# Sustainable Food Systems Roadmap
## for Prizren and Suharekë/Suva Reka Municipalities



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# Contents

## Acronyms

| | |
|---|---|
| AI | Artificial Intelligence |
| ASK | Agency for Statistics in Kosovo |
| BMI | Body Mass Index |
| EC | European Commission |
| EU | European Union |
| EV | Electric vehicle |
| F&V | Fruits and Vegetables |
| F2F | Farm to Fork |
| FADN | Farm Accountancy Data Network |
| FAO | Food and Agriculture Organization of the UN |
| FLW | Food losses and waste |
| FS | Food System |
| FVA | Food and Veterinary Agency |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gas |
| ICT | Information and Communications Technology |
| IMF | International Monetary Fund |
| KfW | Kreditanstalt für Wiederaufbau, a German Development Bank |
| KLMC | Kosovo Landfill Management Company |
| LSU | Livestock Size Unit |
| MAFRD | Ministry of Agriculture, Forestry and Rural Development |
| MESPI | Ministry of Environment, Spatial Planning, and Infrastructure |
| MSME | Small and Medium-sized Enterprise |
| MSW | Municipal Solid Waste |
| NGO | Non-Governmental Organisation |
| NIBIO | Norwegian Institute of Bioeconomy Research |
| OSCE | Organization for Security and Co-operation in Europe |
| PePeKo | Association of fruits and vegetable processors |
| PV | Photovoltaic |
| SDG | Sustainable Development Goal |
| SFS | Sustainable Food System |
| SLCA | Strengthening Local Climate Action |
| SOFA | State of Food and Agriculture |
| UNDP | United Nations Development Programme |
| UNEP | UN environment programme |
| WWTP | Wastewater Treatment Plant |

# Executive summary

This roadmap concerns the transition towards more Sustainable Food Systems (SFS) in two Kosovo[1] municipalities, Prizren and Suharekë/Suva Reka and intends to contribute to minimizing the negative impact of food production on the environment, climate change and GHC emissions.

The objective of this roadmap is to show the current food systems (FSs) and to offer a vision of how to accelerate the transition toward more SFSs for Prizren and Suharekë/Suva Reka and develop a sustainable system that reduces agriculture emissions and builds climate and environmental resilience.

This roadmap is the product of desk review analyses on FSs in Kosovo with a focus on the situation in two target municipalities, as well as extensive meetings with many stakeholders at different levels such as central and local public institutions, private businesses, different associations, and several NGOs. The desk review analyses served to uncover data on current food systems in Kosovo with a focus in Prizren and Suharekë/Suva Reka Municipalities, while the information collected through field visits has been used to validate findings that emerged through the research review. As the SFS is a new concept in Kosovo and in the two target municipalities, the data and experience of partner municipalities regarding SFS are very limited.

The FSs in Kosovo including Prizren and Suharekë/ Suva Reka Municipalities face many challenges and lag behind in terms of the safety-driven food supply chain, efficient food waste management, and the promotion of healthy and nutritious diets. Meetings with stakeholders showed a need for support on a range of FS aspects ranging from farm productivity to the development of sustainable food value chains, environmentally sustainable production, efficient nutrition education, and sustainable diets.

In Kosovo, the agricultural sector is an important and strategic economic activity: it represented 7.4 % of GDP in 2020.[2] The economy of Prizren Municipality is mainly based on agriculture, trade, construction, and food processing, all private enterprises, while the economy of Suharekë/Suva Reka Municipality is predominantly based on rubber, garments and beverages, alcoholic and non-alcoholic drinks production and small trade businesses.

The greenhouse gas (GHG) emissions from the agriculture, forestry and land use sectors account for about 8 % of the total GHG emissions in Kosovo, with registered emission of 706 Gg carbon dioxide ($CO_2$) eq. in 2019. Local institutions do not register the GHG emissions from agriculture at the local level (Prizren and Suharekë/Suva Reka Municipalities). However, the Prizren city inventory of 2014, within city boundaries, compiled with UNDP support, estimated GHG emissions at 1,370,821 t CO2 eq.[3] Both municipalities are working on drafting a GHG inventory, expected to be published in 2023 with UNDP support.

In Kosovo, climate change mitigation and adaptation remain a challenge, especially as Kosovo-specific studies of climate trends, projections and impacts are limited. The GHG emissions in Kosovo 2014-2015, within Series 2: Agriculture and Environment Statistics,[4] shows that the energy sector is the main source of GHG emissions, followed by the agriculture sector. Accelerated and often illegal construction combined with poorly regulated land use planning increases the exposure to hazards. GHG emissions from coal as the main source of energy production in Kosovo

[1] References to Kosovo shall be understood to be in the context of United Nations Security Council resolution 1244 (1999).

[2] MAFRD: Kosovo Green Report 2021; 2021

[3] UNDP Kosovo: Terms of Reference - International Expert – Lead Drafting of the Sustainable Foods Roadmap for Prizren and Suharekë/Suva Reka Municipalities; 2022

[4] https://ask.rks-gov.net/media/2471/ghg-emissions-in-kosovo-2014-2015.pdf

(around 97 % of electricity generation comes from coal), insufficient wastewater treatment, stubble-burning and lack of public environmental awareness contribute to serious air and water pollution and environmental degradation, which Kosovo is working to control, but which compound climate change impacts.

Furthermore, Kosovo remains one of the poorest places in Europe, with an estimated 24.4 % of the population living in poverty in 2017.[5] Kosovo's GDP per capita is just one-quarter of the European Union average.[6] Kosovo lacks a framework for nutrition policy, programs, and dietary guidelines. The health and nutritional status of the population in Kosovo is not well understood, and there is limited information available on this subject. The daily diet in Kosovo is dominated by meat, dairy, and carbohydrates, with limited consumption of diverse and nutritious foods. Eating habits in Kosovo are still traditional in rural areas but changing quickly in urban areas, where eating out is more common. Although nutrition epidemiology is increasingly important globally, Kosovo lags behind in studying its own nutritional situation and in the role of nutrition in disease prevention and healthful eating

Official statistics reported to Eurostat show that 1,000,000 tons of total waste are generated annually in Kosovo.[7] 580,000 tons of Municipal Solid Waste (MSW) are generated, of which 74 % is collected and disposed, 50 % is estimated to be biodegradable municipal waste and 15 % is estimated to be packaging waste.

Too often, food that is not consumed turns into food waste; and households are a large source of food waste. In Kosovo each person produces around 253 kg waste, and of this some 80 kg is household food waste.[8]

Based on literature research and field meetings, the current FSs in Kosovo are facing many challenges in terms of food supply chain monitoring, promotion of healthy and nutritious diets and food waste management. There is little attention to the transformation of FSs into SFSs. The Kosovo 2022 Report states[9] "Kosovo is at an early stage of preparation on the environment and climate change". This report does not explicitly mention progress regarding SFSs but emphasizes that Kosovo needs to improve its legislation to align it with the "Green Agenda for the Western Balkans" goals. Kosovo is involved in the regional agreements and declarations for the Western Balkans and has signed the "Sofia Declaration" with its component on "Sustainable agriculture and food production". By signing the agreement Kosovo has committed to working towards sustainable agriculture and food production, aligning its food chain sectors (like farming, processing, distribution, healthy consumption, and food waste management) with EU standards.

The main conclusions are that traditional agriculture practices in Kosovo need to shift towards more sustainable agriculture to increase food productivity and quality, while protecting the environment. Prizren and Suharekë/Suva Reka Municipalities could consider the five principles of sustainable agriculture outlined by the Food Agriculture Organisation (FAO): a) Boost food chain productivity; b) Protect and spare the environmental resources; c) Improve people's wellbeing and economic growth; d) Foster ecosystems and communities' resilience; and e) Support with governmental initiatives and regulations.

The concept of sustainable agriculture rests on three main pillars, which cover the economic, social, and environmental aspects. In terms of the economic aspect, sustainable agriculture will ensure the profitability and efficiency of farming in Prizren and Suharekë/Suva Reka Municipalities. The social aspect of sustainable agriculture will aim at enough food being provided

[5] https://www.macrotrends.net/countries/XKX/kosovo/poverty-rate
[6] UNICEF Kosovo Programme: Annual Report 2021
[7] Kosovo Integrated Waste Management Strategy (2019-2028) and Action Plan (2019-2021); https://documents.pub/document/kosovo-integrated-waste-management-strategy-2020-2029-and-bio-waste-biodegradable.html?page=3
[8] "European Environment Agency: Municipal waste management in Western Balkan countries — Country profile Kosovo; 2021"
[9] European Commission, Directorate-General for Neighbourhood and Enlargement Negotiations: Kosovo 2022 Report, 2022

to the population, as well as employment and development for local communities. In terms of environmental aspects, sustainable agriculture should encourage a nature-friendly approach to farming, contributing to nature protection. Sustainable agriculture practices could include crop rotation (contributes to the soil as well as to ecological sustainability), modern irrigation techniques, minimum tillage, integrated pest management, integrated weed management, cover crop, urban agriculture, and so on.

The transformation of FSs in Prizren and Suharekë/Suva Reka Municipalities, and in Kosovo, into SFS is crucial to achieving the United Nations 2030 Agenda as well as being in line with the new EU framework on SFS that is under development.

Public finance has a significant impact on the FSs in Kosovo, including in Prizren and Suharekë/Suva Reka Municipalities. The MAFRD of Kosovo provides annual subsidies and incentives to the agriculture and food sectors. These support programmes mainly promote economic growth, reduce the unemployment rate and improve the quality of foods. In recent years, in allocating grants MAFRD has taken into consideration the applicants' investments in renewable energy systems or wastewater treatment plants. However, sustainable food production systems require that agriculture and food policies also seriously consider environmental, climate, social, and health- and nutrition-related problems. At this stage, to achieve SFSs Kosovo therefore needs to start to develop the SFS Legislation Framework, which covers the entire food value chain, from production to consumption, and waste management. Since Kosovo's objective is to join the EU, the drafting of the legal framework for SFSs should be aligned with the EU legislation on SFS, which is also being drafted.

In terms of nutritious, healthy, and safe food diets for all, the Kosovo institutions in Prizren and Suharekë/Suva Reka should acknowledge the problems of malnutrition, excess weight and obesity and their negative impact on the general health of different population groups, particularly children. Health and education authorities should develop programs on recommended dietary intakes as well as dietary guidelines for the nutrition of different population groups. Development of university education programmes related to nutrition as well as the introduction of a subject related to healthy diet and lifestyle to the curricula of educational institutions is needed. Kosovo institutions should support research activities in the field of nutrition with a particular focus on nutrition of children, as well as assessments on how health risks are associated with unhealthy eating habits.

Food loss and waste start on the farm. There are pre- and postharvest losses that could be minimized by improved agricultural advisory services. Cooling infrastructure needs further improvement in the whole food supply chain. The next important step would be waste collection, with a dual waste collection system established with "Green Bins" for organic household waste. Households could then dispose of their organic waste free of charge in separate green bins and thus reduce the overall garbage volume and the linked fee for garbage collection. It would not only reduce unsorted household waste but also make the sorted organic waste available for e.g. composting. If the overall reduction potential is to be fully exploited, it is necessary to think about how to use it in the best way; potential solutions include composting, transforming food waste into energy (and fertilizer), and burning it in incinerators to gain energy. Behaviour and food consumption patterns should also shift towards the reduction of animal-based foods and the promotion of plant-based diets.

Finally, this roadmap analyses the main sectors that need transformation. An SFS is a very complex system and thus this report deals with the main sub-chapters, starting from agriculture incorporating cold chain infrastructure and food waste, as well as energy and transport and finally as an overarching topic Information and Communications Technology (ICT), one of the key drivers in modernisation.

# 1 Introduction

The EU Green Agenda for the Western Balkans reflects the intensifying focus on systems of waste, packaging, transport and consumption, particularly at the local level and the rural-urban nexus. The Green Agenda and the Green Deal – a plan to make the EU climate neutral by 2050 – is a blueprint for possible measures to be adopted jointly by the EU and each of the Western Balkan partners. The Farm to Fork (F2F) Strategy is part of the European Green Deal and aims to make FSs fair, healthy, and environmentally friendly. It is also moving into the area of local SFSs and the deficiency in compliance with the EU's animal and plant health, food safety, and animal welfare standards in Western Balkans.

The agricultural sector in Kosovo contributes 7.4 % to GDP[10] and can contribute to economic development and employment opportunities, especially in rural areas, which is why agriculture is included among the priorities of Kosovo's institutions. The agricultural sector also accounts for 16 % of total export value. On the other hand, Kosovo still depends significantly on imported agricultural products, which accounted for 24.4 % of overall imports. Kosovo's agricultural development is supported by institutions investments in physical assets for agricultural enterprises, product processing and trade, and farm diversification and business development. Farmers are also supported with agricultural inputs, agricultural loans, agricultural sector insurance and capacity building. Kosovo's institutions have been stimulating youth engagement in agricultural activities by setting age limits for farm owners when applying for investment subventions and grants, training, and access to information. Thus, women and young people are more likely to work in agriculture, e.g. at collection points for Fruits and Vegetables (F&V). 88 % of the agricultural land in Kosovo is privately owned and 12 % is public land. Around 93 % of agricultural households own farms smaller than 5 ha, with most of them ranging between 2 and 5 ha. Land fragmentation remains a challenge to viable food production, collection, and transportation.

The global debate over food security became a challenging issue particular after 2022 saw a rapid increase in food prices and shortages around the world. The crises in different regions were caused by compounded geopolitical, economic (e.g. interrupted supply chains) and natural, (e.g. extreme heat, flooding and drought caused by climate change) factors.

Kosovo is undergoing a complex economic, political, and structural transition. It is a net importer of food commodities, with a chronic trade deficit. Therefore, the implications of global food price volatility are crucial in maintaining food security. At the same time, Kosovo is considered to be self-insufficient in meeting domestic demand for the key food staples. Increasing the consumption of local foods is thus key to stimulating local production and food self-sufficiency, which in turn reduces dependency on food imports and associated costs.

The Agriculture, Forestry and Other Land Use (AFOLU) sector accounts for about 13 % of total GHG emissions. The sector consists of three different subsectors: the livestock subsector generates about 600,000 tons of CO2 eq. per year; the land use subsector generates about 2,750,000 tons of CO2 eq. per year; and the crop fertilization subsector, including fertilizer management,- emits about 800,000 tons of CO2 eq.

In the Municipality of Prizren, the second-largest city in Kosovo, 53 % of inhabitants live in the urban area. The local economic activity is mainly based on agriculture, trade, tourism, construction, and food processing, and the Municipality is one of the leading municipalities from the perspective of economic activity. In Suharekë/Suva Reka, only 17 % of the inhabitants live in

10 MAFRD: Kosovo Green Report 2021; 2021

the urban area and the economy is predominantly based on rural agriculture, the processing of rubber and garments, production of beverages and other types of manufacturing.

Although not a signatory to Agenda 2030 and the Sustainable Development Goals (SDGs) at the UN General Assembly because of its status as a non-member, Kosovo took the decision to join global efforts to embrace sustainable development and the SDGs. Kosovo's implementation of Agenda 2030 and the SDGs, which has been voluntary in this context, started in January 2018 with the formal endorsement by Kosovo's parliament of the Resolution on the SDGs, strongly supported by the United Nations Kosovo Team[11].

Kosovo's FS plays a central role in ensuring sustainable development but is under increasing pressure to respond to numerous and complex challenges to provide healthy, safe nutrition for all. Issues of food production, consumption, food trade, agriculture, and animal husbandry as a means of livelihood, advancing equality and equity for marginalised populations, environmental risks and building resilience all resonate powerfully in Kosovo. Addressing these challenges requires multi-sectoral approaches involving, among other sectors, food, agriculture, health, social protection and education.

Having all these ambitious targets in mind, it is essential that farmers and food processors participate voluntarily in this transition process towards a more sustainable FS. It will be possible to achieve this transition if farmers and food processors can realize the same or even greater profits, as for environmental reasons they will not give up their current business models. As in the EU, an incentive scheme is needed to move farmers and other stakeholders towards greater sustainability.

The objective of the roadmap is to elaborate the SFS pathways in the two selected Kosovo municipalities, Prizren and Suharekë/Suva Reka, in order to minimize food production's negative impact on the environment, climate change, and GHG emissions.

# 2 Process of the roadmap

The process for the roadmap included mapping and assessment of food assets, production, locations, behaviours, distribution, consumption patterns, food waste, and technologies, as well as a social and gender analysis. The approach combined desk research analyses of FSs in Kosovo, with a focus on the situation in the two target municipalities, and extensive meetings with relevant stakeholders. It must be highlighted that the SFS is a new concept in the two target municipalities and in general in Kosovo and that the data and experience of partner municipalities about SFS are very limited. However, the mapping and assessment aims to develop potential targeted actions and to create a plan for potential implementation.

During the meetings with stakeholders, the questions were mainly about issues related to sustainable food production systems in Kosovo, such as:

- Do Kosovo and the two municipalities in focus have any strategic documents for SFS?
- What is the relationship between "industrial agriculture" and "traditional farming" in Kosovo and in the two municipalities?
- What is the policy in place to limit GHG emissions?
- Does Kosovo have a policy to reduce the GHG emissions from livestock production for meat, milk, and poultry/eggs?

11 https://www.kuvendikosoves.org/eng/for-the-public/sutainable-development/the-commitment-of-kosovo//

- Does Kosovo have an appropriate legal infrastructure and some exploitation of organic/food waste for energy production?
- Are Kosovo and in particular the two municipalities reforming agricultural subsidies according to SFS as well as reducing food waste?
- Is there a trend towards "plant-based foods" in Kosovo?
- What is the level of agrochemical applications in Kosovo's agriculture?
- What are the challenges, opportunities, and pathways to SFS?

Furthermore, the topic of food loss and food waste was also among the important questions.

# 3 Food Systems in Prizren and Suharekë/Suva Reka Municipalities

## 3.1 Prizren Municipality – an overview

The municipality of Prizren is located in southwestern Kosovo. It covers an area of approximately 640 km2 (64,000 ha) and includes Prizren city and 74 villages. According to the 2011 Kosovo Population and Housing Census, the total population is 177,781[12]; however, it is estimated that in 2022, 200,000 persons or more live in Prizren. The topography of Prizren Municipality is undulating, with an altitude between 300 m and 2,600 m.

The geographic location of Prizren provides conditions suitable for the development of agriculture, stockbreeding, the food industry, and tourism. The climate of Prizren is continental in character, with a mild Mediterranean climate in the lower altitudes, while a harsh alpine climate dominates in the mountains. The mild climatic characteristics nourish a context for rich natural resources, facilitating the cultivation of grapes, as well as other fruits and vegetables.

The distance from the sea is an important indicator of climatic conditions, and Prizren is 105 km from the sea. The average highest temperature in autumn is 17.6ºC. In 60 % of the year, the temperature is higher than 0ºC – which means no frost occurs during 229 days. Yearly average rainfall is 686 mm in Prizren, – ideal for viniculture. Precipitation is higher in the winter and accordingly distribution of rainfall is also convenient for viniculture.

Approximately 40 % of Prizren's population lives in rural areas. Thus, the agriculture sector remains one of the most important sources of employment and income. Agricultural activities include crop and vegetable production. Prizren Municipality has some 14,096 ha of grazing pasture, which is suitable for animal production. The overall number of agricultural holdings is 6,570 and the area of utilized agricultural land is 25,181 ha.[13]

The economy of Prizren Municipality is mainly based on agriculture, trade, construction, and food processing, all private enterprises. There are some 5,400 registered private businesses operating in the Municipality. There is no reliable data on the number of people employed in the private sector. The industrial zone is still pending expropriation.

Prizren has a long tradition of food processing. The main food processing companies are ABI ELIF; EUROFOOD; Dairy "Sharri"; Dairy "Ajka"; Mix Product; Extra Fruits Fillings; JEGE; and Birra Morea. A very active Association – 'Red Gold -Organica', with more than 100 members – operates in Prizren, aiming to improve cooperation among stakeholders and to support all its members in becoming certified with organic standards. Prizren is also a touristic town – and the most visited in Kosovo.

[12] OSCE Mission in Kosovo: Municipal Profile 2018 - Prizren Region

13 Ask Kosovo Agency of Statistics; https://askdata.rks-gov.net/pxweb/en/ASKdata/ASKdata__Agriculture__ Agriculture%20census%202014__2%20Land%20Use/Tabla%202_22.px/table/tableViewLayout1/

The Innovation and Training Park Prizren was recently inaugurated, and it is aiming to become a regional hub for entrepreneurship innovation, business and skills development, and a source of innovative and successful ideas.

In terms of food businesses led by women, in Prizren Municipality there are 170 active enterprises. Most of these are in the field of food processing, preparation, and delivery of foods for different occasions, and different types of restaurants.

The city of Prizren first produced data on GHG emissions for 2014, with the estimation of emissions from energy, agriculture, and waste management sectors. The net GHG emission in 2014 was 1,370,821 t $CO_2$ eq. The stationary energy sector/energy use emitted 26.50 %, the agriculture sector emitted 70 %, and the waste sector emitted 3.37% t $CO_2$ eq. of the total GHG emissions.[14]

## 3.2 Suharekë/Suva Reka Municipality – an overview

The municipality of Suharekë/Suva Reka is located in south-eastern Kosovo. It covers an area of approximately 361 km² and includes Suharekë/Suva Reka town and 42 villages. According to the 2011 Kosovo Population and Housing Census, the total population is 59,722.[15]

The economy of Suharekë/Suva Reka Municipality is predominantly based on rubber, garments and beverages, alcoholic and non-alcoholic drinks production and small businesses. There are some 3,700 registered private businesses, of which approximately 2,316 are active and operating while the rest are considered inactive. There are no reliable data on the number of people employed in the private sector.

The overall number of agricultural holdings is 7,189 and the area of utilized agricultural land is 21,150 ha.[16]. The main processing companies in Suharekë/Suva Reka Municipality are Frutex and Suhareka winery. This municipality is also well known for vineyards, greenhouse production, broiler production and others.

A women's association is very active in Suharekë/Suva Reka Municipality, gathering more than twenty women members engaged in different rural agricultural production businesses such as fruit and vegetable production, livestock, beekeeping, and artisanal food production. There is also a Business Center, which is home to many successful businesses, including processing and production of food and drinks and is very active within the economy of the city.

## 3.3 Key context for the roadmap

For many decades, the area of Prizren and Suharekë/Suva Reka Municipalities has served as a focal point for the production, processing, trading, and consumption of food. In addition, agricultural and food products from these two municipalities have supplied and continue to supply the market of Kosovo and beyond. These two municipalities, apart from being geographically adjacent to each other, share many similar values in terms of food systems.

Global trends, new economic realities, reduction of arable land, climate change and concerns about environment, equity and food safety have affected to capacity of these two municipalities to continue to meet their food needs and to send their products to other markets. At the same

14 UNDP Kosovo: Terms of Reference - International Expert – Lead Drafting of the Sustainable Foods Roadmap for Prizren and Suharekë/Suva Reka Municipalities; 2022
15 OSCE Mission in Kosovo: Municipal Profile 2018 - Prizren Region, Prizren
16 Ask Kosovo Agency of Statistics; https://askdata.rks-gov.net/pxweb/en/ASKdata/ASKdata__Agriculture__ Agriculture%20census%202014__2 %20Land%20Use/Tabla%202_22.px/table/tableViewLayout1/

time, and like the whole of Kosovo, these two municipalities have been shifting away from local food production to a global system, especially over the course of the past two decades. People are less connected to the food they eat. The current FSs are no different to the FSs in other countries, which have a negative impact on our planet, driving climate change and threatening the environment.

The literature research, and stakeholder meetings with many actors directly or indirectly involved in the FSs, show that Kosovo – including Prizren and Suharekë/Suva Reka Municipalities – is facing many challenges and lags behind in terms of the safety-driven food supply chain, efficient food waste management and the promotion of healthy and nutritious diets. Illegal construction, poorly regulated land use planning, insufficient wastewater treatment and lack of public environmental awareness contribute to serious air and water pollution and environmental degradation.

In terms of production and processing, there are shortcomings related to the monitoring of food nutritive values, monitoring of pesticide applications, control of additives, food distribution, food safety policies, consumer protection initiatives, consumer education policies for efficient consumption and policies for sustainable consumption and locally grown food. The daily diet in Kosovo, including in the two target municipalities, is dominated by meat, milk, cheese, eggs, and bread. Furthermore, Kosovo lacks a framework for nutrition policy, programmes, and dietary guidelines as well as lacks promotional activities in transforming behaviour and food consumption patterns towards the reduction of animal-based and increase of plant-based diets.

The current waste management policy is not promoting new solutions through incentives for separation of organic waste. Finally, the literature research and data collection in the field show that there is little attention paid to the transformation of FSs towards SFSs.

In the case of Prizren and Suharekë/Suva Reka Municipalities, the transformation of the FSs from traditional and conventional to more sustainable systems need as many possible actors across the FS acting within their own sphere of interest. Dialogue with a wide range of public, private and local stakeholders is necessary to ensure that all become familiar with the concepts related to SFSs.

As actors with greater influence in the two municipalities, businesses have the opportunity for and crucial role in establishing this transformation and supporting those who are less able to play their part in the transition to more nature-positive production.

Farmers and farmers associations – such as the rural women's associations operating within the FSs of the two target municipalities – are ideal places to promote sustainable business models. Promotion of women's production opportunities and capacities along the value chain is enhanced through the strengthening of their access to information, digital technology, training and financial services etc. Prizren and Suharekë/Suva Reka Municipalities therefore need a roadmap to transform their current FSs into SFS that are sustainable economically, environmentally, socially, and culturally.

## 3.4 Map of food assets, production, distribution, behaviours and consumption, and food waste patterns including social and gender aspects in Prizren and Suharekë/Suva Reka Municipalities

Food mapping is the process of analysing and visualizing various aspects of the food system, including food production, distribution, consumption, and waste. This process involves gathering data on food assets, such as crops and livestock, as well as information on food behaviours, such as eating habits and food preferences. The data will then allow the identification of patterns,

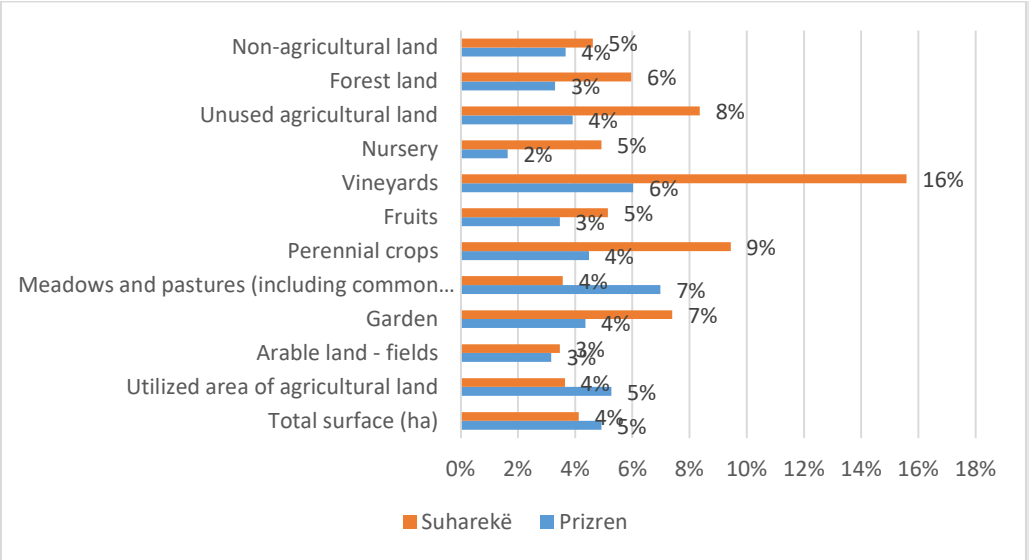
including social and gender aspects, which can influence food choices and access. The ultimate goal of food mapping is to understand and improve the FS by identifying areas for improvement, such as reducing food waste and increasing food access for all people, regardless of their gender or social status.

### 3.4.1 Agricultural production

The situation in the agriculture sector of the two targeted municipalities is very similar to the overall rural situation in Kosovo, which is characterized by small farms.

In Prizren municipality, 15 % of farms are smaller than 2 ha, 24 % are 2-5 ha, 13 % are 5-10 ha, 9 % are 10 to less than 20 ha, 5 % are 20 to less than 30 ha and 33 % are 30 or more ha. In Suharekë/Suva Reka municipality 24 % of farms are 2-5 ha, 29 % are 2 less than 5 ha, 18 % are 5 to less than 10 ha, 11 % are 10 to less than 20 ha, 6 % are 20 to less than 30 ha and 10 % are 30 or more ha. It should be highlighted that some farmers face land ownership issues because of incomplete cadastre. The chart below presents the different types of land in the Prizren and Suharekë/Suva Reka Municipalities.[17] The public forests and forests owned by non-agricultural enterprises are not included.

Chart – Different types of land in Prizren and Suharekë/Suva Reka Municipalities




Food losses are caused by various factors. There are losses of raw materials during primary production, e.g. cultivating wheat and harvesting wheat. Many agricultural products have inedible parts which are not fit for processing. Some of the edible parts are lost during processing, e.g. because of technological reasons and products of inferior quality. When the products are finalised, some are used for shelf-life tests. There is also over-production, and products that cannot be sold are returned to processors.

The table below includes some simplifications, such as that on arable land only cereals are cultivated; furthermore, it considers no perennial crops and assumes that the yield per hectare across Kosovo is the same in the two selected municipalities.

Table - Total food losses in tonnes in Prizren and Suharekë/Suva Reka[18]

17 AC/KAS
18 The consultant's own calculation.

| | Prizren ha | Suharekë/ Suva Reka ha | Total ha | Average yield in tons | Food losses in % | Food losses / ha in tons | Total food losses in tons |
|---|---|---|---|---|---|---|---|
| Total surface | 25 181 | 21 150 | 46 332 | | | | |
| Arable land - fields (cereals) | 5 705 | 6 246 | 11 951 | 3,70 | 20,00 | 0,74 | 8 844 |
| Fruits | 152 | 226 | 377 | 7,10 | 30,00 | 2,13 | 804 |
| Vineyards | 194 | 501 | 695 | 7,00 | 30,00 | 2,10 | 1 459 |
| Total food losses in tons in Prizren and Suharekë/Suva Reka | | | | | | | 11 107 |

The result shows that more than 11,000 tons of food are lost in Prizren and Suharekë/Suva Reka. In other words, 11,000 tons of primary production do not even leave the farms and therefore do not reach the market.

The number of livestock across different categories (sheep, cattle etc.) is usually calculated in Livestock Size Units (LSU); counting only the main agricultural animals, there are almost 25,000 LSU. A LSU corresponds to one dairy cow with a weight of 500 kg. Assuming that the carcase of a slaughtered animal, after the removal of the offal etc., equals 50 % of the animal's live weight i.e. 250 kg and further assuming a life expectancy of 4 years per animal, 1,534 tons of meat are produced per year. If 20 % of meat is lost in primary production, then the loss for Prizren and Suharekë/Suva Reka Municipalities would amount to 307 tons of useable meat (carcase) annually.

Table - Total livestock size units in Prizren and Suharekë/Suva Reka

| | **Total Cattle** | | **Sheep** | | **Goats** | | **Pigs** | | **Poultry** | | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | # | LSU | # | LSU | # | LSU | # | LSU | # | LSU | **LSU** |
| Prizren | 12 701 | 9 637 | 22 809 | 2 281 | 1 493 | 149 | 912 | 192 | 111 006 | 1 911 | 14 170 |
| Suharekë/Suva Reka | 10 884 | 8 048 | 4 609 | 461 | 1 253 | 125 | 85 | 24 | 104 926 | 1 721 | 10 379 |
| | | | | | | | | | | | **24 549** |

Note: 24,549 LSUs result (x 250) in 6,137,250 kg of meat; if each animal is slaughtered on average after 4 years, meat production would be 1,534,313 kg or 1,534 tons; assuming 20 % of food / meat loss (see above) one would calculate a loss of 307 tons of meat (carcase) annually.

### 3.4.2 Production and locations

Fruit and vegetable (F&V) sector

Food is produced by farmers and then sold for fresh consumption or for further processing. In Prizren Municipality, significant agri-food processors include: ABI ELIF, EUROFOOD, Dairy "Sharri", Dairy "Ajka", Mix Product, Extra Fruits Fillings, JEGE and Birra Morea. In Suharekë/Suva Reka Municipalities the significant F&V agri-food processors are Frutex and the Women Farmers Association.

At the level of production food losses take place, and more during production than in the processing.[19] Whatever food waste occurs in agri-food processing is sent back to farmers, to sell

19 Interview with Mr. Bekim ERMENI, Quality Manager and Mr. Fehim REXHEPI, Owner of AGROCELINA, 14 September 2022

usually at lower quality for processing, or to use as green manure, for composting or as animal fodder.

Dairy sector

Table – Dairy companies in the project area[20]

| Dairy | Location | Installed capacity l/d | Actual capacity l/d |
|---|---|---|---|
| SH.P.K ABI | Prizren | 80 000 | 50 000 |
| Sharri | Prizren | 50 000 | 25 000 |
| Qaushi N.P.T | Prizren | 12 000 | 5 000 |
| Afioni | Prizren | 18 000 | 4 000 |
| Eko SHARRI | Prizren | 5 500 | 2 000 |
| Natyra | Suharekë/Suva Reka | 2 500 | 1 400 |

Meat sector[21]

The meat sector in Kosovo is fragmented and incomplete. It is dominated by a large number of small cattle farms (69 % of farms have fewer than nine cattle in their herd) and private butcher shops. In 2019, local cattle farms supplied 54 % of Kosovo's market need for beef, with the remaining 46 % being imported. Total meat consumption per capita in Kosovo is estimated at around 49 kg/year (beef meat 21 kg; chicken meat 23 kg; sheep and goat meat 1.2 kg meat).

The current per capita consumption of cattle meat in Kosovo is therefore still low when compared to Central and Eastern Europe Countries and EU countries. However, with economic growth it is expected that demand will increase, as will the consumption of meat and meat products in Kosovo. According to KFVA, Kosovo has 61 licensed beef slaughterhouses, 16 of them also processing the meat, and 7 chicken slaughterhouses. Currently, meat processors are mainly making products such as sausages, hamburgers, dried meat salamis and hot dogs. As a result of the insufficient primary product supply by Kosovo livestock farmers, local meat processors import 80 % of the raw materials to meet their production needs. Since the percentage of imports of meat has increased continuously in the last five years, Kosovo continues to import live animals and also carcase meat / frozen meat to fulfil the market demand.

The current situation of the slaughterhouses in Kosovo is not encouraging, in terms of sanitary procedures and the handling of the animals prior to slaughter. The main problem in the beef sector is the inadequate quantity supplied. The slaughterhouses are outdated and mainly self-designed by the owners. Most are manual and highly inefficient in comparison to automated regional and EU animal slaughterhouses. Most are involved in processing but without adequate quality packaging. As a result, the domestic beef producers and processors supply only to restaurants and retail meat shops, while it is almost impossible to supply the big supermarkets without better traceability and improved packaging. This situation leads to high seasonality for businesses. During the summer season, when restaurants are busier and weddings more frequent, the demand for domestically-produced and -processed beef is very high. However, in the off-season the turnover of the beef processing plants falls as demand from restaurants decreases. The seasonality problem then translates directly into the farmers having beef supply shortages for slaughtering, and many have not been able to consolidate into commercial farms.

20 EC, SOGEROM: Sector Study Livestock 2021 in the frame of the project "Support to the Ministry of Agriculture, Forestry and Rural Development (MAFRD in Kosovo) in developing its agriculture policy under the financial framework 2021-2027"
21 EC, SOGEROM: Sector Study Livestock 2021 in the frame of the project "Support to the Ministry of Agriculture, Forestry and Rural Development (MAFRD in Kosovo) in developing its agriculture policy under the financial framework 2021-2027"

Moreover, farm practices are very poor and the data on traceability and animal registration are insufficient. The removal of slaughtered animals is not done properly, and animals slaughtered by farmers are not reported. Meat inspection regulations need to be enforced regularly. In most meat shops, carcases are hung in store windows in direct sunlight and with no refrigeration or kept in small refrigerators in the store. For the smaller butcher shops, there is an absence of refrigerated trucks to transport fresh meat and of cold storage facilities to properly store meat. Many small shops have simple refrigerators in which they store carcases/fresh meat after it has been hanging in the unrefrigerated store windows during the day.

As regards waste from slaughterhouses, meat processors and culled animals would need a rendering plant. Kosovo has built one, owned by the Kosovo FVA, but it is not in operation yet.

Table – Slaughterhouse sector in the project area[22]

| Slaughterhouses | Address | Municipality | Activity |
|---|---|---|---|
| EDIN | Rr. Barutana p.n | Prizren | Slaughtering/Processing |
| NADIR SHANTIR | Rr. Tranzitit | Prizren | Slaughtering/Processing |
| BISTRICA | Reçan | Prizren | Slaughtering |
| NAILI | Rr . Tranzitit | Prizren | Slaughtering/Processing |
| MULLABAZI | Rr . Tranzitit | Prizren | Slaughtering |
| B & A | Rr .Fazli Graiçevci | Prizren | Slaughtering |
| YMERI GRUP | Rr. Dervish Salihu | Prizren | Slaughtering/ Processing |
| ILIR BASHA | Rr.Beteja e Pashtrikut | Prizren | Slaughtering |
| XHOSHKUN DRANGOJ | Lubizhdë / Ljubižda | Prizren | Slaughtering/Processing |
| FAT-MANI | Studençan / Studenčane | Suharekë/Suva Reka | Slaughtering/ Processing |

Table – Meat processing sector in the project area[23]

| Meat processing company | Location | Municipality | Activity |
|---|---|---|---|
| ARQE-IKO | Rr. Jeta e re | Prizren | Processing |
| MEDINA | Rr. Tiranës p.n | Prizren | Processing |
| DINAMIKA | Posëlisht | Prizren | Processing |
| BUJAR-COMERC | Magj. Pz-Pr | Prizren | Processing |
| FEVZI | Rr Deshmoret e Kombit | Prizren | Processing |
| N.P.P. "BENI | Shirokë / Shiroke | Suharekë/Suva Reka | Processing / Packaging |
| ADA -GROUP | Shirokë / Shiroke | Suharekë/Suva Reka | Processing |

Wine sector

Suharekë/Suva Reka is the second largest wine area in Kosovo behind Rahovec/Orahovec with 2,465 ha and Prizren is the third largest area.

22 &
23 https://auvk.rks-gov.net/bizneset/bizneset-e-aprovuara-per-ushqime-me-origjine-shtazore/

Prizren Municipality has 198 ha of vineyards; Albatros is a key stakeholder. Suharekë/Suva Reka Municipality has 575 ha of vineyards and key stakeholders are Theranda, Dardania, Labi; altogether these three wineries manage approximately half of all wineries in Suharekë/Suva Reka.

Specific data on waste from vineyards are not available, but it may be calculated that each hectare of wine has some 3,000 plants. During the year, some 1 kg per plant is trimmed, pruned or thinned, resulting in 3 tons per hectare. For Prizren Municipality this would mean around 600 tons of vine residue from vineyards, and for Suharekë/Suva Reka 1,800 tons.

If not burned or mulched, this material would be suitable as fuelwood; this would need a compressing machine and then transport to a biomass heating power plant, such as in Gjakova/Djakovica.

For environmental reasons and for reasons of circular economy, it would be best to mulch these branches; were this not feasible, because of lack of machinery, the estimated waste would be 2,400 tons for both municipalities. If compacted properly, this could be used to fuel the biomass power plant in Gjakovë/Djakovica.

### 3.4.3 Distribution

Food distribution happens between farmers and markets for fresh products, and between agri-food processors and retailers such as grocery shops, supermarkets, and others. In the case of poor food logistics, food is wasted – e.g. by interrupted cold-chains. However, the most significant food waste happens at household level and is therefore not linked to distribution.

Supermarkets are becoming more important in Kosovo;[24] this is linked to the fact that agriculture, at least at subsistence level, is declining and that urbanisation is progressing. A study on the Balkans shows that most of urban inhabitants (60 %) are shopping from hypermarkets and supermarkets. Current supermarkets in Kosovo are: ETC, VIVA FRESH, INTEREX, SUPERVIVA, Albi Market, CONAD Kosova, DEPPO Market, KAM Market, Maxi, Next Market, SPAR, and Landi star.

### 3.4.4 Behaviour and food consumption patterns, including social and gender aspects

A transformation of both food production and food consumption, including reduced meat consumption and the shift to more plant-based diets, is important in reaching climate targets.[25] Reduced meat consumption has impact on global GHG emissions, given that the livestock sector is responsible for approximately 14.5 % of global GHG emissions and is the single most important source of methane, a particularly problematic GHG.[26]
Eating behaviour is determined by quantity and quality of food intake and very much by food consumption patterns; eating is also a social attitude and sitting more often with the family around a table may also have an influence on body weight.

Body Mass Index (BMI) is a measure of body fat in adults based on height and weight. The Albanian figures, as there are no ones for Kosovo, for body mass index are 26.6 for men and

[24] https://en.wikipedia.org/wiki/List_of_supermarket_chains_in_Europe#Albania
[25] IPCC J.M.P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, et al. (Eds.), Climate change and land: An IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems, United Nations. 2019
[26] Gerber, P., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J. et al.: Tackling Climate Change Through Livestock: A Global Assessment of Emissions and Mitigation Opportunities, FAO. 2013

25.6 for women, and thus an average of 26.1. For comparison, the average BMI in Greece is 27.3 and in Austria 25.4.

Western Balkan consumers differ from other countries in the importance they attach to health, natural content, and weight control. In a study of motives underlying food consumption in the Western Balkans,[27] 34 % of the sample (mainly urban women older than 50) were significantly concerned about weight control and health, 31 % were moderately concerned about health and weight, while 21 % were concerned about health but paid less attention to weight control – mainly men and people living with children. The last group (14 %) consisted of unconcerned young men eating less fruit and showing higher impulsiveness.

In Kosovo, with a total population of 1,773,971[28] people, about 63 % of the population lives in rural areas. According to the "Results of the Household Budget Survey, 2017", a great part of the household budget in 2017 was spent on food and housing: 40 % for food and 29 % for housing (of total consumption), followed by transport and clothing costs. Food from own production has been declining steadily as a proportion of total consumption; in 2017 it was 5 %.

In terms of foods, cereals and dairy products are perceived as inferior goods, while the meat, fruits and vegetables are regarded as normal goods.[29] The daily diet in Kosovo is dominated by meat, milk, cheese, eggs, bread, and cereals, contributing to more than half of the consumption of food (in value), followed by vegetables and non-alcoholic beverages.

Traditional behaviour still dominates in rural areas, where women are securing and preparing the food. Much of the field work, especially manual work, is done by women; but on the other hand support for agriculture is dominated by men, with only 4.9 % of farm-owners being women.[30] In urban areas with more single households, this behaviour is changing quickly. Additionally, eating out is more a factor of an urban lifestyle.

Regarding employment, a large percentage of women work in agriculture – far more than the official 3 %, as most women are not formally employed. Furthermore, the F&V processing industry is dominated by women, as most sorting, grading, and packaging is done by women, who are in the majority of cases registered employees.

Only a few studies are available on foods, food consumption and behaviours in Kosovo. According to the study "Nutrition and Health Aspects of food in Balkans"[31,] the traditional Kosovo cuisine is very diverse and, although new western influence increasingly pushes people to eat out, food is still commonly" homemade", mainly from non-processed, locally-sourced ingredients, which do not come from mass imports. The general perception among Kosovars is that traditional food is high in natural content, and this constitutes the main driver for consumption of such products. The study notes that in general, Kosovo's cuisine has developed from what was cultivated and produced from the land where the people lived. Mountain regions are characterized by meat and dairy dishes; pastry dishes were made with locally sourced ingredients and crops.

Information on the nutritional composition of traditional foods in Kosovo is scarce and there are no studies on traditional foods nor nutritional data for such foods, as well as no data on the average intake of calories by Kosovo's inhabitants.

27 Mardon, J. et al - Motives underlying food consumption in the Western Balkans; International Journal of Public Health; 2015
28 https://ask.rks-gov.net/en/kosovo-agency-of-statistics
29 BRAHA, K., CUPÁK, A., QINETI, A., POKRIVČÁK, J.: 'Food Demand System in Transition Economies: Evidence from Kosovo, Conference: 162nd EAAE Seminar: The evaluation of new CAP instruments: Lessons learned and the road ahead At: Budapest, Hungary. 2018
30 https://eca.unwomen.org/en/news/stories/2021/10/in-kosovo-gender-responsive-budgeting-raises-hope-for-rural-women
31 Nutritional and Health Aspects of Food in the Balkans DOI: https://doi.org/10.1016/B978-0-12-820782-

It is a general perception that the use of traditional homemade foods by Kosovars has contributed to prevention of serious problems caused by diet, including noncommunicable diseases and especially overweight and obesity. This is attributed to the fact that vegetables have a central position in Kosovo cuisine. However, "after the 1999 conflict in Kosovo, people moved from rural to urban areas contributing to changing the food consumption pattern from traditional foods that included food preparation at home toward fast-foods.

"Although nutrition epidemiology is developing worldwide into a sector with high public health importance, Kosovo is lagging behind in studying the nutritional situation of its population and that understanding the role of nutrition in the aetiology of many diseases and intervention measures in maintaining healthful eating patterns among different population groups in Kosovo is still receiving little attention. In terms of traditional foods in the Kosovo, there is no food composition database for local products"[32].

In terms of food safety aspects in general, Kosovo has developed a legal basis for food safety and its legislation is also aligned with the EU acquis,[33] but mechanisms are yet not sufficiently prepared to implement it. Kosovo has signed the Stabilization and Association Agreement with the EU, and food quality and safety aspects are among the main areas of the agreement – thus the quality and food safety need to be addressed.[34]

There are no relevant consumer studies available for Kosovo, except on milk.[35] When purchasing milk and dairy products in Kosovo, the following factors are influencing consumer behaviour. Product quality is shown to be a very important factor, with around 61 % of the impact on consumers' choice, followed by product safety and price, as a moderately important factor with 47 %. Other factors such as brand, packaging, origin, and product content have not been shown to be important in affecting purchasing and consumption choices about milk and dairy products.

In the Balkans, women are in charge of cooking and food management in the majority of households.[36] There is a low rate of household food waste and a favourable attitude towards food waste prevention, and the majority is familiar with the most common expiry labels, notably 'use by' and 'best before'[37]. Household food waste is influenced by factors such as meal planning, grocery shopping, storage, cooking and eating.

The beginning of the pandemic was accompanied by significant increases in food loss and waste due to disruptions in supply chains caused by blockages on transport routes, mobility restrictions and quarantine measures, particularly for perishable agricultural products such as fruits, vegetables, fish, meat, and dairy. COVID-19 boosted panic buying and stockpiling, and some families expanded their home stocks, particularly of non-perishable food items. Fears about interruptions in the food supply chain have led to an increase in the amount and the diversity of food purchased by households. Reducing food waste has become critical from financial, environmental, and social standpoints. Altogether it seems that the pandemic has raised awareness of the problem of food waste.

Meanwhile, several pieces of research have highlighted that food waste had decreased in many countries. It seems that changes in consumer behaviour regarding food waste are more likely to be affected by the socioeconomic backdrop of the pandemic than by pro-environmental concerns.

32 Nutritional and Health Aspects of Food in the Balkans DOI: https://doi.org/10.1016/B978-0-12-820782-
33 European Commission. (2017). Kosovo - EU for food safety in Kosovo. Retrieved from ipa_2017_040506.09_ks_eu_for_food_safety_in_kosovo.pdf
34 European Commission / SOGEROM Consortium: Sector studies (crop, livestock, and diversification) for Kosovo within the project "Support to the Ministry of Agriculture, Forestry and Rural Development (MAFRD) in developing its agriculture policy under the financial framework 2021-2027". 2021
35 Bytyqi, N., Muji, S., Rexhepi, A.: Consumer Behavior for Milk and Dairy Products as Daily Consumption Products in Every Household—The Case of Kosovo. Open Journal of Business and Management, 2020, 8, 997-1003. https://www.scirp.org/journal/ojbm
36 Vasko, Z. et al: Food waste perceptions and reported behaviours during the first wave of the COVID-19 pandemic: Evidence from Bosnia and Herzegovina; 2022;
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9490395/
37 Best before dates indicate when a food was best, it does not mean that the food is inedible after this date.

This may be because most people's purchasing behaviour is more determined by their budget than by their environmental awareness.

In general, the most industrialised nations with the highest per capita income generated the most significant food waste. In low-income countries, food is mainly lost in the early and intermediate stages of the food supply chain; considerably less food is wasted at the consumer / household level. Further, the findings indicate that cereals, bakery items, milk, and dairy products tent to be the most wasted food groups. Because of its limited shelf-life, consumers find that old bread is less attractive than fresh. Consequently, bread is one of the most wasted foods globally.

Age, education, job position and family status significantly affect behaviour regarding the quantity of food thrown away. Older people waste less food than their younger counterparts. Married couples with children waste more food than other categories. Most people cook the main meal at home from fresh ingredients, and they do it 3 - 6 times a week, 15 % do it 7 - 10 times per week. 68 % of respondents ate leftovers from the previous day less than twice a week. A tiny number of people do not cook at home at all (<1 %): the frequency of dining out, buying ready meals, or using delivery services is modest.

When it comes to damaged, spoilt or dehydrated food, 40 % of consumers believe that food is still edible beyond the shelf-life date, thus increasing food usage and decreasing food waste. Nevertheless, in some bigger markets in Kosovo, extra label was noticed on products, indicating false expiry dates; re-labelling takes place and there is a need for strict inspections everywhere.

As already mentioned, food waste is significantly lower in developing countries than in developed ones. While in low-income countries waste occurs during production processes, in middle- and high-income countries waste is mostly driven by retailers and consumers. Household food waste is around 30 % of total food waste. In the European Union, households are responsible for about 53 % of the food wasted within the value chain.[38]

A visit to the green market in Prizren showed that almost no food is wasted – from an estimated daily turnover of 50 tons. The reason for this might be that fruits and vegetables are sold at discount prices as soon as their quality deteriorates. In most cases a buyer can be found, even at lower prices. Meanwhile, the food in the green market does not have an official expiration date and therefore no food waste occurs. Smaller quantities of low-quality products are taken home by employees to feed their animals.

### 3.4.5 Food waste and food waste estimates

Official statistics reported to Eurostat state that 1 million tons of total waste is generated annually in Kosovo. The official statistics on quantities of municipal solid waste from 2017 state that:

- 580,000 tons of Municipal Solid Waste (MSW) are generated
- 420,000 tons (74 % of total MSW) are collected and disposed of
- 290,000 tons (50 % of total MSW) are estimated to be biodegradable municipal waste
- 90,000 tons (15 % of total MSW) are estimated to be packaging (paper, plastic, glass, metal).[39]

Food waste is largely produced in households; reasons could include:[40]

38 Jribi, S., Ben Ismail, H., Doggui, D., Debbabi, H.: COVID-19 virus outbreak lockdown: What impacts on household food wastage? Springer Nature B.V. 2020
39 http://kepweb.org/wp-content/uploads/2020/04/F_KEP_D0.00.20-Draft_Waste_Management_ Strategy-2019-2028.pdf
40 Obersteiner, G. at University of Natural Resources and Life Sciences, Vienna; Sacher, C. at Waste Management Association Mid-Tyrol; Urbanova, L. at Glopolis: Appreciate your food and #reducefoodwaste – Guideline for Consumers 2019. STREFOWA, www.interreg-central.eu /STREFOWA, www.reducefoodwaste.eu

a) Not keeping track of stock at home
b) Shopping behaviour (buying too much, not sticking to a shopping list)
c) Too much prepared, cooked or served
d) Lack of ideas for cooking (especially when dealing with leftovers)
e) Wrong storage / treatment of food e.g. not refrigerating
f) Incorrect interpretation of sell-by / best before date
g) Lack of knowledge about preservation methods
h) Lack of awareness / knowledge about environmental and social impacts of food waste.

Food is defined as any substance, whether processed, semi-processed, or raw, that is intended for human consumption, including any substances that have been used in the manufacture, preparation, or treatment of food. This excludes drinks.

Inedible parts of food and unavoidable food waste refer to components associated with a food that in a particular food supply chain are not intended to be consumed by humans. This is food thrown away that would not be edible under normal circumstances for most people. Examples include bones, rind, or pits/stones. Meanwhile, avoidable food waste comes from originally edible matter.

Food waste (including food loss) refers to food, as well as the associated inedible parts, removed from the food supply chain. That means that this matter is not used for normal human consumption.

a) Inedible parts (bones, skins, etc.) Non-avoidable
b) Preparation residues (skins, etc.) Non-avoidable
c) Consumption residues Avoidable
d) Partially consumed food Avoidable
e) Entirely uneaten food (as purchased, whole, unopened) Avoidable[41]

Today, consumer food waste is a challenge. An estimated 17 % of total global food production is wasted: 11 % in households, 5 % in the food service sector and 2 % in retail.[42]

The issue of food waste is currently resurfacing because reducing or increasing losses can improve or worsen food security and, as a result, affect the achievement of some of the Sustainable Development Goals (SDGs, most notably SDG 2, 'Zero Hunger', and SDG 12, 'Responsible Consumption and Production').[43]

The world is producing sufficient food to feed its population and to achieve SDG 2, Zero Hunger. This will also be valid for an increasing population, and the impending production problem could most likely be solved by shifting the human diet step-by-step away from animal proteins. However, global food production would need to double by 2050 if the demand for meat from resource-hungry livestock-raising methods continues.

The problem is that many people cannot afford to buy (sufficient) food; hunger is thus rather a distribution than a production problem. Consequently, in most cases, reducing food waste will not change much in terms of hunger (but it would do much in terms of negative climate impact,

41 Obersteiner, G. at University of Natural Resources and Life Sciences, Vienna; Sacher, C. at Waste Management Association Mid-Tyrol; Urbanova, L. at Glopolis: Efficient treatment of food waste - Guideline for Waste Management sector 2019. Publisher: STREFOWA, www.interreg-central.eu/STREFOWA, www.reducefoodwaste.eu
42 UNEP: Food Waste Index Report 2021. Nairobi
43 Vasko, z. et al: Food waste perceptions and reported behaviours during the first wave of the COVID-19 pandemic: Evidence from Bosnia and Herzegovina; 2022;
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9490395/

because of resources wasted to produce food that is not consumed). Reducing food waste can become important, if physically not enough food is accessible.

Kosovo's GDP per capita is USD 4,860 (nominal) for the year 2021;[44] that is substantially less than neighbouring Albania where the GDP per capita is USD 6,260 (according to International Monetary Fund, IMF).[45] According to UNEP, in Albania the Country Household food waste estimate is 83 kg/capita/year; as data about Kosovo are not available, one might estimate that Kosovo produces around 80 kg/capita/year.[46]

For a full picture, the European Environment Agency states that the "Municipal waste generation in Kosovo has increased from 319,000 tons of waste generated in 2015 to 452,000 tons of waste generated in 2019. This corresponds to 178 kg per capita in 2015 and 253 kg per capita in 2019, roughly half of the EU average of 502 kg per capita in 2019. The reported amount of municipal waste generated corresponds to the quantities that are collected. These numbers are estimated based on the amount of waste produced per household per year multiplied by the number of households covered by regular collection services. The increase of 42 % in total waste treatment between 2015 and 2019 can therefore be mainly attributed to an increase in the share of the population connected to waste collection services."[47]

Considering that these data are dealing only with the quantities collected by municipalities, there is still a question regarding how much was collected by others (e.g. farmers picking up vegetable leftovers from markets, illegal dumping of waste, which then is not considered as collected by municipalities).

80 kg household food waste of 253 kg overall municipal waste equals some 30 % of the total waste. The data do not allow a conclusion about how much food waste – including food losses from agriculture and agri-food processing and food waste from restaurants, grocery shops, supermarkets and other food places – is produced in total per capita. By way of comparison, in Jordan around 50 % of the total collected waste is of organic origin. This "organic waste" is usually mixed and, despite being 50 % organic materials, cannot be separated any further, because separation would be too expensive, and this waste is also considered as hazardous. Hazardous waste has properties that make it dangerous or capable of having a harmful effect on human health or the environment.

Kosovo in general lack the technology, expertise, and infrastructure to reduce food loss and waste, and currently around 30 % of food is wasted. This is also because the farmers are unable to insulate and cool or refrigerate produce after it is harvested. For this reason, Ultra-High Temperature Milk was very popular for many years in Kosovo, as no cooling was needed and therefore the high price was accepted as milk would not become sour.

At present, food waste from small fast-food shops and restaurants is either going to municipality landfills or, to a small extent, to animals raised by the restaurant owner or its employees. According to EU regulations, untreated food waste cannot be served to animals for health reasons; more specifically, regulation (EC) No 1069/2009 prohibits the feeding of catering waste to farmed animals, other than fur animals. As the FVA shows, this common practice of feeding leftovers from restaurants and elsewhere to animals is widespread in Kosovo and not yet prohibited. However, within the accession process this EU regulation will become binding in Kosovo too.

44 https://gdpandeconomy.com/kosovo-gdp/
45 https://en.wikipedia.org/wiki/List_of_countries_by_GDP_(nominal)_per_capita#Table
46 United Nations Environment Programme: Food Waste Index Report 2021. Nairobi
47 „European Environment Agency: Municipal waste management in Western Balkan countries — Country profile Kosovo; 2021"

### 3.4.6 Legal aspects of FS transformation towards sustainability

The transformation of FSs towards SFSs needs policies and food system-related laws. FAO and EU have agreed to increase joint efforts to transform agri-food systems, in order to make them more inclusive, efficient, resilient and sustainable. The FAO's Strategic Framework 2022-31[48] considers "institutions and governance" as one of the main "priority triggers" for transforming processes because governance and institutions influence all the drivers and the channels that link the various elements of agri-food systems with the other systems – for instance, the activities of agri-food systems (primary production, processing, distribution, consumption, disposal etc.) and their interactions with socio-economic and environmental systems.

The EU is working on the EU legislative framework for SFS. In May 2020, the F2F Strategy was published, and the European Commission announced that it will include a proposal for a new Legislative Framework for Sustainable Food Systems (SFS Law). It is expected that the SFS Law, to be approved by the end of 2023, will support SFS transformation.

Based on literature research and field meetings it becomes evident that the current FSs in Kosovo face many challenges in terms of food supply chain monitoring, promotion of healthy and nutritious diets as well as food waste management. There is little attention to the transformation of FSs towards SFSs.

However, the transformation of FSs in Kosovo towards SFSs is crucial to achieving the United Nations' 2030 Agenda as well as to being in line with the forthcoming EU framework on SFSs. Public finance has a significant impact on FSs in Kosovo. Every year the Kosovo Institutions, through various authorities, provide subsidies and incentives to the agriculture and food sectors. These support programmes aim to promote economic growth, reduce the unemployment rate, and improve quality. Sustainable food production systems require that the agriculture and food policies consider also environmental, climate, social, and health- and nutrition-related problems.

Drafting the legal framework for SFSs will also require the alignment of other relevant laws and policies towards environmentally and healthy food systems. The authorities can shift their support through incentives that drive consumption patterns towards healthy and sustainable food choice including changes in eating habits.

Furthermore, the FAO Development Law Service has just released a new study on the role of legislation in promoting healthy diets from an FSs perspective.[49] Legislation is one of the most effective mechanisms available to give effect to the implementation of long-term changes to facilitate the transition to healthier diets. In this context, it is essential to prioritize the right to adequate food (and to water) as a basis for ensuring food security within the framework of SFSs, while considering other elements of FSs and their actors, especially in the wake of the pandemic and the urgent need for rapid recovery and transformation.

In addition to necessary changes in current food consumption patterns, it is vital to move towards sustainable and inclusive food systems, which involve a plethora of actors in addition to consumers. Inclusive and sustainable FSs will guarantee access to healthier diets and ultimately satisfy the human right to adequate food for all. Legislative frameworks will need to be carefully thought out, to cater for the myriad interests across FSs and the need to balance economic viability, environmental concerns and human health, among other factors. This study represents a contribution to the discussion at regional level on how to ensure better nutrition from an FS perspective.

48 FAO: Strategic Framework 2022-31; 2021
49 https://www.fao.org/legal-services/news/detail/es/c/1481006/

Kosovo might take this study as an inspiration and will most likely have to work on similar policies, laws and regulations.

### 3.4.7 Map of food assets

A map of food assets visually depicts particular food resources across a certain area. Such a map aims to expand the understanding of food access and systems, serving as a starting point to explore how the local population accesses food and interacts with various types of food (e.g. charitable food, grocery stores/markets, restaurants). Such a map in the context of this report should reflect categories including farmers markets, green markets (wholesale markets), restaurants (fast food / kebab), grocery and corner stores, supermarkets, petrol stations with fast food or mini-markets, food banks and free prepared food or hot meals, schools with kitchens, military barracks with kitchens, hospitals with kitchens, other public buildings with kitchens / cantinas other places where food is produced or consumed, landfills and others. However, due to limited information, it was not possible to draw such a thing.

In an attempt to provide an overview, a map has been designed showing the major food outlets in Prizren city and some selected villages. (See Annex: Map of food assets.)

# 4 Roadmap on sustainable food systems for Prizren and Suharekë/Suva Reka Municipalities

## 4.1 Sustainable Food System

An FS gathers all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the outputs of these activities, including socio-economic and environmental outcomes.

An SFS is an FS that delivers food security and nutrition for all in such a way that the economic, social, and environmental bases to generate food security and nutrition for future generations are not compromised.

An FS[50] encompasses the entire range of actors and their interlinked value-adding activities involved in the production, aggregation, processing, distribution, consumption, and disposal of food products that originate from agriculture, forestry or fisheries, and parts of the broader economic, societal, and natural environments in which they are embedded. The FS is composed of sub-systems (e.g. farming system, waste management system, input supply system, etc.) and interacts with other key systems (e.g. energy system, trade system, health system, etc.). Therefore, a structural change in the FS might originate from a change in another system; for example, a policy promoting more biofuel – biodiesel and bioethanol – in the energy system will have a significant impact on the food system.

This means that an SFS is

- profitable throughout (economic sustainability);
- beneficial for society (social sustainability); and
- positive or neutral in its impact on the natural environment (environmental sustainability).

[50] FAO: Sustainable food systems. Concept and framework; 2018

In order to be sustainable, the development of the FS needs to generate positive value in three dimensions simultaneously: economic, social and environmental. In the economic dimension, an FS is considered sustainable if the activities conducted by each FS actor or support service provider are commercially or fiscally viable. The activities should generate benefits, or economic value-added, for all categories of stakeholders: wages for workers, taxes for governments, profits for enterprises, and food supply improvements for consumers. In the social dimension, an FS is considered sustainable when there is equity in the distribution of the economic value added, taking into account vulnerable groups categorized by gender, age, race and so on. It is fundamentally important that FS activities contribute to the advancement of desirable socio-cultural outcomes, such as nutrition and health, respect for traditions, satisfactory labour conditions, and animal welfare. In the environmental dimension, sustainability is determined by ensuring that the impacts of FS activities on the surrounding natural environment are neutral or positive, taking into consideration biodiversity, water, soil, animal and plant health, the carbon footprint, the water footprint, food loss and waste, and toxicity.

### 4.1.1 Sustainably improved agri-food production and productivity

Rationale of the pathway

Kosovo is 10,887 km² in area; its population is 1.78 million and growing. Land suitable for agriculture covers 39 % of its size, while forestry represents around 46 %; of that, 60 % is public property and managed by Kosovo Forestry Agency, whereas 40 % is privately controlled.[51] Agriculture is considered a strategic economic activity, and it contributes 7.4 % to GDP; the GDP per capita in 2021 was USD 4,860 (nominal).[52]

Of the agricultural land, 52 % is meadow and pasture, and the rest is used for crop production. 60 % of the agricultural value added comes from crop production (EUR 441 million) and 40 % from the livestock sector (EUR 294 million). The agricultural GDP is composed of 52 % crop production and 48 % animal husbandry.

50 % of Kosovo's farms have less than 2 ha, and 23 % more than 30 ha. The price for agricultural land is increasing continuously; current prices for agricultural land in Prizren Municipality are EUR 40 - 50,000 / ha. Overall, land prices are too high for farming activities – profitability is too low relative to land prices.
According to the data of the MAFRD Green Report of 2020, the total utilized area of agricultural land did not change significantly, and the trend of utilization remains stable. Unfortunately, the overall production value in crop and livestock had decreased since 2016 - 2018. There is also a trend of decreasing vegetable yield per hectare. The areas under fruits, on the other hand, including soft fruits and nuts, are continuously increasing; that reflects the prosperity of this sector.

Livestock and in particular dairy remain the major business activities throughout rural areas of Kosovo. However, it faces the challenge of transforming from an inefficient, small-sized dairy farm sector to one that must eventually compete with the very efficient EU dairy industry.[53] With competition increasing globally, and profit margins decreasing in most countries, it is critically important for dairy farmers in Kosovo to both improve milk quality and enhance the efficiency of milk production. While exports did not change significantly, imports increased steadily.

51 SOGEROM Consortium: Sector studies (crop, livestock, and diversification) for Kosovo within the project "Support to the Ministry of Agriculture, Forestry and Rural Development (MAFRD) in developing its agriculture policy under the financial framework 2021-2027". 2021
52 https://gdpandeconomy.com/kosovo-gdp/
53 EC, SOGEROM: Sector Study Livestock 2021 in the frame of the project "Support to the Ministry of Agriculture, Forestry and Rural Development (MAFRD in Kosovo) in developing its agriculture policy under the financial framework 2021-2027"

The total number of animals for cattle sheep and goats) shows a trend of decline. This is widespread in Europe as farmers reduce their numbers of cattle, mainly dairy cows, and invest in higher yielding animals – so that decreasing headcount is more than balanced by greater yield (e.g. milk) per animal. Kosovo's 2020 average milk production per cow per was only 2,105 litres. Kosovo's milk cows are local breeds with low performance, poor nutrition management, poor stables, and consequently poor hygiene. Due to Kosovo's liberal trade arrangements and the underperforming milk sector, there are huge import volumes and consequently a huge price pressure on local farmers.

The meat sector is considered to have a good import substitution and growth potential in Kosovo, as the demand for meat products is high and Kosovo imports a significant amount of meat products to meet its consumption needs; in 2019 more than EUR 74 million have been imported.[54] Given the right approach, increasing local meat production, and substituting part of the imports could affect overall economic growth. Only several farms are focused on intensive fattening with a relatively low number of heads. Therefore, most of the meat used for processing is imported and only the butcher shops sell fresh domestic meat.[55] Beef is the type of meat most in demand in Kosovo, followed by poultry and lamb. In 2019, local cattle farms supplied 54 % of Kosovo's market need for beef meat. The poultry industry, mostly focusing on egg production, has increased steadily over the past five years. The number of broilers is decreasing, partially because MAFRD is not supporting investments in broiler meat production.

From the macro-economic point of view, it should be mentioned that the overall trade balance in agri-food is heavily in deficit.

Table - Gross domestic product according to economic activities in Euro at current prices[56]

| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Agriculture, hunting, forestry, and fishing | 435,635 | 493,337 | 470,932 | 435,728 | 510,773 |
| Percentage of GDP | 7.7 | 8.2 | 7.4 | 6.5 | 7.2 |
| GDP in total | 5,674,422 | 6,037,273 | 6,356,456 | 6,671,522 | 7,056,172 |

Overall, agricultural production and productivity is generally limited, due to small farm sizes, poor agricultural mechanisation, and farm machinery[57] depreciating due to age and lack of maintenance; the total number of tractors would be sufficient, but there are too many outdated tractors so that mechanisation is not efficient. There is also a lack of advisory services and limited access to agri-finance. Upgrading productivity of the crop and livestock sectors is critical for SFSs, and to becoming less dependent on imported agri-food products.

- Prizren Municipality

Data about agricultural land in the municipality of Prizren are different compared with the ones for Kosovo. The consultant met with the representatives of the agriculture department in Prizren Municipality, who presented the most up-to-date data for the municipality. The Municipality has a total land area of 63,474 hectares, of which around 53 % is dedicated to agriculture, 39 % to forest, and 8 % to other uses.

54 EC, SOGEROM: Sector Study Livestock 2021 in the frame of the project "Support to the Ministry of Agriculture, Forestry and Rural Development (MAFRD in Kosovo) in developing its agriculture policy under the financial framework 2021-2027"
55 EC, SOGEROM: Sector Study Livestock 2021 in the frame of the project "Support to the Ministry of Agriculture, Forestry and Rural Development (MAFRD in Kosovo) in developing its agriculture policy under the financial framework 2021-2027"
56 https://ask.rks-gov.net/media/6003/publikimi-i-revidimit-te-2008-2019.pdf
57 MAFRD - Kosovo / TAMAD: Plant sector study for IPARD Programme; Technical Document, 2013

Land use is as follows: arable land is 12,081 hectares, 1,373 hectares are cultivated with 14 different types of vegetables, 350 hectares are orchards, 230 hectares are vineyards, 6,378 hectares are meadow, 14,096 hectares are pasture, and 27,799 hectares are forest. 5,180 hectares are considered as infertile land, not suitable for farming. The table below shows the production of selected crops.

Table - Production of selected agriculture crops per hectare

| No. | Crop | Harvest/ha | Yield kg/ha | Production/ t |
|---|---|---|---|---|
| 1 | Wheat | 1,700 | 4,200 | 7,310 |
| 2 | Maize | 2,780 | 5,000 | 13,900 |
| 3 | Vegetable | 650 | 25,000 | 16,250 |
| 4 | Barley | 15 | 3,000 | 45 |
| 5 | Oat | 42 | 2,100 | 88.2 |
| 6 | Rye | 15 | 2,400 | 36 |
| 7 | Forage plants | 2,950 | 4,500 | 13,275 |
| 8 | Other | 280 | 3.500 | 980 |

95 % of cultivated agricultural lands are privately owned. The cereal needs are met by agricultural production by 45%, while fodder needs are met by 85% The production of vegetables is disproportionate over the year: from the end of June until the end of October, there is hyper-production compared to the rest of the year

In terms of livestock, Prizren Municipality has: 12,880 cattle; 19,820 sheep; 3,750 goats, 1,120 pigs, 2,450 horses and 62,000 poultry. The existing 179 dairy farms keep between 5 and 55 head, the 110 sheep farms between 30 and 500 sheep, and the 23 goat farms between 20 and 150 goats.

Additionally, there are 119 beekeepers with 30 to 200 hives and 9 chicken farms with a capacity of 1,200 to 8,000 chickens. 148 farmers produce wheat on an area from 2 to 100 hectares, while 146 farmers produce maize in an area between 1 and 30 hectares. There are 304 vineyards with an area between 0.1 and 20 hectares. 107 vegetable farmers produce vegetables in an area of 0.50 to 37 hectares and 113 farmers produce fruits on orchards of 0.2 to 27 hectares.

The production of raw materials of plant and animal origin in Prizren includes several dairy and meat processing companies as well as tree and vegetable processing plants. The main milk processing companies are dairies such as Abi, Sharri, Qaushi, Erha and Afion. The meat industry is represented by the companies Arqe-Iko, Xhoshkun and Shantiri. The main processors of fruits and vegetables are EUROFOOD, ABI and ELIF.

- Suharekë/Suva Reka Municipality

The Municipality of Suharekë/Suva Reka has produced its development plan for 2020-2028[58]. The agricultural data show that the total land surface in the Municipality is 36,099ha. Of this area, 19,377 ha (53.7 %) is fertile agricultural land, 1,652 ha (5 %) is wasteland, and 15,074 ha (42 %) is forest. 12,666 ha is arable land, 1,652 ha is uncultivated, and 2,250 ha is meadow and pasture. The main crops are cereals, vines, vegetables, and fruit trees. 4,481 ha are planted with cereals, 949 ha with grape vines, 646 ha with vegetables and 279 ha with fruit trees. The remaining land consists of 2,250 ha of meadow, 2010 ha converted into pasture and 2,300 ha left as wasteland.

58 DRAFT Plani Zhvillimor Komunal Suharekë 2020–2028

The cultivation of vegetables is quite widespread in this Municipality. Around 531 ha are planted with vegetables, where the main crops include tomato, pepper, potato, watermelon, melon, and onion. In recent years, some 27 hectares of vegetables were planted in greenhouses. The Municipality is also known for vineyards and wine production. The available data show that there are 514 hectares with vineyards.

In terms of livestock, Suharekë/Suva Reka municipality has 9,500 cattle, 7,400 sheep, 420 goats, 25 pigs, and around 5000 poultry. There are 503 registered beekeepers with around 6,000 hives.

As for the food industry, there are several well-known companies operating in this Municipality, such as the Wine Factory "AgroKosova Holding", the meat-processing factory "Flor-en", and the "Frutex" and "Burimi-Ag" factories for the processing of soft drinks.

Potential game-changing solutions for agri-food production and productivity

Food production

1) Improve the agri-food production and productivity in Prizren and Suharekë/Suva Reka Municipalities by working with institutions and partners to stimulate increased access to productivity-enhancing inputs (e.g. credit, fertilizers, improved seeds, matching land use with land potential and ensuring equitable access to land and water resources). Importantly, accomplishing this goal will involve reducing gender bias in access to, control over, and ownership of productive resources.
2) Reduce nutrient losses, in crop production (mainly relevant for nitrogen) as well as in livestock production, especially by promoting the recycling of nutrients in the feed – manure – crop production loop. In parallel, this will lead to lower nutrient losses to the environment. Another important route is to improve the recycling of nutrients in the food system, for example by composting waste from households, restaurants, and food processing facilities.
3) Develop a product knowledge and subsequent advisory support capacity on the blockchain for food traceability. The objective is to develop an easily understandable guide for governments and the private sector that illustrates how the technology works and offers step implementation recommendations for producers, consumers, and intermediaries, focusing on developing country contexts.
4) Expand the access to agricultural advisory services, currently provided by municipalities and the Department for Technical Advisory Services within MAFRD.
5) Promote investments in locally adaptive innovation solutions, through digital farming knowledge such as adopting digital technologies for farming, access to affordable technologies and digitalization, real time weather monitoring stations, aerial vehicles (UAVs), remote sensing and artificial intelligence (AI).
6) Provide advice services and vocational training to enhance farmers' capacity and knowledge, to strengthen producers' skills and creativity in precision agriculture techniques to tackle issues such as low productivity, inefficient agriculture practices and lack of knowledge on crop information and best practices.
7) Develop food safety legislation and management strategies and practices to grow healthy crops and minimize the use of pesticides and diseases, reducing or minimizing risks posed by pesticides to human health and the environment for sustainable pest management and crop nutrition monitoring.
8) Design and support agro-FS renewable energy applications to meet the electricity, heating, cooling, and transport needs of FSs – such as solar irrigation, renewables-based agro-processing systems, geothermal energy, cold storage and refrigeration, and sustainable bioenergy.

9) Conduct studies on different crops and crop production systems which are more productive and sustainable in different soil-climate combinations, considering soil degradation and erosion, and improvement of soil quality.
10) Engage urban communities to develop opportunities for urban agriculture and aquaculture (e.g. aquaponics) to increase the availability of nutritious food in urban environments, in turn to promote healthy diets and to expand economic opportunities.
11) Build community awareness of the importance of conserving the environment, agricultural production and sustainable practices.
12) Improve the data and information base through existing and new tools to guide renewable energy investments in FSs and inform policy makers. The effort should include mapping optimal locations to boost the benefits that renewable energy investments can bring to food systems, complemented by comprehensive cost-benefit analyses that consider the environmental, social, economic and gender aspects of those investments.

Food processing

1) Promote digital transformation of industries to help streamline facility operations and workflows through a range of products, platforms, and devices.
2) Introduce and promote Industrial Internet of Things (IIoT) sensors, for example the internet-connected sensors that collect a wide range of real-time data from site processes to help food processors by providing better data on food safety or real-time quality control. Use IoT sensors to monitor equipment performance and air humidity.
3) Use efficient equipment and materials in food processing facilities, such as LED bulbs, HVAC filters to reduce energy consumption and insulation, and contribute to a more comfortable working environment.
4) Promote renewable energy applications for electricity used in food processing such as heating, cooling, etc.
5) Find ways to conserve water and reduce the amount of water used in food processing plants by using eco-friendly equipment and practices.
6) Establish stronger linkages between agriculture (farmers) and entrepreneurs (food company owners) in agro-food processing.

Food distribution

1) Construct a map of local food producers.
2) Use IoT or platforms to connect traders with local food producers.
3) Invest in transport systems that are more efficient and support cost reduction for local producers.
4) Develop local food supply chains to improve sustainability and to contribute to circular agriculture, to increase the availability of healthy food products, or to improve the resilience of the food system.
5) Promote direct distribution channels to directly delivered product to the consumer applying one channel.
6) Decrease food loss and waste through more efficient distribution systems.
7) Promote eco-friendly for packaging which in a cost-effective way satisfies industry requirements and consumer desires, maintains food safety, and minimizes environmental impact. Shift to food packaging which is recycling-friendly, uses renewable resources such as bioplastic solutions, and uses less material.

Food retail

1) Design food access programmes for residents of rural areas who do not have proper access to food.
2) Effectively integrate of the 6 P's – product, price, place, promotion, people, and presentation – in food marketing strategies to serve as the foundation for an effective growth strategy.
3) Design and implement retail solutions which offer highly efficient refrigeration systems optimized for $CO_2$ refrigeration and other natural refrigerants, to reduce the carbon footprint of supermarket refrigeration systems.

### 4.1.2 Nutritious, healthy, and safe food diets for all

Rationale of the pathway

The adoption of healthy diets from SFSs would safeguard the planet and improve people's health. How food is produced, what is consumed, and how much is lost or wasted all significantly shape the health of both people and planet. To safeguard the natural systems and processes that people depend on requires great food transformation. In Kosovo, including the two targeted municipalities, understanding the role of nutrition in the aetiology of many diseases and intervention measures in maintaining healthful eating patterns among different population groups is still receiving little attention. Statistics on the health and nutritional status of the population in Kosovo and in the two targeted municipalities are also limited. A study focused on the nutrition and dietary intake of pre-school children[59] showed that Kosovo was going through nutritional transition and had not yet developed a nutrition policy for the promotion of balanced healthy diets for children or other population groups. The same study concluded that underweight amongst pre-school children is slightly decreasing, but the prevalence of overweight and obesity is increasing. The observed increase in overweight and obesity is a likely consequence of a rapid change in nutritional behaviour in the last two decades in Kosovo. Children but also other population groups consume more foods with high energy density and less diverse and health supporting foods. According to the study, children should have access to sufficient, safe, and nutritious food, which meets their individual energy needs and is balanced in terms of macro- and micronutrients. There are no data or studies related to the nutrition of other population groups. There are no data available about healthy diets in Prizren and Suharekë/ Suva Reka; it is assumed that these two municipalities show similar ways of eating to the rest of Kosovo. Therefore, the proposed recommendations apply to the two municipalities as to Kosovo in general.

Potential game-changing solutions for nutritious, healthy and safe food diets for all

Food Consumption

1) Develop an integrated framework for healthy diets and sustainable food production.
2) Apply Environmentally Sustainable Food Consumption (ESFC) to minimize the use of natural resources, toxic materials and emissions of waste and pollutants over the lifecycle of food.
3) Promote strong sustainable consumption through habits that are more viable environmentally, such as consuming renewable and efficient goods and services (electric trains, cycling, renewable energy).
4) Grow awareness of diet and food choice impacts on reducing carbon footprint.
5) Set minimum nutrition standards and nutritional values for consumer food products.
6) Develop an incentive programme on nutritious, healthy, and safe food diets for different population groups, to change consumer behaviour from high carbon intensity products to sustainable products.

59 Rysha, A.: Nutrition in kindergartens of Kosovo (Doctoral dissertation). University of Kassel, Germany; 2013

7) Assess how health risks are associated with unhealthy eating habits and design education programme related to nutrition, lifestyle and sustainable food consumption.

### 4.1.3 Reduced food loss and food waste

Rationale of the pathway

Regarding the municipalities of Prizren and Suharekë/Suva Reka, no data about food waste which ends up in landfills are available. During meetings with the representatives of the two municipalities, the consultant learned that apart from some small dono-supported pilot initiatives for separating organic waste, the current waste management system does not separate organic from inorganic waste.

The consultant estimates that each person in the Prizren and Suharekë/Suva Reka Municipalities produces around 80 kg of household food waste annually.

According to the UN World Food Programme, food loss happens when food unavoidably becomes unfit for human consumption before people have a chance to eat it. It is most prevalent in lower-income countries when food is unintentionally damaged or destroyed by pests or mold. Food waste happens when we discard food still fit for human consumption, either before or after it spoils. It happens most often in high-income countries in restaurants, hotels and homes.[60]

According to the FAO, food loss refers to a decrease in mass (dry matter) or nutritional value (quality) of food that was originally intended for human consumption. These losses are mainly caused by inefficiencies in food supply chains, such as poor infrastructure and logistics, lack of technology, insufficient skills, knowledge and management capacity of supply chain actors, and lack of access to markets. In addition, natural disasters play a role. Food waste refers to food appropriate for human consumption being discarded, whether or not it is kept beyond its expiry date or left to spoil. Often this is because food has spoiled, but it can be for other reasons such as oversupply due to markets, or individual consumer shopping/eating habits.[61]

"Food losses and waste (FLW) are (negative) consequences of the way FSs function, technically, culturally and economically."[62] FLW affect food security and nutrition in three main ways: first, a reduction of global and local availability of food; second, a negative impact on food access, for those involved in harvest and post-harvest operations and who face FLW-related economic and income losses, and for consumers due to the contribution of FLW to tightening the food market and raising prices of food; and third, a longer-term effect on food security from the unsustainable use of natural resources on which the future production of food depends.

FLW affects the sustainability of FSs in all the three dimensions: economic, social, and environmental. It induces economic losses and reduces return on investments. It impedes development and hinders social progress. It has an important impact on the environment, both from the superfluous use of resources to produce the food lost and wasted, and from the local and global environmental impacts of putting food waste in landfills, including the emissions of methane, a potent GHG.

FLW globally accounts for 8 - 10 % of GHG emissions, contributing to an unstable climate and extreme weather events such as droughts and flooding. These changes negatively impact crop yields, potentially reduce the nutritional quality of crops and cause supply chain disruptions. Prioritising the reduction of food loss and waste is therefore critical for the transition to sustainable

60 https://www.wfpusa.org/articles/food-loss-vs-food-waste-primer/
61 https://www.eu-fusions.org/index.php/about-food-waste/280-food-waste-definition
62 UN News: https://news.un.org/en/story/2014/07/472222

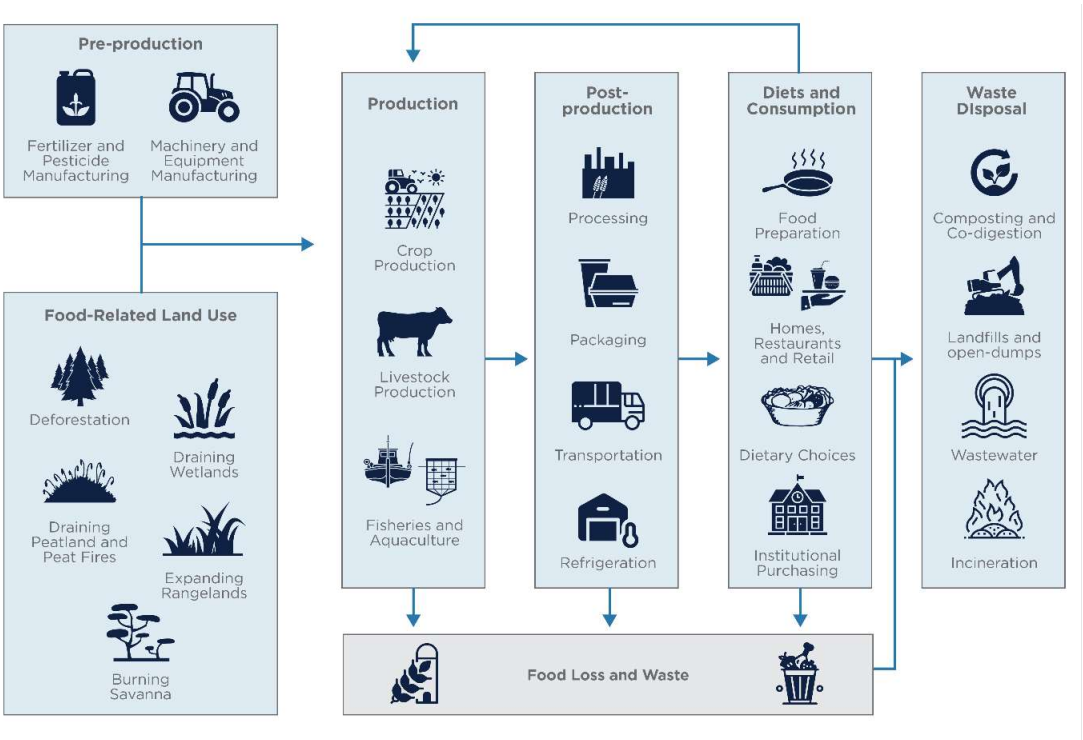
agri-food systems that improve the efficient use of natural resources, lessen their impact on the planet and ensure food security and nutrition.[63]

According to State of Food and Agriculture (SOFA), food loss is the decrease in the quantity or quality of food resulting from decisions and actions by food suppliers in the chain, excluding retailers, food service providers and consumers. In other words, food loss is caused at the beginning of the food supply chain, starting at farm level, and continuing during bulking up activities, logistics and agri-food processing. In addition to food loss, food waste refers to the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service providers and consumers; food waste takes part at the end of the food supply chain.

Looking at the food waste in households, it is apparent that roughly 1/3 of all food produced worldwide is wasted. Where income is low, waste is generally unintentional and occurs on farms and during storage and distribution, because of poorly developed cold chain infrastructure. In regions of higher income, food waste dominates further along the supply chain. Retailers and consumers reject food based on bumps, bruises, and colouring, or simply order, buy, and serve too much. When food is wasted, all the energy, resources, and money that went into producing, processing, packaging, and transporting it are wasted, too. Producing uneaten food squanders, a whole host of resources – seeds, water, energy, land, fertilizer, hours of labour, financial capital – and generates GHGs at every stage. Wasted food is responsible for roughly 8 % of global emissions.

The following graphs shows in detail where food loss and waste are taking place, giving at the same time a hint where food waste loss could be stopped or at least reduced.

Graph - Food Loss and Waste[64]




Cold chain infrastructure is another missing link in Kosovo; the bigger fruit trading companies, such as in the green market of Prizren, naturally have it, as do the Fruit & Vegetables (F&V)

63 https://www.unep.org/news-and-stories/press-release/tackling-food-loss-and-waste-triple-win-opportunity-fao-unep
64 https://www.energypolicy.columbia.edu/research/article/food-and-climate-change-infoguide

processing companies. According to PePeKo, cold chain infrastructure is available at ABI ELIF 19, EUROFOOD, Mix Product, Extra Fruits Fillings, JEGE, K.B Krusha, Agro Krusha and Apetiti Krushe in Prizren Municipality, as well as at the Women Farmers' Association in Suharekë/Suva Reka Municipality. However, there is room for many more cold storage, and this should also be run with renewable energy. Traders in Prizren, and also the Red Gold Cooperative there, have cold chain facilities in place, but not run by renewable energy.

The cold chain infrastructure needs more and better cold storage, cold trucks, and so on. Furthermore, the cold chain infrastructure must become more energy efficient by e.g. better isolation of cold chambers, and the energy production must come from renewables.

Kosovo seems to have a very limited cold storage infrastructure. In 2015 the Green Report mentioned 43 active cold storage facilities (refrigerating warehouses, refrigerators); furthermore, it is known that there are cold storage facilities for raspberries in Shtërpce/Štrpce (40 km east of Prizren) and Podujevë/Podujevo.

The ranking of the solutions is clearly "reduce, reuse, recycle, recover". Starting at farm level, there are pre- and postharvest losses that could be minimized by improved agricultural advisory services.

Potential game-changing solutions for reducing food loss and food waste

1) Conduct research to identify causes of loss and waste in FSs to design appropriate interventions to improve distribution, packaging, and other processes to reduce food wastage.
2) Promote and support integrated cold chain and preservation infrastructure facilities, without any break, from the farm to the consumer.
3) Design and support solutions focused on the cold chain infrastructure recycling industry and product reuse industries.
4) Build capacity to measure and analyse data, cost, and health outcomes to improve policy and behaviour through addressing food waste and loss in the value chain.
5) Promote and design environmentally friendly ways to recycle food waste, such as composting and anaerobic digestion for biogas production, creative use of leftovers, donating food to social marginalized groups and food waste for animal feed, and reuse of food packaging material.
6) Generate knowledge of local FSs to re-localize those systems and revitalize communities through investment, job creation, and resilience building.

### 4.1.4 Financing of agriculture and private sector involvement in the food systems

Rationale of the pathway

Since 2011 farmers have received direct payments from MAFRD, and the Ministry is working to improve the Farm Accountancy Data Network (FADN) system and harmonize it with EU standards. The FADN is an instrument to evaluate the income of agricultural holdings and the impacts of the Common Agricultural Policy and is the only source of microeconomic data that is harmonized across all EU Member States including potential candidate countries.

MAFRD has continued to support the agricultural sector through two programmes: the Direct Payments Programme and the Rural Development Programme. In the period 2016 - 2020, subsidies have increased steadily as a result of support to new sectors but also growth in previously supported sectors. According to the Green Report 2021, in 2020 the total support through direct payments was around EUR 67 million.

It is important to differentiate between MAFRD support schemes and municipal support schemes; richer municipalities such as Prishtinë/Priština provide additional grants to farmers on top of the MAFRD support and are therefore distorting the market. While the EU tries to avoid a competition in providing financial support, Kosovo is still playing one region against the others. The EU wants an equal playing field for agriculture and does not encourage higher support schemes in one municipality than another. In Kosovo, however, farmers are getting substantially more support in Prishtinë/Priština for example than in Dragash/Dragaš, the former is the richer municipality with more taxes collected.

The direct payment scheme applies also to Prizren and Suharekë/Suva Reka Municipalities. The representatives of the Department of Agriculture have provided some information about subsidies for agricultural crops and livestock in Prizren during 2022. During 2022, in the Municipality of Prizren, a total of 1,060 farmers received subsidies. As regards livestock, subsidies were allocated for 1,972 cows and 424 calves, 18,027 sheep, 1,088 goats, 18,950 chickens, and 8,016 beehives. More than 2,300 hectares were planted with cereals, 153 hectares with fruit trees, 227 hectares with vegetables, and 107 hectares with vineyards and these were supported with subsidies. In addition to Kosovo subsidies, local institutions at municipal level have a fund through which they realize projects in agriculture. The following table presents the projects implemented in the Municipality of Prizren.

Table – Projects implemented in the municipality of Prizren

Capital investment

| No. | Project name | Beneficiary/ farmers | Contract/€ | Realized/€ | For payment € |
|---|---|---|---|---|---|
| 1 | Rehabilitation of irrigation canals and cleaning of drainage canals | | 125,000.00 | 124,554.60 | 0 |
| 2 | Rehabilitation of field roads | | 80,000.00 | 60,000.00 | 20,000.00 |
| | Total: | | 205,000.00 | 185,554.60 | 20,445.40 |

Co-financing projects

| No. | Project name | Beneficiary/ farmers | Contract/€ | Realized/€ | For payment € |
|---|---|---|---|---|---|
| 1 | Opening of wells | 102 | 128,989.30 | 128,989.30 | 0 |
| 2 | Building greenhouses | 40 | 229,818.75 | 99,989.05 | 129,829.58 |
| 3 | Establishment of small tree orchards | 22 | 122,709.00 | 113,948.42 | 8,760.58 |
| 4 | Supply of agricultural mechanization | 347 | 178,150.00 | 84,470.00 | 77,530.00 |
| | Total: | 511 | 643,517.05 | 427,397.32 | 216,120.16 |

Subsidies

| No. | Project name | Beneficiary/ farmers | Contract/€ | Realized/€ | For payment € |
|---|---|---|---|---|---|
| 1 | Subsidizing the beekeeping sector | 125 | 35,995.00 | 35,995.00 | 0 |
| 2 | Subsidy of aquaculture - fish farmers | 1 | 5,827.00 | 5,827.00 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| 3 | Milk subsidy | 62 | 69,297.36 | 69,297.36 | 0 |
| 4 | Subsidy of sheep and goats | 123 | 92,700.00 | 92,700.00 | 0 |
| | Total: | 311 | 203,819.36 | 203,819.36 | 0 |

Goods and services

| No. | | Beneficiary/ farmers | Contract/€ | Realized/€ | For payment |
|---|---|---|---|---|---|
| 1 | Artificial insemination of cows and vaccination of sheep | 529 | 97,500.00 | 65,438.80 | 32,061.20 |
| 2 | Treatment of stray dogs | - | 101,129.80 | 101,129.80 | 0.00 |
| 3 | Disinfection and deratization of the city | - | 81,452.12 | 81,452.12 | 0.00 |
| 4 | Soil fertility | - | 39,400.00 | 39,400.00 | 0.00 |
| 5 | Vaccination of dogs against rabies | - | 18,235.00 | 18,235.00 | 0.00 |
| 6 | Drafting of projects for farmers - grant application | 17 | 30,000.00 | 8,550.00 | 21,450.00 |
| | Total: | 546 | 367,885.12 | 314,373.92 | 53,511.20 |

| | | | |
|---|---|---|---|
| TOTAL: I +II+III+IV = | 1,420,221.53 | 1,130,145.20 | 290,076.33 |

As for Suharekë/Suva Reka municipality, according to the Agriculture Department[65] 3,597 farmers are registered. For 2022, 1,113 farmers applied for subsidies from the Ministry of Agriculture, while the total number of farmers who applied for grants and subsidies was 1,200.

In addition to grants and subsidies from the central level, the Municipality of Suharekë/ Suva Reka supported some small projects from its budget. The table below shows some projects implemented in the agriculture field during 2022.

| | Project type | Quantity/units | Value in euros |
|---|---|---|---|
| 1 | Agricultural machinery | 217 | 82,000 |
| 2 | Construction of greenhouses | 59 | 93,000 |
| 3 | Milk subsidies | 59 | 25,000 |
| 4 | Field roads | 25 km | 120,000 |
| 5 | Irrigation channels | 1,000 meters | 80,000 |

Upgrading of food value chains for improved productivity, nutritional quality, safety, and standards would require – besides changing the mindset of the involved stakeholders – access to finance; one of the obstacles is that farmers, especially smallholders, lack collateral. Furthermore, agri-insurance products are not yet developed in Kosovo and even a guarantee fund is missing, something that would particularly help to improve financing within the IPARD light support programmes.

The business environment for private sector investments in the agri-food sector needs further improvements to unleash support. In this respect, increased financing is sorely needed to upgrade food value chains and thus transform the food systems. Investments are needed for larger agri-food processing units; for example, Kosovo has too many dairy companies competing with each other. It would need mergers between the milk companies to create one or two local players who would then be competitive against imports. The meat sector will undergo a transformation, and EU accession will mean an end to cheap imported meat from outside the EU; Kosovo will therefore need new slaughterhouse capacity. There will be a shift from meat processing towards

65 Municipality of Suharekë/Suva Reka, Agriculture Department

slaughterhouses with meat processing; slaughterhouses are currently not very profitable, as cheap meat – especially for the processing sector – is imported.

Potential game-changing solutions for financing of agriculture and private sector involvement in the food systems

1) Develop strategies for building a sustainable resource base to finance interventions, for example through attracting (foreign) direct investment into the agriculture sector and embracing a stronger financial commitment to increase public funding to agriculture and other sectors essential to eradicating food insecurity, at the same time ensuring women's economic empowerment.
2) Encourage more specific investments in locally adaptive innovations and enable access to affordable technologies and digitalisation; ensure equitable access to land and water resources; increase investment in infrastructure (irrigation canals, rural roads, storage including cold storage, processing, and marketing facilities); increase public–private investment in all food safety aspects indicated by the Food and Veterinary Agency, and also in local seeds, semen, and animal breeds.
3) Improve access to finance both for farming enterprises (the supply side of the energy equation) and, most importantly, for end users in FSs (the energy demand side). Examples of tailored financing solutions, including climate finance, on which to build are increasingly available.
4) Build capacity for enterprises, farmers, and communities with bank financing.
5) Develop financing mechanisms and incentive schemes to support greening of food processes through energy efficiency measures, renewable energy and water conservation.

### 4.1.5 Climate change mitigation, adaptation, and biodiversity protection

Rationale of the pathway

In Kosovo, climate change mitigation and adaptation remain a challenge, especially as specific studies of climate trends, projections, and impacts are limited. Kosovo's agriculture sector is an important driver of the economy and vulnerable to water shortages, heat waves, drought and flooding.

In the context of climate change, the FS can itself be a source of problems or solutions. Agriculture including unsustainable crop and livestock production, forestry and associated land use changes contribute up to 30 % of global GHG emissions.[66]

Accelerated and often illegal construction combined with poorly regulated land use planning increases the exposure to hazards. Insufficient wastewater treatment and lack of public environmental awareness contribute to serious air and water pollution and environmental degradation that Kosovo is working to control, and that will compound climate change impacts.[67]

The agricultural sector in Kosovo is experiencing the effects of climate change, reflected in increasing climate variability and unpredictability. Climate change not only affects crop production; it affects the whole market system, impacting the livelihoods of producers and their competitiveness in the markets. During the summer, extreme climate events have increased with more flooding and dry spells during critical growing periods. In the winter, the variability of snowfall affects groundwater accumulation and freeze conditions, affecting fruit budding, the prevalence of pests and diseases, and sufficient water supplies. Finally, inconsistent spring temperatures are shifting Kosovo's crop harvest period. For example, Kosovo historically has

66 UN Food Systems Summit 2021 - Tanzania - National Roadmap to Sustainable Food Systems Transformation by 2030; 2021
67 https://www.climatelinks.org/resources/climate-risk-profile-kosovo

enjoyed a first-to-market advantage and corresponding high sales prices, e.g. for blueberries and asparagus, because of their early harvest period. Changes in harvest timing reduce Kosovo's competitive advantage in tightly integrated and highly competitive markets.

In addition, the pesticides used in agriculture, forestry, and urban environments to control pests, such as insects, weeds and diseases and protect crops, trees, and lawns from damage, if not used or stored properly can have negative effects on the environment.

According to the document issued by the Agency for Statistics in Kosovo on Agriculture and Environment statistics for 2021[68], the area of agricultural land on which pesticides were used was 122,138 ha. Although there are no specific data for the use of pesticides in Prizren and Suharekë/Suva Reka Municipalities, the representatives of the municipal agriculture departments confirmed that farmers operating in these two municipalities use pesticides (herbicides, fungicides, insecticides, rodenticides, etc.) similarly to farmers in other regions of Kosovo.

Pesticides can leach into the soil and make their way into underground water sources. This can lead to the contamination of drinking water and other water sources that people rely on for daily life. Pesticides can also enter ground water through surface water runoff, especially during heavy rainfall or irrigation. Exposure to pesticides in drinking water and other water sources can have negative health effects on humans and wildlife. Some pesticides are toxic to humans and can cause a variety of health problems, including neurological disorders, cancer, and reproductive problems. Pesticides can also harm aquatic life and other wildlife, leading to declines in biodiversity and ecosystem health. To protect ground water and prevent contamination, it is important to use pesticides responsibly and follow proper storage and disposal guidelines. This includes following label instructions, using the lowest effective dosage of pesticides, and disposing of pesticides safely according to local regulations. It is also important to minimize the use of pesticides whenever possible, as reducing the volume of pesticides applied could help to reduce the risk of contamination. Even though the Ministry of Environment, Spatial Planning and Infrastructure stated in 2010 that the impact of rate of biodiversity loss from agriculture activities is relatively low because of limited use of chemical fertilizers and pesticide,[69] it can be assumed that the use of pesticides increased over the last 10 years and contributed to biodiversity loss.
Traditionally, farmers in Kosovo have irrigated their agricultural land with flood systems, which can result in water losses of up to 50 % through soil percolation. The same field can be overirrigated in some places and underirrigated in others, leading to crop stress, which increases susceptibility to pests and diseases and reduces yield.

In Kosovo, heavy and damaging hail is becoming a common occurrence in Kosovo, causing as much as EUR 20,000 of damage per hectare for high-value crops such as blueberries. The installation of anti-hail netting by apple producers offers additional benefits of reducing water loss from the field, regulating light intensity, and providing protection against frost because of the increased temperature beneath the anti-hail netting cover.

Kosovo is experiencing less predictable temperature ranges with unseasonably high daytime and low night-time temperatures. Kosovo's expanding greenhouse sector is affected by increasingly unpredictable temperature fluctuations, especially very low early season temperatures and unseasonably high late season temperatures.

Developing remote monitoring and early warning systems is essential as farmers need accurate forecast information on weather events, pests, and diseases to properly plan short-term risk management and long-term adaptation. In collaboration with IPKO, a Kosovar telecommunication provider, a network of 19 climate monitoring stations across six production zones throughout the

68 https://ask.rks-gov.net/media/7217/anketa-e-ekonomive-bujq%C3 %ABsore-2021.pdf
69 Ministry of Environment and Spatial Planning: Strategy and Action Plan for Biodiversity 2011 – 2020; 2010

Kosovo has been installed. These stations feed into a central location where data are analysed and based on that targeted agronomic advice is formulated about the potential for pest and disease outbreaks for several crops serving more than 1,000 farmers and input suppliers. Farmers also can improve their irrigation management and frost predictions through site-specific weather forecasting data from the system's continuous monitoring of temperature, wind speed, and humidity. Addressing climate change impacts through mitigation and adaptation actions and harnessing the integrity of biodiversity for sustained flows of ecosystem services, is thus critical for SFSs and green growth at large.

Biodiversity loss and land degradation such as soil compaction are also caused by agriculture – especially by fossil-fuelled agriculture with heavy machinery and agro-chemical input on large fields.

Potential game-changing solutions for climate change mitigation, adaptation and biodiversity protection

1) Promote proven practical techniques for climate smart agriculture, such as mulching, intercropping, conservation of agriculture, crop rotation, integrated cop-livestock management, agro-forestry, improved grazing, and improved water management.
2) Support weather monitoring stations combined with smart ITC solutions to provide time-sensitive advice to enhance farmers' adaptive capacity. Modern weather stations do not only record weather data but can forecast – based on the collected time-series – upcoming weather events and even the development of e.g. diseases. Making this knowledge available to farmers could help to mitigate climate impact on agriculture.
3) Balance water extraction from aquifers with replenishment, to prevent lowering of groundwater tables. Apply modern efficient irrigation systems, improving pumping energy efficiency in both aquifers and surface water storage. Increase the efficiency of water use by reducing losses in irrigation systems, applying more efficient application techniques and precision irrigation.
4) Use crop nutrition monitoring systems to optimize crop growth and increase plants' ability to resist pest, disease pressures and changing temperatures.
5) Reduce deforestation to enable stabilization of the soil, prevent erosion, enhance the land's capacity to store water, and moderate air and soil temperatures, help food security and protect animals' habitats and food sources and mitigate animal extinction.
6) Implement biodiversity conservation to create and maintain healthy soils, supporting pollinating plants, controlling pests, and providing habitat for wildlife, including for fish and other species that are vital to food production and agricultural livelihoods. Evaluate land sharing and land sparing, in which high-yield farming is combined with biodiversity conservation.
7) Promote regenerative, sustainable, agro-ecological, and organic agriculture techniques and practices to protected against erosion and loss of soil humidity.
8) Develop linkages between organic agriculture and circular economy, by using as many self-produced farm inputs as possible – manure, compost, farm-grown fodder for the animals.
9) Reduce negative effects of pesticides through withdrawal of broad-spectrum pesticides, improved institutional frameworks, rule enforcement, and increased awareness among farmers on the use of hazardous chemicals.
10) Increase awareness of institutions, farmers, entrepreneurs, and the community on the impacts of climate change in agriculture and wellbeing through information sharing, educative programmes, and media.

### 4.1.6 Resilient food systems and livelihoods

Rationale of the pathway

Resilience is the ability to prepare for, withstand, and recover from a crisis or disruption. Therefore, a resilient FS is able to withstand and recover from disruptions in a way that ensures a sufficient supply of acceptable and accessible food for all.

According to the World Bank, around 20,000 ha are under irrigation in Kosovo in 2020, which corresponds to around 10 % of the arable land. Almost all kinds of agricultural crops are currently irrigated, from alfalfa to pomegranates, but main crops under irrigation are maize, fruits and vegetables. Besides ongoing activities to rehabilitate e.g. the Radoniqi-Dukagjini Irrigation Scheme, the World Bank sees a need or potential to enlarge future areas under irrigation at least up to 130,000 ha. Kosovo is characterised by a low level of canal irrigation. Therefore, farmers are using ground water irrigation systems, but this approach results in high cost due to small structures. Furthermore, farmers in Kosovo are using traditional surface irrigation (flood irrigation), which often results in water losses. Using a modern drip irrigation system would be a water-saving alternative. While there would be a need for more irrigation to balance the influence of climate change and to use the full potential of the agricultural land, there is a question as to whether farmers are able and willing to pay a fair price for the water; this depends largely on the profitability of the crops grown.

In Kosovo there are several agro-ecological zones which favour production of a diversity of foods. The farmers take advantage of these zones and focus mainly on fruits and vegetables. The market for meat and milk products looks less promising, cereals are grown for on-farm consumption and production is not sufficient for the Kosovo market. However, the market infrastructure is good, and the road-network is well established. Sufficient food supply is largely a given, not least because many food products are imported; the economic challenge is rather how to increase exports or to reduce production costs to remain competitive within a (too) liberal trade regime.

Spatial planning is at an early stage. Good agricultural land is disappearing daily as an effect of the change of land use: since the war, housing without planning permission and illegally built housing has resulted in the loss of tens of thousands of hectares. Corruption and poor spatial management are the main drivers for this irreversible development. Similar arguments could be brought forward related to illegal logging and deforestation.

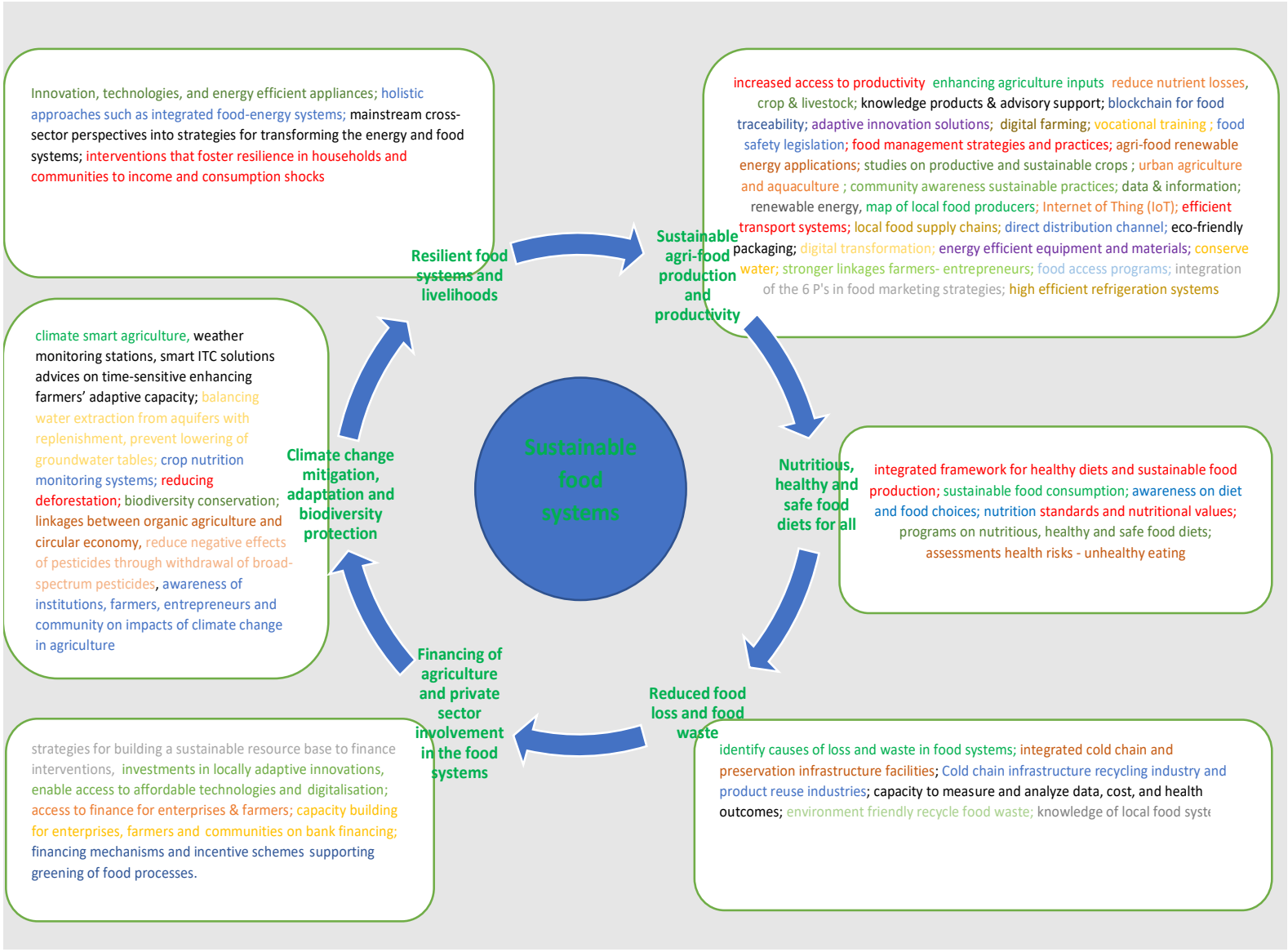
As Kosovo is characterized by many small farms, bigger highly specialised farms are absent and therefore a diversity of products is grown locally; that is positive in terms of resilience, even if there is room to improve the FSs and livelihoods towards a more climate-smart agriculture.

<u>Potential game-changing solutions for resilient FSs and livelihoods</u>

1) Promote innovation in the development of technologies and energy-efficient appliances through dedicated high-risk innovation funds and multi-stakeholder partnerships between energy supply and demand actors to develop or repurpose existing technologies, pilot them for operational viability, and establish supply chains to deliver solutions (which must include long-term operational and maintenance services).
2) Facilitate the development of holistic approaches such as integrated food-energy systems (e.g. agri-voltaic systems) and the water-energy-food nexus to minimise competition and leverage synergies in water and land use.
3) More broadly, mainstream cross-sector perspectives into strategies for transforming the energy and FSs through a stable and supportive enabling environment including dedicated policies and plans, cross-sectoral co-ordination that includes government, the private sector, civil society and end-users, and prioritise low-risk, high-impact action in the near term.
4) Design and implement interventions that foster resilience in households and communities to income and consumption shocks in order to mitigate the effects of these shocks on

Food and Nutrition Service (FNS). Potential mitigation mechanisms include promoting income diversification strategies in rural areas, developing strong credit and insurance markets for agriculture, upholding, and strengthening the food safety net programmes (to target mainly women), encouraging saving behaviours in rural households, and supporting better on-farm storage facilities to stimulate a saving culture and prevent post-harvest losses.

## Graph – Roadmap on SFSs for Prizren and Suharekë/Suva Reka Municipalities



## 4.2 Sectors with the biggest need for transformation

There are several sectors in the food system which are in urgent need of transformation to achieve a more sustainable FS.

Food system elements

- Food production
- Food processing
- Distribution and aggregation
- Marketing
- Markets and purchasing
- Preparation and consumption
- Resource and waste recovery

The FS is composed of the above elements and when food is moved from one stage to the next, it needs energy; transport and cold chain infrastructure are also based on energy. The ITC sector should also be highlighted because the FS will be managed more and more by software programmes designed to increase efficient production.

Starting with food production, agricultural production must cut down use of resources and at the same time keep output at the same level or even increase it. Besides a closer orientation towards regenerative farming, agricultural production must work to cut food losses, pre- and post-harvest, while products are still on the farm. The agricultural challenge is to decouple the use of fossil fuels in food-system transformation and related innovations without compromising food security.

Distribution and aggregation will most likely need more energy for transport and for cooling. To align with the EU Green Deal and its net-zero-emission target, smarter solutions will be needed.

### 4.2.1 Agriculture

As mentioned above, GHG emissions from Kosovo's agriculture, forestry, and land use sector account for about 8 % of Kosovo's total. The transformation of traditional agriculture towards sustainable agriculture is essential in order to reduce these emissions and to produce more and better food while protecting the environment. The five principles of sustainable agriculture outlined by the FAO are:

1) Boost food chain productivity;
2) Protect and spare environmental resources;
3) Improve people's wellbeing and economic growth;
4) Foster ecosystems and communities' resilience;
5) Support with governmental initiatives and regulations.

The concept of sustainable agriculture rests on pillars which cover the economic, social, and environmental aspects. In terms of the economic pillar, sustainable agriculture ensures the farming business's profitability and efficiency. The social pillar focuses on the population, providing enough food including employment and development for local communities. In terms of environmental aspects, sustainable agriculture encourages a nature-friendly approach to farming, contributing to nature protection. Key sustainable agriculture practices include crop rotation (which contributes to soil as well as to ecological sustainability), modern irrigation techniques, minimum tillage, integrated pest management, integrated weed management, cover crop and urban agriculture.

As agriculture needs to improve its circular economy, composting of all kinds of agricultural leftovers should be high on the agenda; this would at the same time aid reduction of fertilizers, as compost contains a substantial amount of minerals, and reduces food waste usually deposited in landfills.

FSs around the world account for about 30 % of the world's total energy consumption. Since most FSs are run primarily on fossil fuels, that means they also account for 20 % of the GHG emissions. These emissions take place at every step of the food chain. Manure and fertilizer give off nitrous oxide while cattle and other animals produce methane. Machinery requires diesel and gasoline, and the entire process is fuelled by coal and natural gas power plants, creating carbon dioxide.[70]

The energy used in food production can be broken down into four parts: agriculture, transportation, processing, and handling.

1) In developed countries agricultural production consumes up to 20 % of the total energy needed for food production. A major part of this is consumed in the forms of gasoline, diesel, electricity and natural gas, while the rest is required for fertilizer and pesticide production. Certain food production requires less energy to produce than others, either because it requires less land and water or because there are fewer industrial processes needed to produce it. The most energy efficient foods include wheat, beans, fish, eggs, nuts and other non-resource-intensive products. The least energy efficient foods are animal-based products.
2) Transport of food from farm to table accounts for around 14 % of the energy that goes into producing food; that includes international movements e.g. to ship avocadoes from South America or even to fly in highly perishable fruits.
3) Food processing - the transformation of raw ingredients into a food product - makes up about 16 % of the total energy consumption.
4) Food handling is by far the largest energy consuming element in producing food, and accounts for nearly 50 % of the energy used in food production. It includes retailers, restaurants, packaging facilities and consumers – E.g. the energy used to package milk and keep it refrigerated in the grocery store and at home falls into this category.

Currently in Prizren and Suharekë/Suva Reka Municipalities fossil fuels are largely used to generate energy. To achieve the net-zero emissions sought by the EU Green Deal, there is a need for a quick shift to renewable energies.

1) Solar photovoltaics (PV) can replace fossil fuels; PV panels offer hyper-local, clean electricity generation and could be grid-connected or part of stand-alone systems. Especially for cold chain infrastructure, solar energy could play an important role, the more sunshine, the more energy would be used for cooling of fruits and vegetables, but also meat, animal products like milk and others. Currently, imperfect cold chains cause huge food waste. A large beverage producer in the area complained about over boarding rules and regulations and that local authorities are supporting the public energy utility company instead of private investors.
2) Wind turbines, from small micro wind turbines to onshore and offshore wind turbines can generate clean electricity in diverse locations, from urban centres to rural areas, and can be operated without access to centralised grids.
3) Biomass feedstock can replace fossil fuels for generating heat and electricity. Biomass can come from forests, annual crops or waste, or energy forests – i.e. perennial trees – and replace conventional coal, oil, and natural gas. A visit to the District Heating Thermal Plant

70 https://www.chooseenergy.com/blog/energy-101/energy-food-production/

in Gjakovë/Djakovica showed the potential for more biomass plants. The plant was established with EU and other donor support (as well as, for the time being, the tubes to transport the heat to clients) and uses fuelwood instead of fossil fuels. At present around 10,000 tons of biomass are needed to cover the demand, but mid-term planning envisages 15,000 tons annually, i.e. per heating season. The power plant is generating heat and a limited supply of power for 2,000 private households, public institutions, and businesses. The fuelwood is purchased by tendering process from private suppliers and the wood comes from nearby forest, with the required certificates. In the future, wood that derives from forest sanitation measures, should also be used – most likely provided by the Kosova Forest Agency. Additionally, around 10 % of the fuelwood volume comes from biodegradable waste from vine pruning. Many more products would be suitable for burning in the District Heating Thermal Plant, but the technology is very sensitive and not every raw material, e.g. straw, can be used. For the future, eight more plants are under consideration, and could use diverse inputs. One of the major related problems in Kosovo is illegal logging; the situation is out of control, with excessive fuelwood certificates issued by municipalities not interested to reduce their revenues. Experts estimate that more than 50 % of wood is illegally cut: the problem is not missing certificates of legal cutting, but that too many certificates have been issued. However, there are efforts to centralise the cutting licences again and to regain control.

4) Biogas is a type of natural gas. It is created by breaking down the bacteria in food waste (organic waste) in "anaerobic digestion" – a digestive process in a purpose-built vessel and an oxygen-free environment. come from diverse sources of food waste such as dairy, meat, poultry, fish, fruit and vegetable, cereal, and bakery, brewing and winemaking. The biogas plants produce biogas and also create another product at least as valuable as renewable energy, because of its nutrient and organic matter content: digestate. Digestates can be used as organic fertilisers for agriculture and could to a certain extent replace mineral fertilisers.
5) Biofuels like biodiesel and bioethanol are smart solutions provided they are not produced with agricultural products that could be used to feed people. Huge quantities of food waste are generated worldwide, and disposal is becoming a challenge. Food waste contains carbohydrates, lipids, phosphates, vitamins, and amino acids. Carbohydrate-, lipid- and carbon-containing materials present in food waste can be converted to bioethanol, biodiesel and biooil. Lipid extracted from food waste is converted to biodiesel in 95–97 % yield.
6) Wastewater can be a source of energy,[71] but first it needs wastewater treatment facilities. Generally, in Kosovo, there is no wastewater treatment. The only substantial wastewater treatment plant is located in Llaushë/Lauša; there are other, small, rural treatment facilities in operation. The wastewater is usually discharging directly into rivers.[72] Increased treatment could help alleviate water quality issues; however, in many areas there are economic constraints. Energy recovery methods, including the use of biogas and incineration of biosolids generated during the treatment process, may help to lessen treatment costs. A significant amount of energy can be recovered from nutrient-rich wastewater, which helps to alleviate some of the costs of treatment. The production of renewable natural gas from biogas has the potential to prolong dwindling natural gas resources used to produce electricity and heat. In the case of biogas production from waste, the final product from the digester can be used as fertilizer. Because handling liquid-phase waste is difficult, the treatment takes place at a centralized wastewater treatment plant (WWTP) and requires additional energy and flow capacity. In Prizren a

71 Breach,P.A., Slobodan P Simonovic, S.P.: Wastewater Treatment Energy Recovery Potential For Adaptation To Global Change: An Integrated Assessment. Environ Manager 2018 Apr;61(4):624-636.
10.1007/s00267-018-0997-6
72 MSCE SHUKU, A.: Importance of waste water treatment on local level in Kosovo; 2018
https://www.sogde.org › site › assets › files › 13239 › shuku_arian_kosovo_10_18.pdf

new wastewater treatment plant has been recently established, financed by the German KfW.

All envisaged solutions must include reduction of energy consumption or at least an increase in energy efficiency, and furthermore a switch of energy supply from fossil fuels to renewables. In order to make the FS more energy efficient, households can contribute by changing to energy-efficient food storage. The investment in energy-saving refrigerators, which use 20 - 30 % less energy, would quickly pay off, especially if the refrigerator is kept fully stocked and thus working most efficiently. (If there is not enough food, one can store containers of water instead.)[73]

### 4.2.2 Transport

For most of human history our ancestors relied on very basic forms of energy: human muscle, animal muscle and the burning of biomass such as wood or crops. But the Industrial Revolution unlocked a whole new energy resource: fossil fuels. Fossil energy has been a fundamental driver of the technological, social, economic and development progress which has followed. Today, Kosovo's electricity production still largely depends on coal; its two power-plants produce about 97 % of domestic electricity, while the remaining 3 % come from renewable sources, such as small hydropower plants.[74]

But fossil fuels come with several negative impacts. When burned they produce $CO_2$ and are the largest driver of global climate change. They are also a major contributor to local air pollution. As promoted by the Green Deal, net-zero emissions are the target and that implies moving away from fossil fuels. Low-carbon sources of energy are needed and that means renewables, as nuclear is not a safe alternative. A transformation of the transport sector is taking place.

Food is shipped globally by water, road, rail and air. The share of global food miles by transport method is shown in the table below. Food miles are measured in ton-kilometres, which is a unit of measure of freight transport which represents the transport of one ton of goods over a distance of one kilometre.[75]

- Water 58.97 %
- Road 30.97 %
- Rail 9.90 %
- Air 0.16 %

Table – Transport modes and corresponding kg $CO_2$ eq. per ton-kilometre[76]

| Transport mode | Ambient transport (kg $CO_2$ eq. per ton-kilometre) | Temperature-controlled transport (kg $CO_2$ eq. per ton-kilometre) |
|---|---|---|
| Road Transport | 0.20 | 0.2 to 0.66 |
| Rail Transport | 0.05 | 0.06 |
| Sea / Inland Water Transport | 0.01 | 0.02 |
| Air Transport | 1.13 | 1.13 |

Transportation and logistics are key sectors for the food industry. The food industry, and especially the dairy sector, depends on the smooth and timely supply of raw materials. Since the

73 https://www.chooseenergy.com/blog/energy-101/energy-food-production/
74 https://balkangreenenergynews.com/kosovo-power-production-to-remain-heavily-dependent-on-coal/
75 https://ourworldindata.org/food-transport-by-mode
76 https://ourworldindata.org/food-transport-by-mode

ingredients required by food industries come from many different geographical locations, sometimes halfway around the world, transportation, and logistics play an important role in ensuring the success of the industry. Because of the short-term nature of raw materials and finished products, the industry faces many unique challenges. Food raw materials such as vegetables and fruits perish even if stored in climate-controlled facilities, and therefore need to be delivered quickly. The same applies to some finished products: most processed foods have an expiry date after which they cannot be consumed: bread and milk products can go bad within a few days. Secondly food has to be preserved in order to keep its quality. Of all the industries, food and dairy is one that can never compromise on quality. While the quality of the food depends upon the manufacturer/producer, logistics has an equally important role in preserving that. Foods can also be quickly contaminated. As food contamination is a serious – potentially lethal, indeed – health hazard, ensuring high standards of hygiene and cleanliness is a predominant transportation and logistics consideration of the industry. There is also a high risk of breakages and damages during transportation (for e.g., eggs). Breakages and damages during transportation cause huge losses to food industries every year. Therefore, special care must be given during packaging, loading, unloading and transit.

The world is well off course in efforts to limit climate change to 1.5°C.[77] With 95 % of the world's transport energy still coming from burning fossil fuels, the transport sector produces a quarter of all energy-related emissions, and without major changes, these are expected to increase. The increasing emissions and rising temperatures are causing more extreme weather events, which in turn are also highly disruptive to transportation and transportation infrastructure.

To achieve an SFS, the decarbonisation of transport is key. The global supply chain uses all kind of transport for food – airplanes, railways, trucks and ships. Regarding road transport, the European Commission proposes ambitious targets for reducing the $CO_2$ emissions of new cars by 55 % by 2030 and of vans by 50%. Furthermore, there are to be zero emissions from new cars by 2035. In order to push this development, emissions trading will be promoted and will put a price on pollution; that will immediately stimulate cleaner fuel use, and re-investment in clean technologies. A similar development can be observed in the aviation sector, where carbon pricing is anticipated. The maritime sector will also be decarbonised. In order to achieve this goal, the EC promotes the growth of the market for zero- and low- emissions vehicles. In practice, all Member States are financially supporting the switch to electric cars.

The deployment of existing transport solutions, such as low or zero-carbon vehicles, automated safety, and intelligent transport systems, must be accelerated. These must be accompanied by the creation of new fuel, power, and digital infrastructures – including for example high-speed battery charging –, while mitigating any harmful consequences.

Looking at the negative climate impact of fossil fuelled transport systems, more intensive promotion of electrification is necessary. Electric vehicles (EVs) are an important part of meeting global goals on climate change. However, while no GHG emissions come directly from EVs, they run on electricity that is, in large part, still produced from fossil fuels in many parts of the world. Consequently, a combination of electrification and renewable energy is required.

Apart from moving towards electric vehicles, vans and trucks, attempts are being made to run ships on electricity or at least green fuel, as well as airplanes. Many railways are electrified; nevertheless, the primary need is an increased production of renewables to make the transport sector more environmentally friendly. For a start, e-cargo-bikes could make a difference, especially for supplying grocery stores with food and delivery to customers.

77 https://www.un.org/sustainabledevelopment/blog/2021/10/transport-transformation-critical-to-address -climate-change-and-universal-access-to-safe-affordable-resilient-mobility/

### 4.2.3 Cold chain infrastructure

Sound post-harvest management can reduce food loss and waste, from the producer to the consumer. Food loss and wastage currently happens at all levels in the value chain from harvesting, processing, packaging, and transport to consumption. Most, if not all, agricultural products are perishable and require a controlled and uninterrupted cold chain infrastructure throughout the value chain from farm to fork.

A cold chain is composed of several elements: a) the cooling systems that bring the commodity (food, vaccines, etc.) to the correct temperature; b) the cold storage, providing the facilities for the storage of goods over time; c) the cold transport, being the conveyances to move the goods at a stable temperature; and d) the cold processing and distribution, providing the facilities for the processing of goods under sanitary conditions.[78]

The cold chain infrastructure is closely linked to the transport sector. The food supply chain needs climate-controlled facilities, as both raw and prepared foods can go bad quickly in the outdoor environment; they need to be stored in climate-controlled facilities before, during and after transportation. In order to preserve freshness, avoid contamination and maintain quality, each food product must be stored at an optimum temperature. Most foods do quite well from 1.1°C. - 4.4 °C. Ensuring proper climate-controlled facilities is an integral part of transportation and logistics for the food and dairy industry. This infrastructure sector is already undergoing a rapid transformation specifically to become more cold –chain-oriented; if the cold chain is interrupted, the temperature is no longer controlled and thus the food will degrade and pathogenic microorganisms (bacteria, mould, etc.) will reproduce.

The cold chain in food covers different stages.

- Production and treatment: [79] At this stage, food must maintain a stable temperature. Cold stores are necessary during this phase, as they allow the product to be handled.
- Transport: During the transport of food, the loading and unloading time must be considered as during this period the food could deteriorate.
- Storage: Food storage should be done in cold rooms and freezers. These need monitoring devices to control and vary the temperature.
- Distribution and points of sale: Food distribution is one of the most complex phases since it is when food can change in temperature. Therefore, distribution of the merchandise must be handled in the shortest possible time until it reaches the point of sale.
- End user: At this stage, the end consumer must protect and preserve food (usually at home) with ideal temperatures until later consumption.

A recent study of PePeKo found out that the F&V processing companies in Kosovo – including ABI ELIF 19, EUROFOOD, Mix Product, Extra Fruits Fillings, JEGE, K.B Krusha, Agro Krusha and Apetiti Krushe in Prizren Municipality as well as the Women Farmers' Association in Suharekë/Suva Reka Municipality – together have sufficient working premises at room temperature and some storage facilities. Technically speaking, cold stores (4°C), cooling chambers (-20 °C) and storage facilities of controlled atmosphere are lacking and need to be expanded in the the coming years.

The cold chain infrastructure needs more and better cold stores, cold trucks and so on. Furthermore, the cold chain infrastructure must become more energy efficient by e.g. better isolation of cold chambers, and its energy should come from renewables.

The cold chain infrastructure is highly developed in the Europe, whereas serious problems exist in less developed countries.

78 https://smartertechnologies.com/smarter-solutions/cold-chain-logistics/
79 https://intersam.es/en/the-importance-of-the-cold-chain-in-food/

According to the Kosovo's Strategy for Agriculture and Rural Development 2022 – 2028,[80] cold storage is insufficient for all types of agriculture products. Data from several sectors show that even though cold storage is still insufficient, there are improvements and continuous growth of cooling capacities. According to a value chain assessment conducted by the Association of Fruit and Vegetable Processors of Kosovo "PePeKo"[81], the 24 member companies of the PePeKo association that operate throughout Kosovo have around 20,000 m2 of cooling chambers of -20 degrees Celsius, and up to 250 m2 freezing chambers of – 40 degrees Celsius. A 2021 study by" Organika",[82] the association of the processors and exporters of NWFP, shows that the 24 members of the association operating in all regions of Kosovo have about 7941 m2 of cooling and freezing chambers.

In recent years, many smart cold chain logistics service solutions to control temperature and humidity during product warehousing and transport have been developed. These are providing the warehouse and logistics industries with an effective solution to reduce product losses during storage and shipping. Most solutions are based on temperature / humidity sensors to concurrently detect and collect humidity and temperature information via Bluetooth or WiFi. These sensors can be attached to lorries, ISO shipping containers, pallets, refrigerators, and other warehouse storage units, giving end-to-end visibility along the entire supply chain. By transmitting information to the supervision platform via a smart monitoring app, the system can notify administrators via online and email about any temperature abnormalities, thus enabling an immediate response.[83]

The benefits of an uninterrupted cold chain are obvious:

- Quick fault identification and resolution
- Preventing economic losses related to products that spoil or go missing
- Improving food quality, safety, and value to the customer
- Lengthening shelf life
- Ensuring that goods are transported and stored according to the manufacturer's recommended temperature range
- Enhancing economic wealth, cash flow and security
- Gaining data insights for better decision making and optimisation

One of the major reasons for food waste is the lack of an efficient cold chain infrastructure, which includes refrigerated transport, pack houses, collection centres, and cold storage. Sustainable agricultural production can also contribute to reducing food waste. Efforts are needed from both ends to improve the current food system. In addition to the social dimension of wasting food, there is also an environmental imperative to avoid further greenhouse gas emissions resulting from food waste that is dumped unprocessed in landfills.

Furthermore, losing or wasting food creates macroeconomic and environmental costs that should be avoided for economic and sustainability reasons. While social reasons are important, undernourishment is not widespread in Kosovo, and therefore, they may not play a crucial part in this respect, even though many people live below the poverty line.

### 4.2.4 ICT

80 Ministry of Agriculture, Forestry and Rural Development - STRATEGY FOR AGRICULTURE AND RURAL DEVELOPMENT, 2022 - 2028
81 Assessment of Fruit and Vegetable Processing industry in Kosovo 2019/2020
82 ORGANIKA- STUDIMI I SEKTORIT TE PRODUKTEVE PYJORE JO-DRUSORE (PPJD-VE) DHE BIMËVE MJEKËSORE DHE AROMATIKE (BMA-VE)
83 https://www.itri.org.tw/english/ListStyle.aspx?DisplayStyle=01_content&SiteID=1&MmmID= 103733353 2362271170&MGID=1127136112465247047

Information and Communications Technology (ICT) is supporting FSs to become leaner, smarter, and safer through a combination of smart connected technologies and products gathering data along the entire supply chain and converting this information into smart communications.

The food-processing sector is gradually shifting to the industry 4.0 concept, and the potential of disruptive computer-based techniques is indispensable.[84] There is big potential in wireless sensor networks, the IoT, big data, artificial intelligence systems, and other information and communication technologies for various applications in the food processing and supply chain. The field of ICT is developing numerous applications for the food sector, e.g. in food procurement, manufacturing, and distribution practices, as well as in the automation and digitalisation of food systems, particularly in sustainable food processing practices. Traceability is another important area where ICT is used. More and more traceability-support systems are being installed to monitor food safety and sustainability indicators.

ICT provides a wide range of solutions for the food sector – including for food waste. Technologies to address food-waste prevention and reuse at consumer level have different objectives:[85]

1) Extend the shelf life of food products;
2) Reduce the generation of surplus food in retail, households, restaurants etc.; and
3) Increase and make more efficient the redistribution of surplus food.

ICT can assist in reducing food waste by focusing among other things on food preservation technologies, food packaging and smart labelling, consumer-oriented smart devices or consumer and food-sharing apps.

Table – Sectors with the biggest need for transformation

| Agriculture | Energy | Transport | Cold Chain Infrastructure | ICT |
|---|---|---|---|---|
| Boost food chain productivity<br><br>Protect and spare environmental resources<br><br>Improve people's wellbeing and economic growth<br><br>Foster ecosystems and communities' resilience<br><br>Support with governmental initiatives and regulations | Solar photovoltaics/solar energy - cold chains<br><br>Wind turbines<br><br>Waste-to-energy: Biomass from feedstock, from forests, annual crops, or waste<br><br>Biogas from different sources of food waste such as dairy, meat, and poultry, fish, fruit and vegetable, cereal and bakery, brewing and winery industries, etc. | Clean transport with no CHG emission transport: vehicles, van, trucks e-cargo-bikes, etc. | Food storage in cold rooms and freezers, using clean energy and efficient energy technologies<br><br>Food distribution in the shortest possible time<br><br>Protection and preservation of food by end users, in ideal temperatures, using energy efficiency technologies | Automation and digitalization of food systems, particularly in sustainable food processing practices<br><br>Apps for the food sector, e.g., in food procurement, manufacturing, and distribution practices, traceability-support systems to control food safety and sustainability indicators<br><br>ICT for reducing food waste: preservation technologies, food packaging and smart labelling, consumer- |

84 Raja, V. et al: ICT applications for the food industry. 2021
10.1016/B978-0-323-91001-9.00001-3
85 UNEP DTU: Reducing Consumer Food Waste Using Green and Digital Technologies. Copenhagen and Nairobi; 2021

| | | | | |
|---|---|---|---|---|
| | Digestate as organic fertilisers for agriculture<br>Biofuels such as biodiesel and bioethanol which are not produced from agricultural products<br>Wastewater | | | oriented smart devices or consumer and food-sharing apps |

Solutions for retailers like shops, grocery stores and supermarkets

As the shelf-life of a product is determined on the label and as it should not be changed, each product – even sugar – comes sooner or later to its expiry date. There are two options near the sell-by date:

1) Reduce price and hope people buy it before the expiry date, based on the concept of supply and demand;
2) Wait until it is rotten.

There are several technology-driven start-ups, such as Wasteless from Israel, with a data-driven approach, using small screens instead of price-tags to display dynamically changing prices for each item on the shelf. These intelligent screens use machine learning to optimize the sales prices and the start-up is claiming to reduce waste by 33 %. A similar initiative for using digital screens to display products' prices is operating in Kosovo, in the InterEX supermarket in Prishtinë/Priština.

Other companies such as Neurolabs from Romania are reducing food waste by accurately predicting demand with Artificial Intelligence (AI). The focus is on predicting sales for supermarkets, but a similar approach would also work for restaurants. With AI it seems to be possible to reduce supermarket waste by up to 40 %.

TeleSense86 a remote sensing company (similar to the Fara group from Kosovo), provides managers with actionable insights about their stored crops, so that they can make more profitable storage and transport decisions quickly and easily. The company's wireless sensors and app work together to continuously monitor crops and automatically send issue alerts to users, mitigating spoilage, infestation, and quality degradation. The company is a provider of remote monitoring solutions for crop storage and transportation in order to reduce food waste and support the food supply chain sustainability. TeleSense uses scalable sensor technology on an artificial intelligence (AI) platform to monitor temperature, humidity and CO2 levels in stored grain and other crops. It uses fixed and portable sensors to monitor the condition of stored food commodities, automates the early detection of potential issues such as hotspots, excess moisture, and pests and mitigates spoilage, quality degradation, and food waste. The TeleSense app provides users with alerts to effectively

- Manage crop quality,
- Reduce waste,
- Ensure safety, and
- Improve operational efficiency.

For example, in Austria, a supermarket introduced monitoring by costumers, promising two non-expired products for free if they detected a product with expired shelf life. This approach puts

86 https://www.prnewswire.com/news-releases/upls-post-harvest-solutions-subsidiary-decco-post-harvest-acquires-telesense-to-strengthen-offering-to-combat-food-waste-301626128.html?mc_cid=64dbea107f&mc_eid=7e191b85ae

the management of the supermarket under pressure, as the more expired products customers find, the poorer is the quality management of the manager and they risk their success fee.

Solutions for restaurants including fast food outlets

It seems that restaurants use about 5-7 times more energy per square metre than any other commercial building. Up to 80 % of that energy is wasted through the use of inefficient lighting, cooling, and heating technologies as well as the use of energy-consuming kitchen appliances. Restaurants can reduce energy consumption and save money by using energy-efficient equipment, and by investing in renewable energy technologies.

Similar to the software with AI for supermarkets from the likes of Wasteless in Israel and Neurolabs in Romania, there are applications for restaurants such as TeleSense from the USA; in Kosovo, the FARA group (https://fara.io) offers a similar application. The software allows restaurants and others to predict exactly how much they would sell by creating a hyper-accurate AI sales forecasting algorithm. The forecasting uses weather data, growth trends, and all of a restaurant's past data to generate forecasts that are 50 % more accurate than using traditional methods. It also allows to forecast down to the menu item level, allowing to dramatically slash food waste.

Yet restaurants collect very little data on what food they throw away and why, and as such have no idea about how to reduce their waste. Software combined with AI is aiming to solve that problem by allowing kitchens to monitor their waste. In practice, a weighing scale and an AI camera equipped with computer vision algorithms record the weight and the type of food as it is thrown into the bin e.g. 30 grams of steak, 500 grams of fries, etc. The member of staff then selects an option from a touchscreen on the wall above to indicate the reason for the waste, e.g.kitchen error, customer complaint, leftover from the plates or unused and spoilt inputs.

Furthermore, there are platforms for restaurants and cafes to sell off about-to-be wasted food at a marked-down price, typically at the end of each day. They get to sell off their surplus stock while attracting new customers to try their food. Hungry, price-conscious consumers can help in the battle against food waste while enjoying delicious food at bargain prices.

Pragmatic, easily-introduced, could be as follows:

1) Easy energy-saving product installation (timers on lights, low-flow toilets and sinks, low-flow spray valves in dish sinks, LED bulbs, motion sensor lights in bathrooms, spot air conditioners, occupancy sensors in freezers, etc);
2) Go vintage to go green, i.e., reusing decor or furniture;
3) Reduce waste through donation (reduce portion sizes if guests are not finishing meals, audit food waste, donate leftover food, etc.);
4) Select green cleaning products;
5) Invest in eco-friendly disposables (straws, utensils, plastic bags, takeout boxes, delivery bags, wrapping on tables, chairs and utensils);
6) Contactless options for choosing menus, and enabling customers access to menus via QR code;
7) Use more local products (to reduce pollution from transportation);
8) Join a recycling programme;
9) Start an individual staff awareness-raising programme.

Solutions for households

There are several approaches to reduce food waste at household level, but also to reuse and recycle:

1) Reduce the use of packaging material when purchasing food, and buy foods in sustainable packaging;
2) Cut down on plastics;
3) Motivate to learn about sustainable food sources.
4) Eat mindfully;
5) Minimize food waste;
6) Collect food waste in a "Green Bin";
7) Recycle food waste (composting);
8) Buy local, seasonal foods;
9) Grow your own;
10) Cut down on meat and prioritise plant-based diets;
11) Say no to straws at home;
12) Grow food in gardens
13) Reduce meat consumption

## 4.3 Orientation

Transforming the Kosovo FS into a sustainable one requires a comprehensive approach that addresses the following main steps:

1) Approaching an ecological balance, preserving natural resources and ecosystems, reducing waste, and minimizing pollution. Encouraging sustainable agriculture through practices like crop rotation, reduced tillage, using natural fertilizers, improved irrigation systems, and integrated pest management in the sense of reduced applications of agrochemicals or even organic farming, with or without certification.
2) Promoting social equity by ensuring that all members of society have access to healthy and culturally appropriate food. Awareness raising to support "fair" trade agreements, also to create socially SFSs.
3) Considering economic viability so that farmers, food processors, and other stakeholders make profit – as if that is not the case, farmers might stop producing for the market.
4) Reducing food loss at primary production and avoiding pre- and post-harvest losses reducing the amount of food that is thrown away, as this leads to a decrease in resources and energy needed to produce food.
5) Improving food packaging to reduce waste.
6) Promoting healthy diets that are diverse and based on whole, unprocessed foods, and reducing the consumption of meat, particularly from intensive livestock systems. Eventually developing alternative protein sources such as insects.
7) Promoting local food to reduce transport costs and the carbon footprint of food transportation (input and output transport) as well as to improve revenues of local enterprises.
8) Encouraging plant-based diets: a diet heavy in animal products contributes to deforestation and GHG emissions, so promoting plant-based diets can help reduce environmental harm. Furthermore, meat-based diets should focus on ruminants as long as they are not fed with fodder consumable by human beings, to avoid fodder competition. Pure grass feeding would be best in terms of environment and food competition.
9) Promoting responsible fishing as overfishing can lead to the collapse of fish populations. Aquaculture could be part of the solution.
10) Promoting renewable energies and reducing the use of fossil fuels, especially coal, also to be in line with the net-zero emission strategy (Green Deal).
11) Support food education and nutrition though programmes to help people understand the benefits of SFSs and make informed choices about their diets.

12) Foster community based FSs based on local resources and knowledge, promote local economies, and create stronger connections between producers and consumers through the development of farmers' markets.
13) Develop sustainable food policies with detailed action plans also at municipal levels.
14) Enhance data collection and analysis to better understand the food system, monitor its sustainability, and identify opportunities for improvement.
15) Invest in research and development by the private sector as well as by the public sector to develop new technologies and methods that can help make food production more sustainable; that might include increasing energy efficiency, shifting energy production towards renewable energy, reducing waste and wastewater, etc.

As is evident, these measures cannot be considered individually as e.g. food waste is a topic by itself and also part of applying new technologies.

A roadmap for the Prizren and Suharekë/Suva Reka Municipalities needs to reflect local circumstances. Transforming the FS into a more sustainable one requires a multi-faceted approach that addresses the various aspects of food production, distribution, and consumption. With an orientation on agriculture, transport, cold-storage infrastructure and ICT, the following steps can help to achieve this transformation.

1. Agriculture: By adopting sustainable farming practices such as regenerative agriculture, agro-forestry, and precision agriculture, farmers can improve soil health, reduce the use of synthetic chemicals (also by using more manure and compost), and increase the productivity of their land.
2. Transport: Improving the transportation and distribution of food products can help to reduce food waste and improve food security. This can be achieved by improving local logistics and using more sustainable modes of transport such as electric vehicles (as soon as renewable energy is produced locally in the municipalities to fuel these cars and vehicles, possibly with a focus on public transport).
3. Cold-storage infrastructure: Investing in cold-storage infrastructure can help to keep food fresh for longer periods of time, reducing food waste and improving food security. This can also help to support the growth of local FSs and reduce the carbon footprint of food transportation.
4. ICT: The use of ICT in the FS can help to improve efficiency, reduce waste, and promote sustainable practices. For example, precision agriculture technologies can help farmers to optimize their use of resources, while food traceability systems can help to ensure that food products are safe and sustainably produced.

Overall, these efforts should be guided by a systemic and holistic approach that involves collaboration between government, industry, and community stakeholders to create a more sustainable and equitable food system.

In summary, a re-orientation towards an SFS provides multiple benefits for the environment, the economy, public health, and social equity, making it a crucial step in addressing the complex challenges of our time.

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# 6 Annex: Map of food assets

FOOD FACTORY

FABRIKAT USHQIMORE

ABI PROGRES

EUROFOOD SH.P.K

MEKA FOOD

QUMESHTORJA SHARRI

MIX PRODUCT

ABI QUMESHTORJA

RESTAURANT'S RESTAURANTET

MARKET'S

DEPPO MARKET

ETC

INTEREX

VIVA FRESH

ALBI MARKET

SMALL MARKETS

PETROL STATIONS

POMPAT E BENZINES

SHELL PETROL

FATONI PETROL

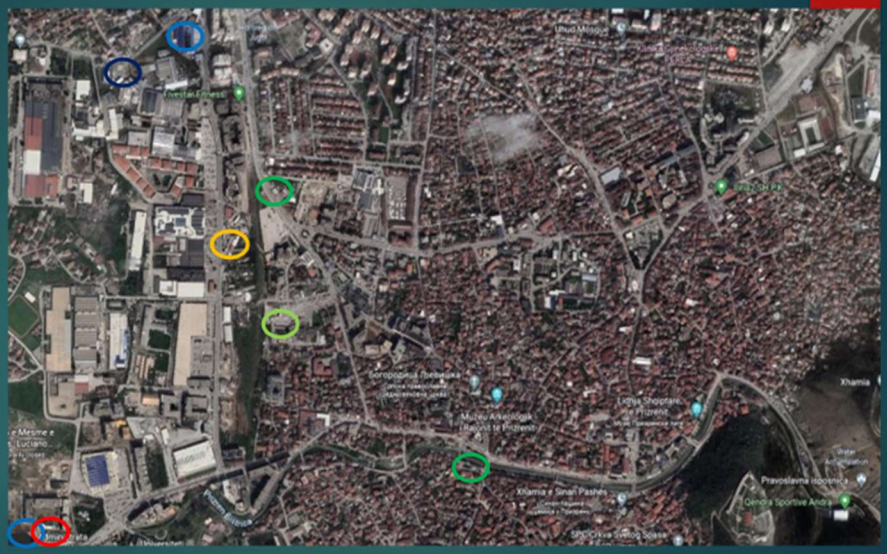
EL PETROL

ZHUR PETROL

IP PETROL

HiB PETROL

EXFIX PETROL



RESTAURANT'S PETROL STATIONS

ARBANA

PIRANE

KRUSHE E MADHE

RESTAURANT'S PETROL STATIONS

LUBIZHDE

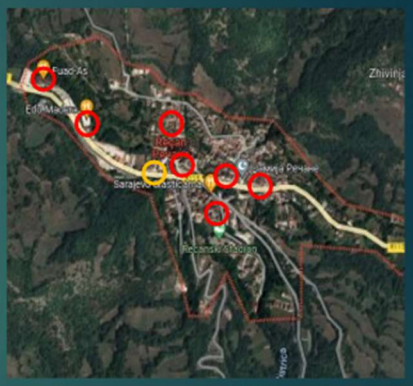
MALESIA E RE

MANASTIRC

RESTAURANT'S PETROL STATIONS

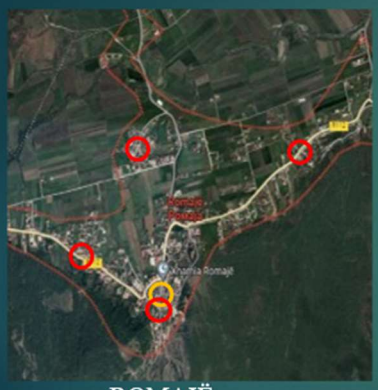
LANDOVICE

PETROVA



REÇAN

RESTAURANT'S PETROL STATIONS



ROMAJË

VLASHNJA

ZHUR

## Annex: Persons met, and institutions visited

| Institution | Name | Date | Place |
|---|---|---|---|
| FAO | Naser Krasniqi | 7 September 2022 | Prishtinë/ Priština |
| AUV | Flamur Kadriu | 7 September 2022 | Prishtinë/ Priština |
| MESP | Ismail Hetemaj | 7 September 2022 | Prishtinë/ Priština |
| MAFRD | Blerim Hasani | 8 September 2022 | Prishtinë/ Priština |
| GIZ project | Mustafe Kastrati | 8 September 2022 | Prishtinë/ Priština |
| ORGANIKA | Faton Nagavci | 8 September 2022 | Prishtinë/ Priština |
| PEPEKO | Hartim Gashi | 8 September 2022 | Prishtinë/ Priština |
| Ministry of economy (Department of Energy) | Sabit Gashi | 9 September 2022 | Prishtinë/ Priština |
| Agricultural Department in Suharekë Municipality | Ardian Kotorri | 9 September 2022 | Suharekë/ Suva Reka |
| Municipality of Suharekë Head of MGGCs | Enver Shabani | 9 September 2022 | Suharekë/ Suva Reka |
| Municipality of Prizren MGGCs | Muhamet Bajrami | 10 September 2022 | Prizren |
| Agricultural Department in Prizren Municipality | Jakup Kastrati | 10 September 2022 | Prizren |
| Agricultural Department in Prizren Municipality | Hajrullah Hoxha | 10 September 2022 | Prizren |
| ABI & ELIF L.L.C./Prizren (Food processing/Food marketing) | Alajdin Fusha | 10 September 2022 | Prizren |
| Gastronomy Association | Krenar Krajku | 10 September 2022 | Prizren |
| Visit to the green market (Prizren) | Field visit | 10 September 2022 | Prizren |
| EUROFOOD L.L.C. – Prizren (Food processing/Food marketing | Mehmet Shala | 13 September 2022 | Prizren |
| Women Cooperative Suharekë "Grate Fermere" Association | Aida Kuqi Ganimete Vata | 13 September 2022 | Suharekë/ Suva Reka |
| HAndikos - Suhareke | Suzana Gashi | 13 September 2022 | Suharekë/ Suva Reka |
| University of Prizren | Rifat Morina (Professor) | 13 September 2022 | Prizren |
| Cooperative 'Red Gold' Recan-Prizren | Ismet Osmani | 14 September 2022 | Prizren |
| Agrocelina (Based in the Municipality of Rahovec but doing business with Prizren processors) | Bekim Ermeni | 14 September 2022 | Rahovec/ Orahovac |
| Agrocelina (Based in the Municipality of Rahovec but doing business with Prizren processors) | Fehim Rexhepi | 14 September 2022 | Rahovec/ Orahovac |
| KB NEKTAR Mamushe | Fati Mazreku | 14 September 2022 | Mamushë/ Mamuša |
| Company - Frutex | Betim Kryeziu | 14 September 2022 | Suharekë/ Suva Reka |
| NGO - Termokiss | Miranda Mehmeti | 15 September 2022 | Prishtinë/ Priština |
| NGO- Ec me ndryshe | Valon Zhabali | 5 October 2022 | Prishtinë/ Priština |

| | | | |
|---|---|---|---|
| NGO - Thy | Visar Haxhifazliu | 5 October 2022 | Prizren |
| Dairy Sharri | Nderim Halimi | 6 October 2022 | Prizren |
| Elderly House | Halil Kastrati | 17 October 2022 | Prizren |
| Tregu Fatoni Prizren | Businesses | 17 October 2022 | Prizren |
| Biomass Heat and Power Station | Albana Dulutahu-Skivjani | 17 October 2022 | Gjakovë/ Djakovica |