important hub of the university's internal network. Both students and teachers of the university's faculties can use the high level services, and it also provides space for the development of formal and informal relationships.

2 Background

In the 2021 UI GreenMetric World University Ranking, the University of Szeged stepped forward from 86th to 85th place, making it one of the greenest universities in the world, as well as in Europe and Hungary by now. SZTE jointly with the University of Pécs for first place in the area of „Setting and Infrastructure" and second place in the indicator of „Water" respectively (SZTE, 2021; UI Green Metric, 2021).
The University of Szeged is strongly committed to environmental awareness and sustainability, stressing the significance of sustainable development goals and making extensive use of renewable energy sources like geothermal energy, greywater and solar power. The university also serves as the Hungarian coordinator of the UI GreenMetric International Network. In addition, several mid-year student awareness-raising events and energy-reducing improvements play a crucial part in SZTE's life. Some examples are as follows (SZTE, 2021):

- SZTE supported the procurement of full electric vehicles, which suits the University's green philosophy. The five electric cars are used for internal mailing tasks as well as emergency blood transport;
- SZTE maintains close relations to the experts and network member institutions of the UI GreenMetric Network in order to share knowl-

edge and good practices, to launch an international sustainability course and to help the work dedicated to awareness-raising and social responsibility;
- as one of the „greenest" HE institutions in Hungary, SZTE places a strong emphasis on expanding green procurements and green services to set a positive national and international example;
- University of Szeged established SZTE *Greennovation Center*, whose vision is to become an internationally acknowledged research, development and innovation center that empowers innovators to develop world-class solutions in the field of green technologies for sustainable development and a liveable future;
- the University supports the green ideas and solutions of the Study and Information Centre (TIK), which is the best-known hub of university life even for outsiders.

The Study and Information Centre strives to elaborate and use creative, inventive methods, which will most likely have preventive, cost-saving and attitude-shaping effects. The list below contains the most important measures and services which also could serve the wider community:

1. Providing green events and sustainable catering

- the Center encloses Green Event Recommendation to every offers,
- opportunity for all or individual attendees to be involved in carbon offset program during and event or conference,
- during events the Center acts socially and environmentally responsible and/or organises social programs that support local environment actions and social entities,
- use of seasonal food only and *low food mile catering* provided by its catering partner,
- beverages and other foods served in bulk to minimise packaging and waste,
- possibility to choose a fair-trade coffee break.

2. Waste minimisation

- selective waste collection across the Center,
- providing selective waste collection on all events.

3. Energy efficiency

- elaboration and communication of a detailed environmental energy policy,
- installing solar panel to generate warm water,
- economic mode of electric machines and electronic devices,
- medium-power LED lighting,
- central control of temperature and lighting.

4. Trees for life

- planting trees and flowers to the Center's park improving soil and air quality,
- they use indoor plants to improve air quality, as well as, to make the work environment more desirable.

5. Environmental arrangements

- use of recycled paper and stationery, such as scrap paper for notepads,
- double-sided printing when it is necessary,
- Earth Day Event in every year and online Green News for employers,
- use of biodegradable cleaning products including soaps, as well as recycled paper towels and toilet paper (SZTE, 2011).

As a result of the favourable perception of the initiatives and their results, the Center has been recognized with numerous awards:

- „Architecture Public Award of the Year" (2008),
- „The most greening office" award at the Green Office competition announced by the KÖVET Association for Sustainable Management (2009),
- „Creative Special Award" at the Green Office competition announced by the KÖVET Association for Sustainable Management (2010),
- „Runner up" award in the Special Projects category of the FIABCI international real estate development competition (2010),
- The OECD chose the Center as one of the most significant educational investments of our time,
- „Cycle-friendly workplace" title (2010 and 2011).

3 Discussion questions and tasks for students

The concept of green universities obviously has numerous advantages, but at the same time, its implementation does not seem to be common. In the literature, the factors that are most influential towards green engagement, as well as those that hinder its introduction, can be found (Ralph and Stubbs, 2014).

Main factors affecting the integration of sustainability into the operation of universities:

- ethical obligation to address sustainability issues,
- universities have a moral obligation to educate the future's decision makers and develop special knowledge that can help create a sustainable environment based on their pool of knowledge and research capacities.
- due to their widespread social influence and presence, they must set a good example in connection with their solutions.
- universities are under pressure from their stakeholders to address sustainability by offering answers to the global challenges and by leveraging their expertise to give a voice to the formulation of national and international policy.
- the improved brand and reputation brought about by environmental leadership within the society can also help institutions become more financially viable through higher student recruitment and through cost savings by increasing environmental efficiencies.

Limiting factors in general:

- according to the literature the main barriers to integrating sustainability into universities stem from internal issues,
- limited resources and competing priorities, including intertemporal decisions focusing on different types of savings,
- lack of understanding and awareness of pro-environmental transformation,
- resistance to change,
- operations, teaching, research, and outreach are not synchronised because of the lack of a coherent institutional perspective.

In summary, we can conclude that the greening of universities has the following specific benefits:

- cost reduction,

- increasing the credibility of pro-environmental education and research activities,
- promoting the third mission of universities, especially in the field of sustainability,
- it can be a place to test pilot projects,
- building a green image.

Task for students

Task No. 1.

- In your opinion, what other areas of university operation may be affected by greening? Please, support your answers with arguments.

Task No. 2.

- Please, prepare the stakeholder map of your university! Make suggestions regarding how the university could enhance its educational activities and its effects on sustainability for the individual stakeholders along the interactions of each link.

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Public transportation in cities

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Problem description

The development of public transportation in cities is a response to some key sustainability issues. The most directly it refers to 11th Sustainable Development Goal in United Nation Agenda 2030 to "make cities and human settlements inclusive, safe, resilient, and sustainable". As transport systems significantly impacts on the environment, accounting for between 20% and 25% of world energy consumption and carbon dioxide emissions, it is essential to implement sustainable transport, which minimalizes the negative effects. Target 11.2: "Affordable and sustainable transport systems" refers directly to aim of "expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons by 2030". Sustainable transport should be safe, affordable, and accessible for all.
Miejskie Przedsiębiorstwo Komunikacyjne w Poznaniu Sp. z o.o. (**MPK Poznań**) is a carrier that provides transportation service in accordance with the order of the organizer of public transportation in Poznań, one of the biggest cities in Poland.

Miejskie Przedsiębiorstwo Komunikacyjne w Poznaniu (MPK Poznań)

1. Description of the business project

The origins of public transportation in Poznan date back to the mid-19th century. The first regular horse-drawn tram line began operating on July

31, 1880. From 1891, horse-drawn omnibuses transported passengers from the railroad station to the city, and in the summer also to resorts on the outskirts of Poznan. In 1880, the Poznań Horse Railway Society was founded and was granted the rights to build and operate tramway transportation in Poznań. Passenger transportation by electric traction street cars began in Poznan in March 1898, initially along horse-drawn tram routes, which were rapidly expanded.
After formal transformations of legal status, currently **Miejskie Przedsiębiorstwo Komunikacyjne w Poznaniu (MPK Poznań)** is public transport provider with over 140 years of tradition, being a limited liability company of the Municipality of Poznan. Authority of Poznan is the only owner of MPK, possessing 100% of ownership. The registered office of the Company and the area of its operations is the City of Poznań.

2. Strategic goals of MPK Poznań

MPK Poznań strives to build the Company's brand as "My Friendly Poznań Transportation" by encouraging passengers, residents and employees, to participate in the life of public transportation and MPK Poznań. The Company makes every effort to recognize and meet the needs of the City of Poznań and all residents.
In 2021 MPK Poznań employs more than 2,200 employees, of which bus and tram drivers are the largest number (52.62% of total employment), followed by transportation and technical services (34.33%), administration (10.28%) and finally management (2.77%). In 2021, despite the restrictions on public transport due to the COVID-19 pandemic, MPK Poznan carried out 30,370,000 kilometres of transportation, of which 37.2% were tram-kilometres on tram transport and 62.8% were bus-kilometres on bus transport. In 2021, MPK Poznań had an average of about 600 means of transportation, both buses and trams.

3. Identification and characterization of the business model

MPK Poznań delivers the following activities:

- Conducting transport services on the territory of the city of Poznań and intercommunal
- Conducting transport services for passengers and freights
- Running trams and buses

- Management of rolling stock (dispatching trams and buses to transport lines in accordance, daily supervision of the fluidity of public transport, elimination of the consequences of traffic incidents, training of employees, vehicle rental),
- Maintaining the smooth running of MPK vehicles through the actions of emergency and technical crews and Traffic Supervision employees
- Maintenance of track and network infrastructure (current repairs),
- Maintenance of tram stops,
- Transportation and operation of tourist lines in the summer season,
- Operation of Vehicle Inspection Station,
- Rental of advertising space on trams and buses.

MPK Poznan carried about 230 million passengers annually.
MPK Poznań operates 91 transportation lines, of which 74 are day lines and 17 are night lines. Most of these lines are bus lines, there are 57 day bus lines and 15 night bus lines, while 17 lines are day tram lines and 2 night tram lines. The length of these lines is over 1100 km, around 850 km of day lines and 300 of night lines.
The bus and tram fleet consisted of 273 trams and 293 buses in 2021. MPK Poznań is pursuing a policy of replacing worn-out rolling stock with new technological equipment that meets environmental standards and enhances passenger comfort. Of the 293 buses owned in 2021, 1 bus was hybrid and 58 buses were electric (Solaris Urbino 12 and Solaris Urbino 18). It means the increase of 37 electric buses year-to-year, as 21 electric buses were in operation in 2020.
Transport services are the main source of revenue, accounting for 97.8% of it. Revenue dynamics amounted to a 15% increase in 2021 compared to 2020, but public transportation was affected by COVID-19 roadblocks and restrictions in those years. Despite the smaller number of tram lines and their shorter lengths, tram transport generated over 54% of revenues.
The punctuality rate in public transportation is one of the most important features. In 2021, MPK Poznań managed to reach the punctuality rate equals to 94.31% for tram transport and equals to 96.37% for bus transport, which were at higher level than the expected.

4. Company Value Network

MPK Poznań is closely connected with its Owner - the City of Poznań. Investments aimed at meeting the standards of public transport services

are possible only with the support of the City of Poznań authorities. The implementation of investments requires financial outlays, being feasible only with the support of the local authority.
MPK Poznań cooperates with Zarząd Transportu Miejskiego (ZTM) in Poznań, as ZTM formally orders transportation services from MPK Poznań. MPK Poznan's cooperation with ZTM is aimed at developing standards for transport services and optimizing the use of tram and bus infrastructure.
Since MPK Poznan is a public company, it must work with its suppliers based on public procurement law.

5. Corporate culture

The corporate culture of MPK Poznań base on seeking personal and professional development for all its employees. MPK Poznań provides its employees with access to knowledge, assistance in acquiring higher and specialized qualifications, opportunities for retraining and changing positions throughout the company.
While it's true that about 40% of the workforce has been on the job for less than 10 years, MPK Poznan also employs about 6.5% of the staff for more than 40 years. The largest group of employees (17.1%) is aged 51-55.

6. Organisational setup

As public company, employing around 2,200 people, the organisational structure of MPK Poznan reflects its legal nature and areas of activities. There are three authorities of the company:

- Shareholders' Meeting - single-handedly handed by the Mayor of the City of Poznań,
- Supervisory Council - composed of 4 members appointed by the Shareholders' Meeting, and 2 members elected by employees of MPK Poznan.

Management Board - composed of President and two Members of the Management Board, being the Deputy President for Economic and Financial Affairs, and the Deputy President for Technical Affairs.
President of MPK Poznań leads the Human Resource Division, Management Office, Public Relationship Office, Team of Quality Management and Internal Control, Bus Transportation Department, Tram Transportation Department, Traffic Supervision Department and Traffic Engineering Department.

Deputy President for Economic and Financial Affairs is responsible for Accounting Division, Logistic Division, Team of Environmental Protection, Team of Property and Casualty Protection, and Controlling Department.
Deputy President for Technical Affairs manages Technical Facilities Division and Infrastructure Division, as well as Department of Planning and Procurement of Materials for Technical Support and Department of Company Emergency Services.

7. Company strategy

MPK Poznan is implementing modern solutions for transport safety, aiming at reducing the negative impact of public transport on the environment in the following aspects:

- air protection (reduction of transport emissions),
- protection of the biosphere and land (green areas),
- protection of the soil and water environment: (control of soil and water near the filling station),
- waste management (selective collection and waste minimization),
- water and sewage management,
- Reduction of traffic noise (repair and maintenance of track infrastructure and tram fleet).

Digitalization supports MPK Poznań in conducting a policy of open communication with passengers, communicating operating rules, ongoing investments and changes in public transport.
MPK Poznań strives to support people with disabilities in public transportation, both through investments in rolling stock and stops accessible to all, but also through the "myMPK" ICT application for the blind and visually impaired.
MPK Poznań is also active in the city's cultural offerings, by honouring anniversaries and events closely related to the history of Poznań, the history of its public transportation, as well as by organizing meetings and festivals for residents.

8. The role of innovation and investments in the company

Investments and innovations introduced by MPK are designed to improve the comfort of passengers, city residents and protect the environment.
Renewal of the bus fleet allowed MPK Poznań company to achieve a bus fleet ratio meeting the Euro5 or Euro6 emission standard (including most

EEV) of 67.2% in 2021. The structure of buses used by MPK Poznan based on their emission standards is the following:

- ELECTRIC - 17,2% of buses,
- Euro 6 - 17,8% of buses,
- EEV (>E5,<E6) - 47,3% f buses,
- Euro 5 - 2,1% of buses,
- Euro 4 - 0,9% of buses,
- Euro 3 - 14,8% of buses.

Installations of water recovery circuit, a water treatment station, and recirculation and replacement of the oil-derived substances allows implementing the idea of circular economy and mitigation of water waste. Thanks to this, in 2021 water consumption by MPK Poznań was reduced by 12% compared to 2020.
The following investments are done to reduce the energy consumption:

- construction of charging infrastructure for road public transport,
- charging stations for electric buses,
- replacement of lighting with LEDs,
- thermal efficiency improvement related to the transformer station building,
- replacement of oil-immersed transformers with dry-type, transformers,
- execution of works on the traction network: replacement of an SN-15 kV cable line, and reconstruction of the 600 V DC power supply system,
- modernisation of the switch on the tram terminal (small circle entry),
- purchase and installation of a modern overrun switch drive together with the control system,
- provision of the switch with the electric drive,
- control and heating system of the switch.

In 2021, thanks to equipment of trams with braking energy recuperation, the energy consumption was reduced by about 10,018,981 kWh, and the amount of CO2 emitted into the atmosphere during electricity generation was reduced by about 9,600 tons.

9. Future prospects

MPK Poznań's vision is to continue the development of the Company, based on the improvement in the availability of services with the optimization of operational costs and more effective use of human, material, IT and financial resources.
MPK Poznan is continuing an investment to renew the Company's fleet, specifically replacing more buses. The development of the existing fleet is aimed at meeting the highest standards of emission standards and equipping the rolling stock with modern technologies with solutions to reduce fuel consumption (e.g. Mild Hybrid).
Improving the bus and tram fleet makes it possible to achieve a high level of passenger comfort and safety. At the same time, replacing the oldest buses contributes to improving air quality in Poznań, and consequently to improving the standard of living in the city.
MPK Poznan is also developing ICT systems and service availability in the IT area to increase the security of access to data and the IT environment, secure data processing in the physical areas of tram and bus stops, and increase the availability and quality of transport service information for passengers.

10. Keys to success

MPK Poznań is public transport operator, delivering public transportation for passengers in Poznań, one of the biggest cities in Poland. During over 140 years of history of public transport in the city, the success of MPK Poznań has been achieved thanks to the permanent investment in passengers safety and comfort, cooperation for the benefit of residents, ensuring high quality services while reducing environmental nuisance for the city and its residents.
As affordable and sustainable public transport is one of the SDGs of Agenda 20230, the further improvement of service quality is expected to be done by MPK Poznań.

Questions for undergraduate students

- What kind of activities do you recommend to undertake, to promote public transportation in cities?
- Which groups of residents should be encouraged to use public transportation? What marketing instruments can be applied to each of these groups to increase their use of public transportation?
- What activities should the company take to make public transportation more environmentally friendly

Questions for postgraduate students

- What kind of promotional campaign would you recommend to promote the idea of public transport? Why?
- What kind of social partners should the company collaborate with to make public transportation more environmentally friendly? How the collaboration should focus on in the case of different stakeholders?
- How should green innovation in public transportation be financed?

The peculiarities of the Social Project in Maluku

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Problem description

1. Introduction

The Sisters of Blessed Marija Petković - The Order of the Daughters of Mercy[1] is a non-profit religious organization. This organization was founded in Blato on the island of Korčula on October 4, 1920. and operating worldwide with more than 290 sisters in 5 continents. The sisters follow the example of Blessed Marija Petković, the founder of this order, who founded the Order last century, caring for orphans, the sick and the upbringing and education of socially vulnerable girls. The mentioned sisters have always supported mission work, which resulted in the expansion of their activities to Argentina, Chile, DR Congo, etc... In 2019, the sisters launched a Social Project in Maluku, 70 km from Kinshasa, the capital of DR Congo (see Figure 1). It is a social project that aims to improve the difficult living conditions of the local population in order to provide basic educational and social prerequisites for life as well as stimulate agriculture in that area.

The aim of this paper is to point out the importance of developing humanitarian projects in third world countries. Management is particularly important in mission activity, as well as solving the issues of collecting financial resources, cooperation with the local community, project management, and other important topics faced by the sisters, i.e. their organization, which wants to achieve an important social impact on the local

[1] Figlie della misericordia del TOR di San Francesco - FDM

population's quality of life. In this work, we pay special attention to the role of religious communities, especially women's ones, in the implementation of mission activities, emphasizing the importance and role of social and women entrepreneurship, which are the key features of this social project.

The specifics of the management of non-profit organizations such as the case of running social project in Maluku derive from the specificities and mission of non-profit organizations. Non-profit organizations are those organizations that have a social mission, are agents of social change and are focused primarily on social goals, not economic ones like profit-oriented organizations Marić (2018:240).

Another special feature of this Project is specifics of social entrepreneurship, especially female entrepreneurship. Finally, the connection between management and spirituality, more precisely religious organizations, is possible, which is written about by numerous authors, including Marić, Belak, Kovač (2019.), etc., and thus various initiatives of alternative forms of business appear where social entrepreneurs have expressed values of solidarity, humanity, the need for cooperation, dialogue, respect for diversity, but above all respect for the dignity of the person and the need

Figure 1: Maluku project – DR Congo

for concrete help, which includes education, but also the growth of the individual and the community. The consequences of such business activities are new companies and initiatives of social entrepreneurs, such as the social entrepreneurship of the company Economy of Community - following authors state more about it: Marić, Aleksić (2015.); Magzan, Milotić, (2010) and Marić (2015.)

Social project in Maluku (Democratic Republic of Congo is excellent example of social entrepreneurship and project management in field of humanitarian work and it is created by guidance of Nouns Blessed Marija Petkovic. In the mission of the company, the guiding idea is clearly expressed, i.e. the mission of the company itself - "The charisma of the Founder encourages and obliges us to build a culture of life, which protects life and accepts it as a gift from God from birth to natural death." We are called to recognize the greatness and dignity of every human being, especially the sufferer. We ask blessed Marija Petković for intercession, she, who was sensitive to social injustice, stood up for families, children and young people."[2]

This project is very specific because it has characteristic of women entrepreneurship and connected with mission of catholic religious organization. But this project goes beyond religious dimension giving perspective of ensuring education and medical help and providing resources for agriculture … has a strong social impact for the local community in a way of ensuring sustainability for local inhabitants. Due to understanding elements of this project it is necessary to explain essentials of social entrepreneurship; women entrepreneurs and operating the Congregation of Sisters of Blessed Marija Petković. It should be pointed out that the community of Sisters of Blessed Marija Petkovic is originally a Croatian community of international character that was founded in Blato on the island of Korčula and today has its headquarters in Rome.

2. The Social Project and women social entrepreneurship

Social entrepreneurship represents the creation of socioeconomic structures, connections, institutions, organizations and measures that result in sustainable social benefits. Generated profits are used for the benefit of certain oppressed social groups.

Social entrepreneurship has become a worldwide phenomenon , generating great interest and an extensive literature. (Worth, 2013: 385) In the strive for excellence, the organizations in modern business environment often have to reconcile conflicting goals and aspirations in order to reach not only market and economic but social goals as well. As a result, social entrepreneurship and social enterprises have emerged as the new business phenomena. (Marić, Aleksić (2015: 1028) Social entrepreneurship addresses different types of stakeholders. That fact gives legitimacy to social entrepreneurship; it implies that in all sectors of society there is sup-

[2] http://marijapropetog.hr/provincija/vjera/povijest pristupljeno 9.02.2023.

port and open- mindedness to new solutions and approaches in solving social problems (Baturina, 2013:138- 139).

A social entrepreneur is a person who takes risks, takes actions, creates values for society and initiates positive changes: it is an agent of social and economic change who plays a key role in changing the public sector and the perception of certain social issues.

Social entrepreneurs are considered to be the changing agents in the social sector by engaging in a process of continuous innovation (Dees, 1998). Social entrepreneurs make significant and diverse contributions to their communities and societies, adopting business models to offer creative solutions to complex and persistent social problems (Zahra et al., 2008).

A social entrepreneur is a person who is a visionary, a restless spirit, sensitive to injustice, an idealist, but at the same time a person of action who sets things in motion and creates changes, one who does not give up and does not accept failure. We cannot understand social entrepreneurship without the alphabet of non-profit organization management. with this aim, we will also explain the basic concepts of the activities of non-profit organizations, which includes: mission, social influence, volunteering, efficiency, measurement and management concepts of non-profit organizations, the complexity of their management and social innovation Marić(2018.b)

Female entrepreneurship has all the characteristics of social entrepreneurship, but something a little different, in the field of religious organization the role of woman is huge especially in humanitarian work. Schumpeter (1956.) stresses „Women entrepreneurs are those women who innovate, initiate or adopt a business activity".

In short, women entrepreneurs are those who envision a business enterprise, initiate it, organize it, combine factors of production, operate the enterprise, undertake risks and handle economic uncertainty involved in running it. Characteristics of women entrepreneurs:[3]

1. risk bearer
2. self-confident
3. independent
4. innovative
5. information seeker
6. looking for opportunities
7. persuasion

[3] https://www.entrepreneur.com/leadership/8-qualities-female-entrepreneurs--need-to-succeed/428136

8. proper planning
9. efficient monitoring
10. ability to mobilize the resources
11. foresight and vision
12. quality conscious
13. good organizer
14. feedback
15. open mind
16. technical knowledge
17. business secrecy
18. high motivation
19. mental ability
20. intelligence

3. The peculiarities of the Project Maluku

Following the example of their founder Blessed Marija Petković, who sent her Sisters to faraway Argentina in 1936 on missionary work, they decided to travel to the unfamiliar regions of the African continent. On September 8, 2019, the nuns opened a new community in Maluku, 70 km from Kinshasa, the capital of the DR Congo. The Social Project was born from living together with the local population and observing their way of life and their needs.

Upon their arrival, the sisters immediately began fulfilling their mission. They lived in a rented house and used a rented car and have started to accomplish their social impact in the local community.

The Order of the Daughters of Mercy is a non-profit organization with religious mission founded by Blessed Marija Petković) and it is the carrier of this Project. Today it has 400 sisters around the world in a dozen countries, and only a few are in Maluku.

The Maluku Project in the DR Congo is a social and agricultural project that aims to strengthen the local community and provide a better life for the poor and needy local population. The purpose of the Social Project has triple goals: (1) Acceptance, care and integral formation of children and young people, (2) Acceptance and care for left-behind children and (3) Help for the sick.

Specific characteristics of this social project as original are: 1.The founders are nuns/women/social entrepreneurs and members of the project and 2. The aim is social, educational, and agricultural development of the local community.

Despite many obstacles, the resilience of this project is in the strong charisma of the leadership of FDM (Figlie della misericordia) nuns - servant leadership style, donors, and local population as volunteers.
Finally, the significant social impact of the project initiates woman's self-esteem, reflected through the efforts to provide a better and safer life, enable education, develop a local community through agriculture and a variety of entrepreneurial projects.
There are several challenges Sisters are faced everyday and they have to solve it as soon as possible to ensure finishing the Projects and to fulfill their mission. Those challenges are:

- Construction of the road to the field where the house for the sisters and the casa famiglia are being built
- Water supply – getting solar wells...
- Energy independence– buying an electricity generator.
- Home and farm security.
- Securing funds for the completion of the monastery – building of the 'casa famiglia' has been financed by the Bishops' Conference of Italy
- Insurance of financial resources for agriculture (some money has been insured, but not enough)

The Sisters faced numerous challenges and problems, but their courage, heart and kindness prevailed so that this project continues and fulfills its mission.The issue of the project management, fundraising, construction of the whole complex, novelty of involvement in agriculture, cooperation with the local population, finding experts and donors, reporting about projects are just some of the challenges they face daily in implementing this project and have to be resolved effectively by management. This is precisely why it is important to understand the specifics of the charisma of this community, but also the essence of social entrepreneurship, especially female entrepreneurship, in fulfilling social influence in a local community like this one in Maluku, where there are specific problems and a vulnerable population that needs help.

4. Conclusion

The Order of the Daughters of Mercy is a non-profit organization with religious mission (founded by Blessed Marija Petković) and today has 300 sisters around the world in a dozen countries. The Maluku Project in the DR Congo is a social and agricultural project that aims to strengthen the

local community and provide a better life for the poor and needy local population. Project management, fundraising, construction of the whole complex, novelty of involvement in agriculture, cooperation with the local population, finding experts and donors, reporting about projects are just some of the challenges they face daily in implementing this project.
Despite numerous difficulties and obstacles, this project is a bright example of successful social entrepreneurship and confirmation that even small efforts can improve life in the local community. It is interesting that a small venture of the Sisters of the Order of the Daughters of Charity of Blessed Maria Petković is making an important change in the community, first by giving hope to the local residents and helping in education, but also in the social and development sense, designing agricultural potentials and training the residents to learn, become more connected and empowered.

5. Discussion questions

1. In which country does this social project take place?
2. What areas of activity do the nuns have in the project?
3. What do you think, why was the DR Congo in Africa chosen for the project?
4. How could they secure financing for this project? Suggest some ideas!
5. Are you personally interested in this type of missionary activity as a volunteer?
6. Explain how, in your opinion, the COVID-19 crisis affects the resilience of the project?
7. Where are origins of the Order of the Daughters of Mercy, which country?
8. Do you know the numbers of members (nouns) in this organization?
9. How does the missionary activity of religious communities differ from some other non-profit organizations that deal with humanitarian missionary work?
10. What key problems do the sisters face in implementing this social project?

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Air pollution

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Problem description

Air pollution can be defined as "an air condition in which substances are present at concentrations above their normal levels in the environment and thus have significant effects on people, animals, vegetation, or materials" (Seinfeld, 1986). These substances include gases such as sulphur and nitrogen oxides, carbon oxides, hydrocarbons; particulate matter such as smoke, dust, fumes and radioactive substances (Ashmore, 2005). Thus, air pollution is the release of chemicals, particles or biological materials that cause discomfort, illness or even cause death to humans, harm other living organisms as well as food crops and damage the overall environment (Choudhary, Garg, 2013). The seriousness of this problem is also presented in the 2030 Agenda and the Sustainable Development Goals, more specifically: **SDG 3 Good health and well-being** (Target 3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination), **SDG 11 Sustainable cities and communities** (Target 11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management), **SDG 12 Responsible consumption and production** (Target 12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment), **SDG 13 Climate action** (United Nations, 2015).
Most air pollution comes from energy use and production. The burning of fossil fuels releases gases and chemicals into the air. Air pollution not only contributes to climate change but also worsens it, which is an extremely

destructive feedback effect. Air pollution in the form of carbon dioxide (CO_2) and methane increases the Earth's temperature. Another type of air pollution, smog, is then worsened by this increased heat, which forms when the weather is warmer and there is more ultraviolet radiation. Climate change is also increasing the production of allergenic air pollutants, including fungi (due to wet conditions caused by extreme weather and increased flooding) and pollen (due to a longer pollen season) (Mackenzie, 2021).

Air pollution occurs when gases, dust particles, fumes (or smoke) or bad-smelling substances that are harmful to people, animals, plants and the planet enter the atmosphere. They create smog and acid rain, cause cancer and respiratory diseases, reduce the ozone layer of the atmosphere and contribute to global warming and climate change. Air pollutants can be solid particles, liquid droplets or gases. In addition, they can be natural or man-made. Pollutants can be classified as primary or secondary. Primary pollutants are usually produced directly by a process, such as ash from a volcanic eruption, carbon monoxide gas from motor vehicle exhausts or sulphur dioxide released from factories. Secondary pollutants are not emitted directly. Instead, they are formed in the air when primary pollutants react or interact (Choudhary, Garg, 2013).

The sources of air pollution are numerous and can be divided into two main categories: (a) natural; and (b) anthropogenic - man-made.

Natural causes include: volcanic eruptions, forest fires, pollen dispersion, evaporation of organic compounds, natural radioactivity and wind-blown dust. Through these phenomena, poisonous gases such as SO2, hydrogen sulfide (H_2S) or CO can also be subsequently released into the air (Sonwani, Maurya, 2018). We cannot control natural pollution, but we can at least try to reduce it with a more environmentally friendly approach of humans. However, we can mainly influence the factors by which humans pollute the air. These are mainly:

- **Automobiles and thermal power plants:** motor vehicles are the main contributor to total air pollution (i.e. ~60%) (Cadle et al., 1997, 2004). Automobiles, aircraft, transport ships are the main sources of air pollutants, which include CO, unburned hydrocarbons and nitrogen oxide.
- **Industries:** paper and pulp factories, oil refineries, fertilizer and steel production are the main anthropogenic sources of air pollution. They release several toxic gases such as CO, SO_2 and sulphur dioxide (SO_3), nitric oxide (NO) and hydrocarbons (HC) into the atmos-

phere. The textile, pesticide and insecticide industries cause serious problems for human health and the environment. The unpleasant odours emitted by the food and tannery industries also pose a serious threat to the environment. Gases released in various accidents also pose serious threats.

- **Burning of fossil fuels:** the burning of wood, fossil fuels and charcoal causes air pollution by releasing CO_2, carbon and SO_2 into the atmosphere.
- **Agricultural activities:** pesticides and insecticides used in the agricultural sector cause air pollution. Also landfilling of waste, which produces methane. Methane is highly flammable and can form explosive mixtures with air.
- **Military use:** for example, nuclear weapons testing contributes to nuclear pollution. Nuclear pollution is very harmful to flora and fauna. Also toxic gases, bacteriological warfare and missile technology etc.

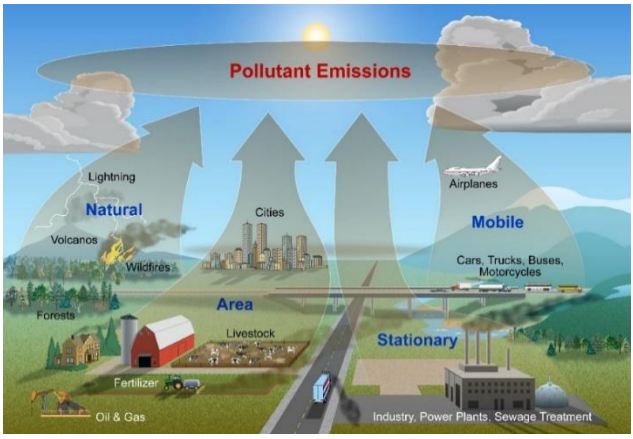

Figure 1 Main air pollutants

Source: National Park Service, 2018

- **Vapours from paints**, hair sprays, polishes, aerosol sprays and other dissolvents (Sonwani, Maurya, 2018; Choudhary, Garg, 2013).

Air pollution undoubtedly has huge impacts on human health and also economic impacts. Industrialisation and urbanisation are major causes of environmental degradation and a range of environmental problems such as visibility impairment/fogging, eutrophication, acid rain, ozone de-

pletion and global climate change. All these are destroying trees, crops, farms, animals and further making water resources harmful to humans and animals that depend on water (Sonwani, Maurya, 2018; Choudhary, Garg, 2013). Efforts to address air pollution are always problematic. Therefore, preventive measures are always a better way to control air pollution (Vallero, 2015). However, prevention has to come from both governments in the form of support and adoption of various regulations and measures and also from individuals.

Some of the basic measures to help mitigate air pollution include:

- **Burn less coal and all fossil fuels:** pollution from burning all fossil fuels is bad for the air, but burning coal has a greater impact on air pollution than burning oil or gas because it releases more CO_2, SO_2 and heavy metals. More than a third of the electricity generated in the world comes from burning coal. Since 2014, global demand for coal has started to decline. Some countries, such as Japan and South Korea, are moving more towards nuclear power, and the amount of electricity supplied globally from clean, renewable sources such as wind, solar and hydro is increasing.
- **Reducing the impact of cars:** vehicles produce exhaust emissions full of CO_2, NO_2 and other pollutants. Driving less in favour of public transport, cycling, walking or car sharing helps reduce air pollution. Using more fuel-efficient cars or electric cars that do not depend on fossil fuels also reduces air pollution. Many cities are helping by investing in better and more affordable public transport and by developing urban plans that include infrastructure for walking, cycling and public transport and introduce car-sharing schemes.
- **Save energy:** at home, at work, everywhere. Demand for electricity, which is most often produced by burning fossil fuels, has grown exponentially in recent decades. We need to turn off the lights, use energy-saving LED bulbs, prioritise energy-saving appliances, etc. Several countries are using renewable energy sources, nuclear power or lower-emission sources such as natural gas to meet the growing demand for energy.
- **Follow air quality warnings:** on days with high levels of air pollution, it is even more advisable to choose to car share or use eco-friendly modes of transport (UCAR, 2023)**.**

Air pollution cannot be completely eliminated in today's Anthropocene era, but it is essential to actively take effective measures to minimise it. National governments have also committed themselves to this in the 2030

Agenda for Sustainable Development and their role is to develop air protection guidelines and regulations to limit emissions in an effort to control air pollution. Of course, an active and conscious approach by individuals is also needed (Choudhary, Garg, 2013).
The less gasoline we burn, the better we are at reducing air pollution and the harmful effects of climate change. Therefore, we also need to make the right choices when it comes to transport. Everyone should contribute to reducing this problem. When driving, we should preferably choose a car that uses less petrol or choose an electric car. Buying food locally reduces the consumption of fossil fuels that are burned when food is transported by car, air or ship (Mackenzie, 2021).

Car sharing

From the above, the concept of car sharing represents a more than suitable and beneficial alternative. Car sharing is one of the pillars of sustainable urban mobility. There are different forms of car sharing model. The concept most commonly used in cities is flexible car sharing or open-access car sharing (ShareNow, 2023). Car sharing is an innovative and increasingly widespread mode of transport around the city. It is a good option for ordinary citizens, but it can also be a cost-effective and environmentally friendly option for businesses. Car sharing is a great alternative to traditional renting, whether it's about protecting the environment or getting from A to B. A car sharing service is a form of car rental that allows a person to rent a vehicle on an hourly basis.
Although car sharing schemes are not yet everywhere, they are growing in popularity and availability. This service has the following main advantages:

- **Environmentally friendly:** many people are trying to reduce their carbon footprint. Car sharing can help reduce the number of vehicles on the road, the number of kilometres driven. The fewer vehicles on the road, the less congestion and CO_2 emissions. It also reduces the need for additional parking spaces. This makes it possible to create more green spaces (Ghosal, 2022). Car sharing helps cities to reduce traffic congestion, air pollution and parking shortages. Each shared car replaces eight to twenty private cars in a city, freeing up valuable space for living. Shared cars are used up to six

times more often than private cars, meaning cars spend more time on the road rather than parked and clogging up the streets. In Berlin, for example, this has freed up more than 12,000 m2 of parking space. The approximately 11 million kilometres driven annually by car-sharing vehicles are replacing around 52 million kilometres driven by private car - the same situation in cities across Europe. In addition, older, less environmentally friendly cars are being replaced by new low-emission and electric cars. Car sharing fleets already have significantly lower CO2 emissions than the average car registered in Europe. In addition, the growing number of electric cars in car sharing fleets can further reduce air and noise emissions in cities. The use of electric cars in car sharing is a logical extension of the sustainable car sharing concept (ShareNow, 2023).

- **Cost-effective:** owning a car is expensive. It costs a lot of money per year, from petrol to parking to maintenance and insurance costs, plus other related expenses. Car sharing allows one to rent many types of vehicles by the hour or day and only pay for the time one uses them. Membership prices are low and there are no operating or maintenance costs associated with them either.
- **Stress reduction:** the main advantage of car sharing is its convenience; members can quickly take a vehicle that suits their needs at a moment's notice. With a large choice of vehicles, car sharing is ideal for quick trips around town or weekend trips. Some people only have one car in the household, in such cases owning another car can seem like a burden.
- **Increased access:** car sharing reduces congestion and pollution in the city, it also makes travel more affordable and easier (Ghosal, 2022).
- **Car sharing is convenient:** for many, car sharing has become a valuable addition to the public transport network. Flexibility is the key factor here. Rentals can be started and ended anywhere and anytime within the home area. As a practical addition to the urban mobility mix, flexible car sharing thus meets both the desire for spontaneous mobility and the sustainability aspect (ShareNow, 2023).

Car sharing is primarily defined by environmental and social objectives and not by business and financial objectives. It is designed for local users to support community transport and environmental goals. Its mission, vision and values lead to actions to reduce car ownership, reduce the distance covered by vehicle, improve the use and development of urban

areas, provide affordable access to vehicles for all constituents, as well as motivate residents to walk, cycle and use buses and trains, reduce dependence on fossil fuels and at the same time reduce greenhouse gas emissions.
Car sharing is a membership-based service available to all qualified drivers in the community. No separate written agreement is required each time a member reserves and uses a vehicle. This service helps members save money over the cost of individual car ownership by encouraging them to drive less often, plan trips more, use other modes of transportation more, and share fuel-efficient vehicles when a car is no longer needed (CSA, 2023). Car sharing is considered to be the future of urban mobility.

Description of the business project: SHARE CAR in Nitra

Car sharing is an important element for achieving sustainability and mitigating many environmental problems – not only the problem of air pollution, but also, for example, the problem of climate change (which has been described as the most serious environmental problem facing the world, because climate change will have much more serious impacts than the other consequences of the environmental crisis), the depletion of resources.
In addition, car sharing also has many of the above-mentioned positive social and economic impacts. That is why it has also been described as the future of mobility - especially in cities. As in many countries, this alternative mode of transport has been gaining ground in Slovakia in recent years, where, alongside the possibilities of car sharing, carpooling, Uber or Bolt, it is a very convenient alternative to owning a car and the flexibility and convenience that this brings.
This system has also started to actively develop in Nitra, as one of the 8 regional cities in Slovakia – It is the 5th largest city in Slovakia, but it is also the oldest city in Slovakia, whose first written mention dates back to 826. As of 2022, it had a population of 76,508. The total area of the city is 100.5km2. There are two universities in the city, which significantly increases the number of people in the city during the academic year, and there is also a Jaguar Land Rover car factory, whose presence in the city also means that there are many foreigners, as well as people from other

parts of Slovakia living here for work or commuting to the city. Car share is thus a great opportunity and help for the city (Virtuálnô.sk., 2022).

SHARE CAR and its goals

The company SHARE CAR (NRCAR s. r. o.) was established in 2018. The company operates in the field of mobility, mainly carsharing and bikesharing. Their goal is to work with cities, municipalities, companies and communities in Slovakia in mobility and shared transport projects. They started their activities in Nitra with the intention to contribute to modern and efficient transport that combines other modes of transport, such as public transport and bicycles. They see the car as an efficient mode of individual transport that can be well combined with other modes of transport. It is this good interoperability that they believe should ensure efficient use of transport when people need it (SHARE CAR, 2020).
That is why the company focuses on car and bike sharing. It considers it important to complement the available public transport system with individual shared transport. Shared transport saves space in the city, reduces the number of cars, helps the environment and last but not least it is about the convenience it provides by not having to deal with the purchase and operation of a car.
It is also the company's aim and intention to design and operate other projects in addition to its own. For example, residential car sharing, corporate (fleet), urban or community car sharing. Their aim is to jointly support the development of shared transport in Nitra and in Slovakia in general. They point to the fact that the idea of community car sharing is to have cars available for people living in cities or communities. They are used by all users in the system. The cars are publicly available, working around the clock, you just need a mobile app for that. In this way, shared cars can replace many private cars, which has many of the positive impacts mentioned above (Illéš, 2019).
They base their work on the following benefits for cities, companies, communities and individuals

- The cars can be owned by the city or the community and the city or community receives a profit from renting them;
- A flexible online system for car rental management and reservations;

- More efficient use of company cars, or a reduction in the number of them;
- SHARE CAR takes care of the right selection of cars - both electric and petrol - to cover the narrow city centre as well as the outskirts and the possibility of taking the car on a trip. Because they are guided by the motto that car sharing is also about being able to have the right car every day, whether it's a shopping trip in the city or a family trip, without the need to have several cars in the family;
- SHARE CAR takes care of the complete management of the reservation system, including invoicing;
- SHARE CAR, as the system operator, takes care of the set-up and operation of the car sharing system;
- Possibility of simultaneous management of cars publicly shared for citizens as well as non-publicly shared for communities or closed groups (SHARE CAR, 2020).

Ecological aspect

- Fewer cars on the road means a positive impact on the environment;
- Fewer cars will result in fewer car parks and thus the development of green spaces in cities;

Figure 2 SHARE CAR vehicle
Source: SHARE CAR, 2020

- Car sharing can replace up to ten private cars in traffic, which contributes to reducing congestion and better traffic in the city. This means fewer cars = greener city;
- Our vision is to combine car sharing and cooperation with public transport, thus creating even greener cities;
- They also announce the preparation of many new benefits for their users, as well as the expansion of the car fleet with the possibility to choose the vehicle according to their wishes and needs (SHARE CAR, 2020).

The company operates 4 cars, 8 bicycles, reports 100 satisfied customers and 35,000 kilometres driven.

"Mobility project tailored to your requirements"

The company offers the ability to design, implement and operate a complete car and bike share system if you are interested in incorporating car and bike share into your community, residential housing or company. It also offers participation in the SHARE CAR system with the ability to use all cars in their system. This means additional benefits when traveling from city to city and using shared cars in multiple locations across the country. Their aim is to work with cities, municipalities, companies and communities in Slovakia in mobility and shared transport projects, thus contributing to modern and efficient transport in combination with other modes of transport, such as public transport and rail transport. They see the car as an efficient mode of individual transport that can be well combined with other modes of transport. They also highlight the fact that one does not have to ride alone in a car and can share the available seats, which adds to the environmental friendliness and efficiency of this mode of transport (SHARE CAR, 2020).

How it works

The procedure for successfully using the service is as follows:

- **Registration:** fill in the registration form, pay the refundable deposit and then the SHARE CAR card will be delivered;

- **Reservation:** the smartphone is actually a reservation system that the user carries with him/her at all times. Reservation is also available on PC and tablet (web application);
- **Driving:** users have freedom, no one limits them in the number of kilometres they can drive and they can also travel outside the borders of Slovakia (it is good to notify the provider in advance);
- **Return of the car:** The car must be returned to the same zone where it was taken. A map on the provider's website will provide information on where the car can be picked up and returned (SHARE CAR, 2020).

What needs to be paid:
A registration fee (refundable security deposit) is paid upon registration and then only the cost of the rental time and mileage. Everything from fuel, parking, tyres, servicing and insurance is included in the rental price. An invoice is issued for the services (length of the accounting period - calendar month), which must be paid within 14 days.
The rental car can be driven by another person, but the person for whom the car was rented is responsible. The user of the car pays the toll abroad, but the Slovak toll is included in the price of the rental. Another advantage is the possibility of having several chip cards on one account for family members or employees. If it is necessary to refuel, there is also a refuelling card in the car, with which the fuel bill is paid (SHARE CAR, 2020).

Benefits of using SHARE CAR

- Being able to use the car for a few hours or a few days, as and when you need to;
- No need to deal with buying your own car and putting a strain on your budget;
- No need to deal with the operation and maintenance of the car;
- When a car is not in use, it does not cost anything;
- The car is only used when one needs/wants it and its operation is taken care of by SHARE CAR (SHARE CAR, 2020).

To what does a person contribute by using this service?

- To reducing the number of cars on the road;
- To improving the traffic situation - fewer cars = less congestion;
- Fewer cars on the road = positive impact on the environment;
- Fewer cars = reduction of parking needed for cars and development of green spaces (Illéš, 2019).

Vision, goals, plans

The Share car project is also referred to as a startup, which had the ambition to reach other, mostly larger cities that could benefit from such a service and offer citizens an interesting alternative for transportation within the city, but also outside it. This service, which originated in Nitra, represents a private and unique project of its kind in Slovakia - because they were the first. Today, more car sharing companies have been operating in various cities in Slovakia since roughly 2022, which has probably also contributed to SHARE CAR not breaking through to other cities. However, it will retain its primacy, and it will also certainly take credit for the development of this mode of transport in Slovakia, as it set up the first real car sharing system in Slovakia (Illéš, 2019).
It was also exceptional for its offer of designing, implementing and operating car sharing projects from companies, communities, etc. SHARE CAR offered to set up and operate such a service in any city, or it can be set up by various companies that want to provide such an option either to the public or to their employees. The advantage is that SHARE CAR can take care of the whole process of setting up and running it (SHARE CAR, 2020).
Official website of the company:
https://www.sharecar.sk/o-nas/#1591113604791-3f493c27-17d3
Facebook website:
https://www.facebook.com/sharecar.sk/

Questions for students

- Which environmental problem do you personally perceive as the most serious and to what position do you put the air pollution? Why?
- What measures do you think can most effectively reduce the air pollution and the negative impacts as its consequences? Why?
- How do you personally contribute to air pollution? are you willing to change it and reduce your impact? If so, how?
- How do you assess the intention of the presented model? Why?
- Can the effective functioning of a given model of the company really contribute to the improvement of the polluted air? Why?
- Based on the presentation of the model, what changes would you propose to implement to make it more effective in achieving cleaner air? Why?
- Analyse the strengths and weaknesses of the given model.
- Design and describe your own strategy to decrease air pollution in your country.

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Waste management problem

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Problem description

Resource overconsumption and waste generation is a problem that contributes significantly to the global environmental crisis and addressing it is therefore essential to achieving environmental sustainability. The huge increase in population has given rise to huge quantities of liquid and solid waste, which is a matter of national and global concern. The international community has been developing and implementing projects for the efficient and sustainable management of waste for several decades, and their efforts are intensifying as the problem is a very serious one. Due to ever-increasing production, landfill capacities are being overstretched and waste is having a devastating impact on ecosystems around the world. Solid waste management is thus a central pillar of long-term sustainable environmental policies (European Commission, 2015). It is also presented in the 2030 Agenda for Sustainable Development and is specifically addressed in **SDG 11 Sustainable cities and communities** (Target 11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management), **SDG 12 Responsible consumption and production** (Targets 12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment and 12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse) (United Nations, 2015).
The volume of waste itself is not so much the problem, but the inability of individuals, companies, governments – along with waste disposal companies - to cope with the task of waste reduction and environmental safety (Ado, Muktar, 2011).

Every household produces a lot of waste every year. Some items are recycled, others become part of landfill. As demand increases, more and more goods are being produced, and this in turn leads to more and more waste that needs to be disposed of. Most waste is disposed of in underground landfills. However, the presence of huge landfills throughout cities poses serious environmental problems, affecting human health, deteriorating soil quality, affecting natural life, contributing to air pollution and leading to climate change (Mravcová, 2018).

The way waste is disposed of has a huge impact on the environment. Waste in landfills mostly rots and decomposes. They cause unpleasant odours, but they can also produce methane gas, which is explosive and contributes to the greenhouse effect. The leachate from waste is also a major pollutant today. Most of the world deals with waste in mainly two ways: either burning it or burying it. Neither is good for people or the environment. Burning waste contributes to global warming and pollutes lakes, forests, oceans and cities, even on the other side of the world. Most incinerators in industrialised countries today already remove large quantities of pollutants, ensuring cleaner air. But most of what they remove ends up in landfill anyway. Burying garbage also causes air and water pollution. As the problem of waste accumulation reaches threatening proportions, the world community's efforts are focused on waste control and management. At the same time, many countries, as well as individual cities, are trying to manage waste management on their own. It can be stated that, compared to the 1990s, the situation of waste production and management is improving, both at the individual and societal level. The positive values point to increasing efforts to recycle material. However, the environmental impacts caused by landfills are still enormous (Skye, 2023).

Our earth's resources are limited. Currently, raw materials for plastics production are becoming scarce, and those that can be reused often end up in landfills anyway (Ado, Muktar, 2011).

Other issues related to waste management

- **Decomposition:** sometimes full landfill sites are covered with earth and grass is planted on them, turning it into a recreation area, for example. The escaping gases coming from these sites is a constant problem and creates ongoing costs despite the new facade of the landfill. Decomposition happens slowly in the absence of oxygen.

- **Impact on natural life:** birds and mammals (such as bears) are attracted by uncovered landfills. These animals change their long-term behaviour. For example, birds stop migrating to feed on landfills. The animals may then also suffer from poisoning from bad food.
- **Landfill fires:** landfill gases and the abundance of waste can easily erupt into fires. These pollute both the air and the water. If not controlled on time they can destroy the natural surroundings. Landfills also commonly produce a highly flammable gas - methane - as well as various chemicals that can increase the chemical burden of these landfills and spread pollution to soil and water sources. Smog from these fires can also cause respiratory problems.
- **Climate change:** methane and carbon dioxide that are produced in landfills are greenhouse gases that lead to global warming and climate change (Skye, n.d.).
- **Waste burning:** plastics tend to produce toxic substances when burned. Gases from burning can pollute the air and contribute to acid rain, while ash from incinerators can contain heavy metals and other toxins. But on the other hand, waste burning can also generate energy. Indeed, littering leads to unnecessary loss of resources. It wastes raw materials, the energy to process them and money. Reducing waste means less impact for the environment, less resources and energy used, and saves money (Green choices, 2023).

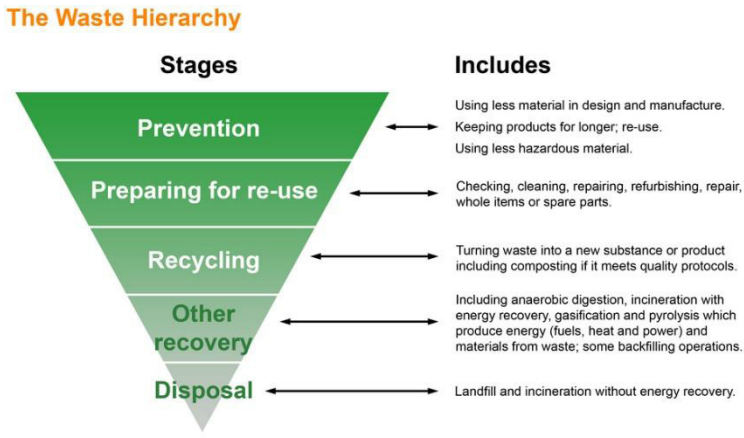
Possible solutions for solid waste reduction

Given the harmful effects of waste management, the number of landfills and the amount of waste in them need to be reduced in particular. This requires individual action, government policy and private enterprise. The following actions can be considered very effective:

- **Increase recycling and composting:** most of the waste in landfills can easily be recycled already at household level. Increasing recycling and composting leads to a reduction in waste. But this requires individual action as well as adequate and efficient collection and treatment of separated waste by government and industry. However, it should be stressed that recycling is also cheaper than landfilling or burning.
- **Mining as a creative solution:** long-existing landfills contain a lot of mineral raw materials that just rot in them. This creates a unique op-

portunity for 'green' mining. With precious metals and other minerals found in electronic waste, more and more companies are looking at landfills as gold mines. This activity can work and be profitable without government support. Some companies are coming forward with research that the economic and environmental benefits far outweigh the costs. Challenges to extract buried metals and electronic products can reduce landfills and their associated problems in the long term.

– **Energy production:** what was once a problem, namely the very high proportion of methane in landfill gas, is now also seen as an opportunity and can be utilised as a source of energy. Landfill gas is the third largest source of methane emissions. Instead of becoming a pollutant and a risk, it can be extracted by drilling in landfills, then used to generate electricity as well as heat for energy projects or used as an alternative fuel, mainly in the industrial sector (Skye, 2023).



Source: EMS Mastery, 2012

Waste generation is inevitable, and every individual, business and organisation produces waste every day. However, the habits and materials we use can reduce both its production and impact and can make a difference. Normal waste overflows landfills, creates greenhouse gases and wastes non-renewable energy resources. However, recycling reduces greenhouse gas emissions and conserves our natural resources (Converse Energy Future, 2023). Traditional waste management strategies include reusing ma-

terials, recovering materials through recycling, burning, and landfilling. In recent years, recycling has become the preferred waste management option for many industries (World Press, 2009).

Recycling

The recycling process transforms and converts waste and discarded materials into new items and materials for further use. Therefore, it is a good alternative to any waste of a "conventional" nature and has the ability to save the use of additional materials. The process can also help to reduce greenhouse gas emissions, for example in relation to the production of plastics. The recycling process can prevent waste from going to landfill, while having the potential to be a useful product or material, and reduces the consumption of fresh raw materials, thus reducing further energy consumption, air pollution due to incineration, water pollution, etc. Therefore, recycling has become a critical component of waste reduction and represents the third factor of the waste management hierarchy: "Reduce, Reuse and Recycle" (Recycling.com, 2019).
Recycling is considered the most effective way to protect the Earth's environment. By simply reusing materials instead of throwing them away, we can not only reduce the number of waste materials but also conserve future natural resources (Lamma, 2021). Recycling plastic materials means less use of new plastics made from hydrocarbons and fossil fuels. Recycling plastics saves one ton of raw materials, which is about 16.8 barrels of oil. Similarly, recycling wood and paper can save forests and trees. Recycling 1 ton of office paper can save 7,650 gallons of water, 18 trees, 647 gallons of oil, and 2.28 m3 of landfill (Ado, Muktar, 2011). Recycling helps to reduce energy consumption. In 2014, for example, enough municipal waste was recycled to provide electricity for almost 29 million households. Recycling helps protect habitats and forests - for example, if 10% of existing newspapers in the US were recycled, nearly 26,500,000 trees could be saved each year. Recycling paper can reduce air pollution by almost 78% and also helps reduce global warming - for example, in 2017, 178 metric tonnes of greenhouse gases were reduced by recycling municipal solid waste (Canon Hygiene, 2017). Recycling and composting of waste leads to significant reductions in greenhouse gases and emissions. For example, in 2014, roughly 89 million tonnes of recycled and composted municipal waste led to a reduction of more than 181 million tonnes of equivalent

carbon dioxide emissions, comparable to the annual emissions from more than 38 million private cars (EPA, 2023).
However, people often do not take these steps themselves, even though it is now generally easy to recycle. Mainly because they think that they, as individuals, can make no difference in this huge world. Therefore, it is also necessary to spread awareness that every such activity contributes to change (Canon Hygiene, 2017). And it is recycling that can make the difference in the safety of the environment.
An effective recycling system can only be successful if there is active and effective support from governments as well as from NGOs and cities, for example through various support projects. Sufficient awareness of the need for recycling and collection of hazardous goods is also essential, as well as exploring ways and means to increase the use of waste products, exploring ways to improve the recyclability of materials, creating financial stability in the recycling market, involving the manufacturing sector, encouraging legislative intervention by governments and green policies. Recycling does not require any particularly advanced technologies. However, it is essential that, in addition to international support, the issue is actively promoted at national level (Guererro, Maas, Hogland, 2013).
Recycling rates are increasing in each country, which includes recycling of different materials, but also composting and decomposition of bio-waste. There is a clear link between increasing recycling rates and decreasing landfill rates. Countries are generally using different policy instruments to move waste away from landfill and towards higher recycling rates. However, these instruments are designed and implemented in different ways in each country, which affects their effectiveness (EEA, 2013).

Description of the business project: "Systém zálohovania na Slovensku" (Deposit return system in Slovakia)

Recycling is an important element contributing to more sustainable environmental development and is now a necessity with the increasing amount of waste, the standard of living and more than 8 billion people in the world. The countries that contribute most to waste production are the countries of the so-called Global North, as richer countries with more advanced economies, more opportunities and higher living standards, which includes Slovakia.

Slovakia is a small country with an area of 49 035 km2 and a population of 5.447 million. It is part of the EU, which it joined together with nine other countries on 1 May 2004. Globally, but also in the countries of the European Union, an increase can be observed in the amount of recycled waste - or waste collected for recycling and subsequent reuse of materials. However, Slovakia is one of the EU countries whose rate in this area is lower than, for example, in Western European countries, so it is taking various measures also within the framework of international commitments arising, for example, from the 2030 Agenda for Sustainable Development and the Sustainable Development Goals and targets of the European Union. The level of recycling in Slovakia is increasing every year, but we are still a long way from the EU target of recycling 65% of waste by 2035, which is now already being met by Germany.

Therefore, Slovakia has to implement various measures, which include the introduction of the deposit return system for plastic bottles and cans from 1 January 2022. The campaign is called Slovakia backs up with the slogans – we don't shrink, we don't throw away, we back up!

For this purpose, a new non-profit organization has been created – Deposit return system administrator, which creates, finances and coordinates the functioning of the deposit return system of disposable beverage packaging in Slovakia. This non-profit organisation is made up of four non-profit organisations mandated by the Ministry of the Environment of the Slovak Republic – a consortium of AVNM (Association of producers of soft drinks and mineral waters in Slovakia), SZVPS (Slovak Association of producers of beer and malt), SAMO (Slovak Alliance of Modern Trade) and ZOSR (Association of Trade of the Slovak Republic), which represents producers of soft drinks and mineral waters, producers of beer and representatives of wholesale and retail trade. Their members jointly place on the market almost 80% of all backed-up packaging and represent more than 3 000 commercial operations. This alliance ensures better transparency of the system, better mutual control and coordination, and a common interest in a smooth, economic and environmentally sustainable system that is consumer-friendly and meets collection targets (Správca zálohového systému, 2022b).

Model objective in the context of EU objectives

The aim of the model is for Slovakia to become a country without freely thrown plastic bottles and cans. At the same time, plastic bottles and cans are not useless waste. They are valuable materials whose recycling makes sense. By adopting this model, Slovakia is committed to increasing the current collection rate of beverage packaging from 60% to 90% in 2025. For this purpose, it has opted for a deposit return system that combines the efforts of producers, traders, consumers and the State, represented by the Slovak Ministry of the Environment. The deposit return system gives the chance to collect more and higher quality material for recycling and reuse in new packaging, reducing free-flowing waste and saving natural resources.

The scheme is based on European legislation that has made it mandatory for all countries to ensure a 90% collection rate of plastic beverage packaging by 2029 and to find effective ways to ensure this. Slovakia has chosen the deposit route, which is currently the only realistic proven solution to ensure high collection rates and at the same time higher recycling and the use of recycled materials in the production of new packaging (Správca zálohového systému, 2023).

This is also linked to other EU targets – for example, the obligatory addition of recycled content to all packaging that is placed on the market – 25% by 2025 and then 30% from 2030 onwards. From this perspective, it is important to ensure that manufacturers have sufficient quantities of material of a quality that can be used in the production of food packaging. Another is the desire of producers to close the material loop and achieve a circular economy.

The deposit return system thus represents a modern means of extended producer responsibility which, through the collection of disposable beverage packaging, involves everyone in the fight against this waste and mobilises everyone to protect the environment. Based on a review of the experience of countries where deposit return systems have been in place for years, the necessary increase in recycling rates is only possible through a deposit return system. The deposit return system was chosen on the basis of a review of the experience of countries where it has been operating successfully for years. In Lithuania, for example, the collection rate was at 30% before the introduction of the system. A few years after the introduction of the deposit return system, the collection rate for beverage containers was as high as 90%. This means that if the system is set up cor-

rectly, it has a high potential to achieve the targets set. The same can be seen in the statistics for Sweden, Norway and Finland, where the system has been in place since the 1980s or 1990s. The priority is therefore to encourage recycling.
Thus, deposit gives the chance to collect more of the higher quality material for recycling, reusing it in new packaging while saving natural resources (Správca zálohového systému, 2022a).

How the system works

- The backup system has established the following procedures:
- The manufacturer registers beverage packaging with the Administrator. It shall pay a deposit and a fee for each package placed on the market;
- The producer sells the beverage to a trader who pays the deposit in addition to the price;
- The trader sells the beverage to the consumer, who pays both the price of the beverage and the deposit;
- The consumer returns the packaging to the trader, who returns the deposit back to the consumer;
- The trader returns the collected packaging to the Administrator, who pays the deposit and a handling fee in return for handling the packaging;
- The Controller shall arrange for the inspection, counting, transport and processing of the packaging;
- The material from the Administrator goes to the recycler;
- The recycler processes the material. The manufacturer can then use it to produce new bottles and cans (source) (Správca zálohového systému, 2022a).

Administration and purpose of the model

The system is regulated and controlled by the Ministry of the Environment of the Slovak Republic, but is not state funded. It is financed by producer fees, material sales and uncollected deposits. The established deposit sys-

tem is normally in deficit and, as it is an extended producer responsibility system, the management deficit is always financed by producer fees.
All producers who place beverage packaging on the market in disposable packaging, whether plastic or metal, must register with the scheme. And distributors who sell beverages to end users and set up a collection point - either compulsorily or voluntarily.
The administrator of the deposit system has the following priorities, namely to promote the recycling of the collected material and its subsequent use for the same purpose for which it was originally produced. The administrator subscribes to the principles of the circular economy and promotes bottle-to-bottle or can-to-can recycling. The aim is to ensure that material is not just thrown away and recycled once but rotated in a closed material circle.
All disposable plastic beverage bottles and cans with a capacity of 0.1 l up to and including 3 l are deposited. Each deposited bottle or can has a "Z" symbol in recycling arrows and the text "ZÁLOHOVANÉ" (DEPOSITED) on it. Disposable plastic bottles and cans of beverages such as mineral water, sweetened drinks, fruit juices, iced teas, energy drinks, beer, wine or mixed alcoholic beverages are collected. Milk, milk-containing beverages, syrups and alcoholic beverages with an alcohol content of more than 15 % shall not be backed up. Packaging from foodstuffs that are not beverages, such as oil or vinegar, are also not be collected (Správca zálohového systému, 2022a).
The deposit for each such package is 15 eurocents. The deposit shall be refunded to the consumer on return of the container to the collection point. The packaging may be returned to a collection machine – 'deposit machine' – or directly to the responsible staff member in smaller operations with manual collection. The consumer receives a coupon with a val-

Figure 2 Symbol for deposit return system bottles and cans

Source: Správca zálohového systému, 2022b

ue according to the quantity of packaging returned, which can be claimed at the cash desk of the given shop.
More than 3000 collection points have been managed for collection purposes. The collection network will be gradually expanded. A map of the collection network can be found on the website www.slovenskozalohuje.sk (Správca zálohového systému, 2022a).

Implementation of the model

The system was introduced on 1 January 2022, with two transition periods, as both producers and retailers needed time to discard old packaging and to put only deposit packaging into circulation. Until 31 January 2022, old non-returnable packaging could be placed on the market by producers and the retailer could distribute non-returnable packaging until 30 June 2022. From 1 July 2022, only returnable plastic bottles and cans for beverages with the Z symbol can be found on the Slovak market (Správca zálohového systému, 2023).

Figure 3 One of numerous advertisements for support of this model

Source: https://www.facebook.com/slovenskozalohuje/videos/2317893205035637/

What happens to the collected packaging?

Once collected, the packaging is transported to a sorting centre where it is sorted by material type and colour and compacted into large cubes weighing approximately 300 kg. They are then sent for recycling. The recycled material can be used to make new plastic bottles and cans. Over and over again.
Data shows that 1.1 billion deposit packages were put on the market in 2022. 821 million were collected (the 1 billion mark was reached on 28 March 2023). For 2022, the regulatory target for the deposit return system was set at a return rate of 60%. Overall, however, the result was a positive surprise, as the return rate reached 71%. At the same time, one has to take into account the transitional periods when people were still buying or even had stocks of packaging that were not deposited (Správca zálohového systému, 2022a).

Plans and targets for 2023

The year 2023 is the second year of the deposit return system and the first year that the deposit return system is fully functional without any transition period. The Administrator's goal is to justify the excellent results of the first year and to seek solutions to make the system more efficient.
As part of the improvement of the efficiency of the deposit return system, the Administrator plans to systematically expand the subscription network and to strengthen the areas where customers today do not have the possibility to return the deposited packaging in their neighbourhood. This is a gradual process, which also depends on the willingness of smaller shops to set up drop-off points, as they do so on a voluntary basis – so there is an effort by the Administrator to look for opportunities for cooperation so that the deposit option is widely available and motivating for all.
The Administrator wants not only to expand the network of outlets but also to improve the existing one. Therefore, in cooperation with the retailers, they are constantly working on the harmonisation of the individual points of sale, both at the technological level in terms of the relationship between the retailer and the supplier of its technical equipment (backup machine), but also in terms of the support provided by the staff present.

Although the law specifies the return of the packaging directly to the shop, the Administrator is working to create the possibility of returning the deposit beverage packaging at other locations, such as aquaparks, within the drinking regimes of companies, swimming pools or festivals.
The aim is to ensure that the transport is sustainable, efficient and environmentally friendly, making it as cost and CO2 efficient as possible. There is a binding target for 2023, namely a rate of return of 80% (Správca zálohového systému, 2022a).
The official website of the model is:
https://slovenskozalohuje.sk/
The facebook website is of the model is:
https://www.facebook.com/slovenskozalohuje

Questions for students

- Does the waste management pose a serious problem for achieving environmental sustainability according to you? why?
- Do you perceive recycling as an appropriate method for solving the problem of waste disposal? which method do you perceive the most effective and why?
- Do you think that the Slovak model of Deposit return system can make a significant progress in achieving needed level of recycling and improve the waste management system in the country? Why?
- Analyse the strengths and weaknesses of the given model.
- what do you think shall be changed to improve the effectiveness of presented model? Why?
- Propose own strategy to ensure higher recycling level in your country.
- Do you think that existing regulations and targets on recycling at European level are sufficient enough? Why?

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SUSTAINABILITY
OF THE DISTRIBUTION SECTOR

Work humanization via robotization in warehouses – case study of Gideon Brothers

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Problem description

1. Introduction to warehouse robotization

Application of various automation technologies to business operations has been an ongoing trend since the 1940ies. Since the late 1980s robotization of various production and logistic processes is rapidly developing. The new millennium brought us to the era of intelligent robots and the robotics industry is one of the fastest-growing markets in the past decade. The global industrial robotics market was valued at around USD 78,1 billion in 2018 and USD 90 billion in 2019, while for 2028 predictions show that the value of the robotics market will exceed USD 165 billion (Statista, 2022).

There are following main types of robots developed and used to facilitate operations inside warehouses:

1. Automated guided vehicles (AGV)
2. Autonomous mobile robots (AMR)

Automated guided vehicles (AGV) are the older type of robots. They travel around storing facilities following fixed routes i.e., their path through the warehouse is predefined and firmly determined. Usually, such robots use rails, magnetic stripes, or wires which are fixed on the floor of the storage facility. Some newer generations of AGV use sensors, barcodes, or wireless communication devices located on shelves to move around the warehouse. Moreover, the newest versions use sensors and cameras embedded and supported by light detection ranging (LiDAR) and multi scheduling systems to detect obstacles and prevent collisions (Lu et al., 2023; MeiliRobots, 2023).

Autonomous mobile robots (AMR) are robots that use sophisticated navigation systems with built-in maps and sensors to move inside warehouses. They are based on the usage of artificial intelligence principles. They can collect visual data and interpret visual data to "understand" the environment and to autonomously move in dynamic spaces (Rubio *et al.*, 2019; MeiliRobots, 2023). They are able to "see" and avoid objects and persons around and they are highly precise in sorting and manipulating various packages. (Poduval and Rajalakshmy, 2022). Moreover, AMRs are able to create their own routes, change routes in real-time when some obstacle is recognized and in such a manner, they are able to interact with other logistic technology and with humans in dynamic environments (MeiliRobots, 2023).

There are numerous advantages outlined in literature regarding robotization of warehouses. In Figure 1 we can observe that benefits include increase of accuracy, safety, efficiency, positively influences inventory optimization, productivity of workers and positively influences working conditions within the warehouses. On the other hand, some authors emphasise that there are still some challenges and doubts regarding robotization of warehouses such as low standardisation, lack of interoperability, increase of needed knowledge, rather high costs of implementation.

Nonetheless, despite all recognized challenges, robotization in logistics is rapidly growing. Retailers, wholesalers, distributors and logistic companies are investing more and more money in warehouse robotization. There are various predictions and forecasts for market growth in this industry. According to Mordor Intelligence (2023), the warehouse robotics global market was valued at USD 9.88 billion in 2021 and it is expected to reach USD 23.09 billion by 2027, registering a CAGR of 15.33% over the forecast period. According to Allied Market Research (2023), presented numbers are smaller and they state that the global warehouse robotics market was valued at USD 4,4 billion in 2020 and is projected to reach USD 15,8 billion by 2030, growing at a CAGR of 13.2% from 2021 to 2030. However, all market predictions agree on one fact, there is a rapid growth in this industry and it will continue in the next period.

In addition to AGVs and AMRs, inside some warehouses, there are **unmanned aerial vehicles (UAV)** implemented as a new or experimental technology of warehouse automation (Skrinjar *et al.*, 2019). UAVs, or commonly called "drones", fly around warehouses and usually, they have cameras and RFID scanners to track and scan inventories. Their main purpose is oriented toward operations regarding goods stored in high positions. UAVs can be used to manipulate goods of a small weight on top shelf positions. Also, they are used for the purpose of inventory optimiza-

tion because they can alert warehouse operators that inventory dropped beneath the standard value at a certain position on the shelf. Recognized benefits of introducing UAVs (drones) to warehouses are inventory optimization, reduction of labour costs, improvement of warehouse capacity utilisation (top-shelves positions usage), more accurate data collection etc. While challenges are the following: technology is very young and rather expensive, some solutions are in the validation stage, requirements for flight space, need for special training for efficient usage, not standardised equipment, low possibilities of integration with existing technologies (AGVs, AVRs, applied warehousing management system – WMS). (MeiliRobots, 2023; Malang *et al.,* 2023)

To illustrate the potential of this market and to draw attention to robot impact on job change and sustainability, in advance we will describe the case of one company specialised as a market leader in smart warehouse robotization. Firstly, we will give some facts on company development, their market positioning and product development. Then we will discuss practical in-field application of their autonomous mobile robots (AMRs) in real warehouses. At the end there are questions and tasks to develop further discussion on impacts of robots on sustainability in economic, environmental and social aspects.

2. Gideon Brothers and the development of smart warehouse robots

Gideon Brothers was established in 2017 in Osijek, Croatia. It is a privately owned company registered for business activity Computer programming (NACE 62.01). In 2021 the company had revenues larger than a half million EUR. It employs more than 80 workers and 15% of workers have PhD degrees (sources: Poslovna Hrvatska, 2022; Gideon Brothers – About, 2023). In Table 1 revenues, the number of employees, and total assets per employee in Gideon Brothers are shown from company establishment till nowadays.

Table 1: Selected business data for Gideon Brothers in the period 2017 till 2021

Indicator	2017	2018	2019	2020	2021
Revenues in 000 EUR	380	170	500	1.180	530
Number of employees	16	25	42	53	83
Total assets per employee in 000 EUR	19	73	94	91	114

Source: FINA (2023); Poslovna Hrvatska (2022); Note: for EUR rounded values are expressed; data are for Gideon Brothers Croatia only and do not include indicators for USA and Germany branches

Since its beginning, the company has specialized in robotization and artificial intelligence (AI). In 2021 they were one of three global companies and only one European company which develop autonomous technologies for internal closed industrial and logistic environments with navigation based on visual perception and usage of stereoscopic cameras and deep learning (HGK, 2023; T-portal, 2022).
The basic principles that Gideon Brothers implement when developing robots are (JaTrgovac, 2023; HGK, 2023; Index, 2022; Poduzetnik.biz, 2023, Netokracija, 2022):

- Possibility of implementation in every warehouse object without any modification of facilities
- Minimum costs of implementation and maintenance
- Simple integration and implementation in existing warehouse systems
- Short cycles of workers' education and adjustments
- Maximum collaboration with humans and other technologies already utilised in warehouses
- Focusing on the improvement of human work by resolving heavy, dirty and repetitive tasks
- Own learning and own self-navigation improvement
- Enabled to function autonomously in dynamic environments
- Providing final solutions in cooperation with leading logistic companies
- Majority of operations are located in Croatia, especially product development.

At the moment there are 2 main types of robots launched as final solutions incorporating fully developed hardware and software components. In addition, several projects based on further innovations are in the developing or testing stage in which logistic companies are heavily involved. Figure 2 shows two robot types successfully integrated to logistic systems of several companies in various industries. Both robots are aimed to collaborate with workers. Their objective is to reduce the weight that people physically manipulate in warehouses and reduce the need to walk between storage positions (Robotics247, 2023).
Robots are able to learn and perceive the environment in real time, so they can self-optimise their routes and avoid friction with objects and people in real time. Moreover, they are equipped with applications that can be installed to various platforms (PCs, tablets or other mobile devic-

es) and integrated into existing warehouse management systems. Both robots follow high safety standards complied to EU machinery directives and ISO norms (Gideon Brothers – Solutions, 2023).

The company has undergone several investment cycles, in 2018 in two investment cycles several Croatian investors and international companies invested EUR 3,415 million in Gideon Brothers. In 2019 investments were EUR 2,6 million. While the largest investment cycle of EUR 25,4 million took place in 2021 and the largest investors were Koch Disruptive Technologies (KDT; risk capital fund with more than 300 branches and production facilities around globe), DB Schenker (global leader in logistics), Prologis Ventures (risk capital fund) and Rite-Hite (global leader in logistic technologies of warehouse entrance and exit ramps). At the end of the investment cycle, Gideon Brother executive Board included 2 new managers, one from KDT and one from DB Scehnker. Data on investments are compiled from the following sources: JaTrgovac (2023), Netokracija (2022), Vecernji (2022), Jutarnji (2023).

Gideon Brothers' vision for logistics robotization in the next 10 years is to develop and incorporate even smarter technology solutions of deep perception and deep learning to enable robots to experience environments like humans (Poduzetnik.biz, 2023). As 10-year predictions show that the robotic market in warehousing areas will exceed 15 million autonomous mobile robots (Poduzetnik.biz, 2023), Gideon Brothers recently opened offices in Boston (USA) and Munich (Germany), to improve their market reach and to extend marketing abilities. For achieving a stable market position, founders identify several strategic streams important for future development (upon founders' interview in Netokracija, 2022):

a) business internationalisation to USA and Western Europe
b) faster research, development, and commercialization of AMRs
c) broadening of expert team in Croatia, but also in EU and USA by employing high-skilled and enthusiastic employees
d) investment in production capacities and scaling production lines to be able to significantly larger quantities of robots
e) developing a global distribution network
f) developing a network of system integrators.

Regarding future employees' development, Gideon Brothers plan to double its number of employees till the end of 2023, following profiles of workers and job positions are in the focus: (1) software and hardware engineers, (2) experts in production, sales, marketing, and customer success developers, (3) product managers, (4) experts in machine learning and computer vision (Netokracija, 2022).

Trey

Autonomous forklift for trailer loading and unloading operations

Casey

Autonomous picking and storing robot

Figure 1. Gideon Brother's Autonomous mobile robots Trey and Casey

Source: Robotics24/7 (2023); Gideon Brothers – Solutions (2023)

In numerous interviews, founders emphasise their readiness to invest in workers in Croatia to develop and promote Croatia as a centre of excellence in robotics and artificial intelligence (Netokracija, 2022). In that sense Gideon Brothers are active members at several joint EU financed projects in cooperation with Croatian universities (Poslovni dnevnik, 2022b).

3. Practical in-field application of robots produced by Gideon Brothers

Three Croatian companies were involved in first testing, development and fast implementation of AMRs in their logistic distribution centres and warehouses, those are: Tokić, Orbico and Atlantic Trade.

Tokić is a retailer of automobile, bus, truck and motorcycle parts and accessories with more than 230 suppliers. It has 110 outlets in Croatia and Slovenia, and it has more than 300.000 different items in its warehouses and/or outlets (Tokic - About us, 2023).

Orbico is a wholesaler company and distributor in the field of cosmetics and fast-moving consumer goods. They distribute more than 500 brands from 170 suppliers and they operate on 20 markets. Company employs 920 people and has warehousing capacities of almost 55.000 square metres with more than 50.000 pallet positions. (JaTrgovac, 2022).

Atlantic Group is a Croatian multinational company that combines the production, development, sale and distribution of consumer goods. It is present in more than 40 markets. It has 12 own produced brands. Its products' portfolio includes coffee, vitamins and supplements, soft drinks, sweets, gourmet products, and baby food. Atlantic Group employs more than 5.500 employees. (Atlantic Group – Investors, 2023).
First robot implementation by **Tokić** took place in December 2018 and it included extensive testing of robots in order fulfilment tasks by manipulation of products from warehouse position to packaging area near the exit ramp. Second implementation included delivery of packaging for disposal. In both cases processes were controlled by workers via application on their tablets (T-portal, 2022).
Robot application in **Tokić case** confirmed following:

- Gideon Brother robots can recognize all changes in real time and react to them promptly by changing routes and actively avoiding collisions.
- Robots can carry heavy loads up to 800 kg including both small packages and pallets.
- They need a flat floor to efficiently move around, but this is already a standard for many years since forklifts are already in extensive use.
- Battery is designed to last up to 10 hours without charging, but robots can charge during the workday when workload is lower and the battery can be changed quickly without any special knowledge when necessary.
- Robots are designed in accordance with all regulations of work-safety in warehouses, so the speed limit is 5 kms per hour which is the average human walking speed and legal standard for all machines applied in warehouses.
- Robots' perception is 360 degrees based on stereoscopic cameras and several sensors.

It is important to emphasise that in **Tokić distribution centre** implementation of Gideon Brothers' robots did not require any intervention into facilities, shelves organisation or reorganisation of storing positions. Moreover, robots took over real tasks on the very first day of installation (T-portal, 2022). All that was needed was first space mapping within its application. Robot was introduced to space and it circled around to "observe and learn" how space is organised. In Tokić's case, the robot was directly connected to the existing warehouse management system (T-portal, 2022).

Orbico in 2019 also implemented two solutions of applications on demand in which workers assign and control tasks of robots (JaTrgovac, 2022). Like in Tokić, robot supporting software was easily integrated into existing warehouse management systems and no investment into adjustments of facilities was needed. Orbico's manager emphasised that yet during first implementation robots reduced repetitive manipulation tasks and improved workers' productivity and satisfaction due to providing a more interesting and more interactive working environment. Moreover, some tasks were assigned to robots during night hours in which the majority of workers do not work. By that all-around clock application, added value was increased and costs of manipulation were decreased.

Atlantic Group has used Gideon Brothers' robots since 2019 in the integrated intelligent modular platform in which orders to robots were generated directly from the warehouse management system in a modus operandi called "swarm robotics" (Poslovni dnevnik, 2022b; LiderMedia, 2023). Swarm robotics includes a larger number of robots in cooperation with humans and with other robots. The main task of such application is to additionally increase the flow of goods and improve the efficiency of logistics operations. As this is one step forward in improving robot intelligence, Atlantic Group, Gideon Brothers and Faculty of Mechanical Engineering and Naval Architecture of University of Zagreb developed a joint development project and applied for funding within the European structural and investment fund.

During implementation of AMRs in their logistic centres, managers in **Atlantic Group** noticed that workers' general attitudes towards everyday cooperation with robots changes over time. Workers recognize that robots are very useful tools which ensure easier, more interesting and more productive work (Poslovni dnevnik, 2022b). So, they do not feel the threat or discomfort caused by the use of robots anymore. Their work satisfaction is enhanced as well (Poslovni dnevnik, 2022a). Moreover, managers claim that robots can enhance long-term sustainability and profitability of the company (Poslovni dnevnik, 2022a; LiderMedia, 2023).

4. Conclusions

By definition, work in a warehouse is heavy, low paid and there is a large fluctuation of workers. Moreover, in the last period there is a scarcity of available warehouse workers at the work market around Europe. Algorithms, machine learning and robotic sight are technologies which enable

smart localization and navigation within dynamic and closed spaces. Such technologies are important because people and machines within warehouses are not static, warehouses are dynamic systems. From the first in-field applications of Gideon Brothers smart autonomous mobile robots (AMRs) based on such technologies and implemented in Tokić, Orbico and Atlantic Group distribution centers it was confirmed that robots positively change job description of warehouse workers because they are capable to do dirty, dangerous, heavy and dull repetitive part of work. By assigning this part of work to robots, people in logistics can focus on more complex and creative tasks with higher rate of productivity and earn higher salaries. However, there are still some challenges and obstacles that prevent high-scale robotization of logistic processes. Anyhow, forecasts show that robotization in logistics is here to stay and to further develop in the next couple years. Therefore, emerging topics that are addressed in recent literature in business administration are tackling topic such as technology impacts on workplaces, knowledge and skills improvement, technostress, cobotics and willingness of workers to cooperate and collaborate with robots as colleagues (for example see: Paluch *et al.*, 2021; Khoa *et al.*, 2022; Turja, 2021; Torrejón Pérez & González Vázquez, 2021).

Questions, discussion and team work

1. Technology described in this case study has a positive impact on achieving several UN SDGs. Can you identify which UN SDGs are those? Explain your opinion.
2. Recognize and describe local community contribution or impact of the company described in case!
3. What are some negative impacts of robotization to the environmental aspect of sustainability? How can we influence further development in this field to reduce negative impacts on the environment?
4. Investigate which types of robots are already in wide use in logistics. Describe at least one type of robots aimed to improve logistic processes and address how warehouse robots contribute to economic and social aspects of sustainability. For this task you can visit the official Gideon Brothers' web page and see their solutions and read product brochures.
5. Prepare yourself for an interview on the topic "Robotization and its influence on sustainability" with (a) manager of Gideon Brothers and

(b) manager of a certain logistics and distribution center! Outline 5 questions for each manager!

6. In some sectors there are humanoid robots in experimental or real use. Do a small research and find at least one example how humanoid robots are used in doing business. Briefly describe areas of their work and give your opinion what are real dangers of implementation of "smart" robots supported with artificial intelligence. How can or should humankind protect itself from bad scenarios of robotization?
7. In one of their stages of development, Gideon Brothers established their international offices. What do you think, should Gideon Brothers do promotion of their technologies as a company originating from South Eastern European (SEE) market (i.e. Croatia) or would it be more appealing to neglect that fact? Debate is a country or region of origin sometimes detrimental in global marketing activities. Give clear arguments for your standpoint and outline some examples of branded products for which you are not aware of the originating market!
8. Firstly, describe: what is Croatia famous for in your country (regarding business activities, products, industries)? Investigate what is the average salary and level of education needed in those sector(s) or industries. Secondly, investigate the topic "ICT companies in Croatia" and "unicorn companies in Croatia" then debate should Croatia brand itself in some other directions and how. Finally, could this rebranding affect economic and social development of Croatia and influence poverty reduction and well-being of its citizens? Why?

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Magazyn Dobra charity store case study

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Problem description – predatory usage of natural resources

Predatory usage of natural resources is one of the most challenging problems of economy worldwide. Modern civilization consumes resources at such a rate that it will be impossible to leave them behind their future generations in the quantity in which they are available to currently living people. In 1971, for the first time, the day of ecological debt was established, i.e. the moment of exhaustion of natural resources Earth's resources that the planet can regenerate within 365 days. Then the day came on December 25, in 2022 - on July 28, and in Poland this day fell on May 25. If the way running a business and consumption will remain unchanged, until 2050 Ecological Debt Day will fall at the end of April, which can be illustrated by saying that humanity will then need three planets to meet its needs. A close relationship is observed between GDP growth and the consumption of natural resources - the combination of GDP and the amounts consumed resources, including energy is observed. Despite numerous technological innovations that capitalism is very favorable, the global material footprint is growing, which contributes to constantly growing emissionscarbon dioxide into the atmosphere and increases the risk of destabilization of the entire ecosystem(Borusiak, 2023). In the light of these facts, shortening time of products usage should be regarded as a practice requiring change (Dewberry et al., 2017). There are several ways of extending the time of products use – creating distribution channels of previously used products is one of them.The structure of these channels is presented on Figure 1.

As shown on Figure 1, there is a big variety of retail formats helping to extend a products' life cycle. Many of them are used as the base of successful business models, for example vintage stores or pawn stores. A charity

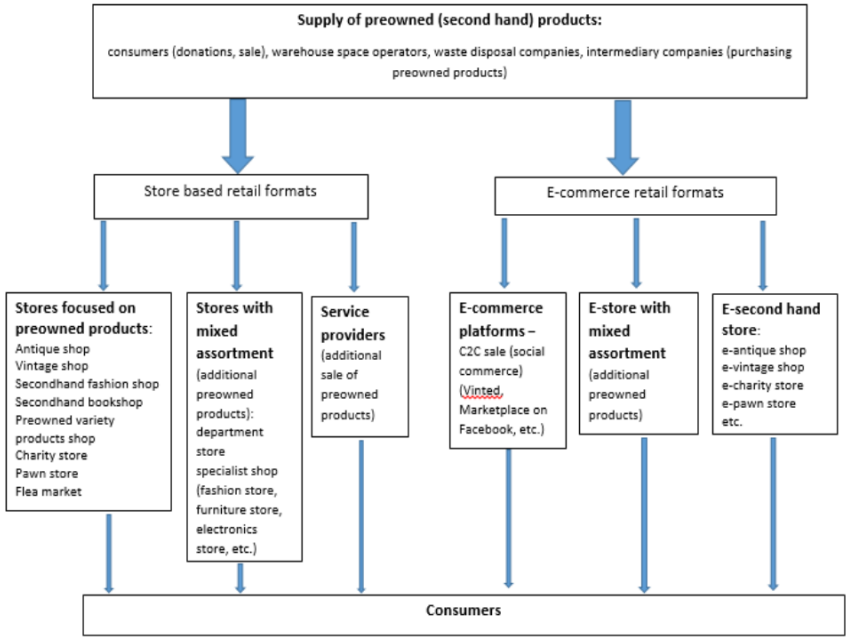

Figure 1.The structure of second-hand products distribution channels

Source: own compilation

store, by definition, is not for business.The idea of this format was developed in Great Britain, where they started to operate for the first time. The number of charity shop has been increasing dynamically in the place they were born but they are also been opened in the countries which have no tradition in this regard (like Poland). Their most important feature is that gently used products, donated mainly by individuals are sold in these shops. The low price level can be obtained through the low costs resulting from the involvement of volunteers in running the stores. The surplus of the revenue over the costs is devoted to charity (Borusiak & Kucharska, 2023)2009, 425–449.

Foundation "Magazyn Dobra"

The origin of the Foundation, its objectives, and main rules

On 12 December 2018 the agreement on setting up the "Magazyn Dobra" foundation was signed by 14 founder members. All of them are PUEB

professors (mainly Department of Commerce and Marketing staff) and Ph.D. students. The foundation was registered in court in Poznań on 9 March2018, and the store was opened for the first time on 27 October 2018. To explain the meaning of the name of the foundation it must said that it is a double meaningexpression. “Magazyn” means “warehouse”, whereas “Dobra” means *good* or *goodness*, andalso *goods, products*. Therefore “Magazyn Dobra” can be understood as a place where products are stored, but also a place where goodness is done.

The founders decided to open a charity store in order to give things a second life what could help to protect an environment by reducing the level of products waste. On the other hand, it was chosen in order to give people a good opportunity to do something good in a relatively simple way. So a charity shop formula (doing something to limit resources waste, and helping other people) could reinforce the motivation to get involved in the venture, both as a donor, a buyer, and a volunteer. It should be also mentioned that due to the fact that the store was established by a university staff, it was also planned to use it for teaching sustainability and sustainable consumption to students of marketing, especially for enhancing students’ environmental knowledge and awareness as well as their self-efficacy in the field of natural resources protection(Borusiak et al., 2019).

The main rules of Magazyn Dobra charity store are as follows:

- It is store based venture, located nearby the university, and in the city centre at the same time. The area of the store is 25 square meters.
- All people working for the store are volunteers.
- The store beneficiaries are different in every quarter of a year. They are chosen by Facebook community voting. The candidates must meet several conditions: their headquarter must be located in Poznań or in the Poznań district and they must be involved in the direct help to people in need. Any organization may apply for a beneficiary status not more often than once a year.
- In order to build people trust and prove the transparency of activity, the financial outcomes are published every month on Facebook profile: https://www.facebook.com/magazyn.dobra. They report the monthly revenue, the cost of rent a store, electricity, and accounting service.
- The confirmations of money transfer to beneficiaries are published on the Foundation website: www.magazyndobra.pl
- Prices are generally kept at the low level and decided by the committee.

– Facebook profile is the main communication channel of Magazyn Dobra charity store. Apart from financial reports, also new offers are published there. Instagram is also used but the number of followers is significantly lower there.
– The assortment consists of nine group of products:

  • Accessories and haberdashery,
  • Household and garden appliances (excluding furniture),
  • Small electronic equipment,
  • Children's supplies,
  • Sports and tourist equipment,
  • Culture and entertainment (books, games, etc.),
  • Office supplies and stationery,
  • Art and collector's items,
  • Medical and cosmetic supplies.

Products are possessed for free from the individuals which do not need these goods any more, but they are still good and can be sold. Only clean and complete products are accepted.

Magazyn Dobra outcomes

Data presenting financial outcomes of Magazyn Dobra charity store are presented in Table 1.

Sales revenue in the analysed period went down during pandemic COVID-19, when store was closed (due to the legal regulations) for almost 2 months. Next year it started to increase slightly. It is also visible that the surpluses devoted to beneficiaries, excluding 2020 year, increase.

Magazyn Dobra had 10 beneficiaries till September 2023, some of them were chosen several times. The most successful was the local organization which takes care of homeless people in Poznań – Magazyn Dobra collected money for them four times already and they were also chosen for the last quarter of 2023. The other beneficiaries were, among others, hospice in Poznań (three times), bone marrow donors organization (twice), the others were beneficiaries only once. It is visible that the more beneficiaries are involved (by publishing information on their own Facebook profile and by motivating people to donate goods and to buy them), the better the financial results of a quarter.

Magazyn Dobra charity store managed to build the community around it. Its Facebook profile is liked by 5.2 thousand people and observed by 5.5

Table 1. Revenues and surpluses devoted to beneficiaries by Magazyn Dobra (October 2018-September 2023)

Year	Sales revenue (PLN)	Surpluses devoted to beneficiaries (PLN)
2018	7253.50	3 005.02
2019	33 400.00	16 684.19
2020	27 506.00	13 199.99
2021	33 351.24	17 760.48
2022	34 795.50	19 947.79
2023 (till September)	22 234.50	11 044.29
Total	158 540.74	81 641.76

Source: own compilation

thousand. Women are the majority of the group, what is consistent with the results of the previous research showing that women more frequently engage in charitable activities than men(Borusiak &Kucharska, 2019). The detailed structure by age and gender of this community is presented on Figure 2.

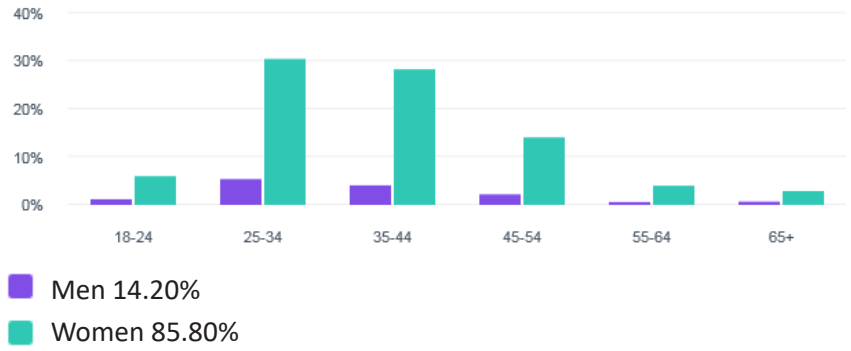

Figure 2. Magazyn Dobra FB profile followers structure (by age and gender)

Questions for students

- Describe the contribution of Magazyn Dobra charity store to sustainable development. Find as many aspects as possible.
- How would you assess the impact of the store presented above on the environment? Look for data regarding the shortening products life cycle phenomenon.

- What are the advantages of disadvantages of the presented formula of a charity store described above?
- What would you recommend to reinforce students' motivation to get involved in Magazyn Dobra charity store?
- What activities would you advise to promote Magazyn Dobra among people?
- How would you modify Magazyn Dobra formula in order to get better results in terms of revenues, and surpluses?

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Patagonia and slow fashion

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Most human activities generate waste; however, in recent years, the rate and quantity of waste have increased due to excessive consumption and production(Amasuomo & Baird, 2016). The uncollected and not recycled waste is usually dumped in watercourses, vacant land, or burned in the open air. Such practices pose a health risk, clogged drains that cause floods or end up in the ocean damaging the planet's biodiversity (Rodic-Wiersma & Wilson, 2017).Fashion is one of the industries that highly account for the issue of waste management.

The fashion industry negatively influences climate, water and energy usage, and the environment. This is due to the increase in fashion demand and the vast growth of the fashion industry, making it one of the major pollutants on the planet. It is estimated that the projected trends of the fashion industry will expand in value from 1.5$ trillion in 2020 to 2.5$ by 2025 (Papamichael et al., 2022).During the last 15 years, clothing production has doubled, accounting for 60% of the total textile production(Moorhouse, 2020). Fashion companies are interested in quick profits and rapid trend turnovers. Thus, they produce clothes that do not last long and are promoted only for a short period of the year(Centobelli et al., 2022). The fashion industry encourages consumers to view clothing as something disposable.

Meanwhile, new trends coming from bespoke celebrity fashion shows are instantly available from affordable retailers to consumers. In recent years,mass-producing fashion companies have been producing new collections every two weeks(Moorhouse, 2020). That way, the fashion industry, due to the constant production and consumption of continuous trends and short-term clothes, apart from the excessive carbon emission, end up producing about 92 million tons of textile waste. That accounts for about 73% of the clothing ending up in landfills, and less than 1% is recycled into new clothing(Moorhouse, 2020).Most of this clothing waste, around 13 million tons of textile waste, comes from manufacturers and clothing retailers. These tons of unsold clothes are solid waste, clogging rivers,

greenways, and parks and creating a severe waste management problem (Bick et al., 2018). Even if we tried to recycle more of our old clothes, it is essential to acknowledge that about 60% of these closes cannot be recycled due to synthetic fibers, so they end up in landfills or burned realized toxic gasses. Thus, it is noted that the global waste management issue is becoming more significant due to fashion.

Sustainable fashion

As mentioned above, the apparel industry harms the environment. To deal with this issue, sustainable fashion has emerged. Ethical, eco and slow fashion are some approaches highlighting sustainable fashion and suggesting that "fast fashion needs to slow down(Mukendi et al., 2019). But what is sustainable fashion? Sustainable fashion is the response to fast fashion; it challenges fast fashion by breaking down the already established boundaries between the fashion industry and stakeholders, it slows the production and the consumption process to a more sustainable time frame, it focuses on ethics and human rights of the workers, it respects the environment and the natural resources (Henninger et al., 2016).
The slow fashion movement is interrelated with sustainable fashion. Same as sustainable fashion, it emerged as a response to the unsustainable practices of fast fashion. The critical value of slow fashion is to balance and slow down fashion throughout the manufacturing process and to slow down fashion consumption by providing long-lasting clothing.

Patagonia and their environmental actions

The emergence of slow fashion has promoted sustainable brands, such as Patagonia, a slow-fashion brand, to take over a significant share of the fashion industry. Patagonia has been in the retail industry since 1973, founded by the mountain climber activist Yvon Chouinard in Ventura, California. They started as an outdoor clothing retailer in the U.S., focusing on climbing, hiking, fly fishing, and skiing gear. However, the recent years they have produced a wide variety of apparel and fashion. The founder started the company following four core values representing their tri-

ple-bottom-line focus. Firstly, to produce the most durable materials that are also sustainable; second, to cause no harm; thirdly, to use the business to protect nature; and lastly, not bound by convention.

What makes Patagonia a sustainable brand, and how is Patagonia dealing with the tons of waste coming from the textile industry? First of all, Patagonia has been a member of the "one percent for the planet" organization since 1986, which means they donate at least 1% of their profits towards environmental causes. Since then, Patagonia has donated about $90,000,000 to these organizations. In addition, since 2012, Patagonia has been a Certified B Corporation. This accreditation is usually awarded to a nonprofit organization that positively impacts society and the environment. This private benefit organization has won numerous awards for its environmental actions, such as the 2017 Accenture Strategy Award for Circular Economy Multinational, Environmental Achievement and Leadership Award for Organizational Impact, and many more. Moreover, the 2021 Fashion Transparency Index gave them an overall transparency rating of 51-60%, which is higher than most fashion companies; they also ranked 71-80% on their policy and commitment to sustainability.

Throughout the years, Patagonia has proven that they are aware of the fashion industry's negative environmental impact and the amount of waste it produces. To tackle this issue, Patagonia 2005 launched the Common Threads Recycling Program, which aimed at reducing the number of products that Patagonia customers purchased. During this time, Patagonia wanted to create a line that never ended up in a landfill. The first part of this program was to encourage customers to fix their damaged clothing instead of throwing them away; thus, they aimed on reducing clothing waste. Patagonia published guides assisting customers on how to repair their clothes by themselves and even encouraged them to ship their damaged clothes to their repair facility charging only an affordable fee.

The second part of this program focused on creating a second-hand market for clothes that did not fit or were no longer worn by their customers. To do so, Patagonia collaborated with eBay to develop a storefront and created its online marketplace for second-hand clothing on its main website. Some years later, that initiative turned into Worn Wear, which made it possible for consumers to purchase second-hand items in selected stores. Worn Wear accounts for 5$ millions of Patagonia's business.

In addition, to reduce and prevent fashion waste, Patagonia uses 100% recycled down in many of its product lines. The recycled materials are usually taken from discarded furniture, cushions, and comforters that are clean and lab-tested for their quality before turning them into Patagonia's

clothes. In past years, Patagonia has produced much clothing with recycling materials, for instance, the Responsibili-Tee, a 100% recycled, Fair Trade Certified T-shirt, each made with 4.8 plastic bottles and 0.3 pounds of cotton scrap. As of 2021, about 90% of Patagonia's fabrics will be recycled, organic, and traceable. In addition, Patagonia is mainly using environmentally responsible materials, such as organic cotton, wool, natural rubber, and various recycled materials; that way, even if their clothes end up in a landfill or get burned, they are not going to release toxic gases to the environment. These initiatives reduce not only fashion waste but also the general landfill issue.

Another recycling initiative aiming at reducing textile waste is an innovative program introduced by Patagonia called "Take-Back." Patagonia encouraged their customers to bring their old and no longer in-use Tees to a local retail shop. Then once Patagonia was receiving them, they recycled them into Infinna fiber. Patagonia wanted to tackle the take-make-waste model of the fashion industry and reduce the waste from their clothes by recycling them into new and responsible Tee instead of throwing them in landfills.

The last environmental action that the founder of Patagonia and his family did was to transfer their ownership of Patagonia, valued at 3$ billion, to a specially designed trust and a nonprofit organization that aims to combat climate change and protect undeveloped land all over the planet. The company's founder will no longer have access to the profits of Patagonia, and the management of the profit and the company will be managed by an environmentally active nonprofit organization (The Holdfast Collective) focusing on protecting the planet. Patagonia will continue as a private corporation, but the profits will not be controlled by the founder but by the nonprofit organization. That way, the nonprofit organization will ensure that the company is still following its environmental values and focusing on becoming zero waste and reducing the fashion industry waste.

It is essential to mention that Patagonia can be seen as a great example of a company that managed to find a balance between sustainability and profitability. By constantly focusing on its environmental actions and being very transparent with its activities, Patagonia managed to have an average annual sale of 1$ billion USD and very loyal customers. By having in the center of their actions the value, "we are in business to save our planet," they managed not only to make million dollars donations but also to sustain their profitability. To conclude, Patagonia did not only manage to find a way to tackle the waste problem that is caused by fast fashion but

also to shake the current consumer and production economic system by introducing a sustainable and profitable business model.

Questions

- Do you think fashion is affecting the amount of waste ending up in landfills?
- What are the main differences between fast and slow fashion?
- How would you asses Patagonia initiative of reducing textile waste?
- What more would you do if you were the CEO of Patagonia?
- Do you believe that Patagonia's strategy is greenwashing?
- Profitability and Sustainability, can it work?

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