Interreg CENTRAL EUROPE

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TeBiCE

D.1.2.3
Report on existing state-of-the-art value chains in target Central Europe

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Contents

1. Introduction

The value chains were analyzed to outline the "state of the art" of existing chains in Central European regions.

The activity tried to evaluate the potential, in terms of quantity, density and quality of the available biomass, to be valorised in value chains capable of valorising the by-products/waste generated in the agri-food sector.

In particular, the following were taken into consideration:

a) quantity (in kg per tonnes processed) and quality of by-products and waste pre-eminent agri-food sectors for Central Europe countries (dairy, fruit, etc.);

b) the continuity of availability of biomass to consider the possible seasonality of production; c) the actors that produce the biomass, i.e. the producing companies' biomass, in order to pave the way for what is possible clustering at local level to ensure critical mass

the creation of value chains;

d) the existence of value chains capable of valorising by-products and waste generated in the agri-food sector.

As described in deliverable 1.1.1., an evaluation matrix has been defined to identify and evaluate the potential of the value chains according to a scientific and technical approach. The method is based on a mostly economic assessment, conducted through the application of a matrix that includes a set of performance criteria and indicators. The matrix allows to define the most promising value chain/s in a given area by benchmarking the results obtained by the application of the matrix to single by-products/waste originating from a feedstock.

Furthermore, a mapping with graphs or physical maps was realized to show better the distribution of companies and quantities of by-product/wastes for the most relevant value-chains.

2. EVALUATION MATRIX OF VALUE CHAINS

2.1. METHODOLOGY AND LIST OF VALUE CHAINS

As defined in deliverable 1.1.1., the proposed matrix allows to give a score, representing the economic potential, to value chains. The calculation of the "value", together with its weighting, of each parameter set in the matrix for a single value chain originating by by-products and waste allow, in a second stage, to benchmark different gained scores and therefore to appoint most promising value chains.

Criteria and parameters that was considered are the following ones:

a) Share scientific or technical reports on the feasibility and potential of a value chain for the by-product/waste being assessed;
b) Number of producers of feedstock that generate the by-product or waste
c) Number of by-product producers in local territories
d) Estimate quantities of by-product/waste available;
e) Potential availability, that is: estimate potential supply, i.e. the quantities of by-product/waste obtained by processing, distribution (or concentration) on territory and continuity of by-product/waste production over the year;
f) Establish potential end-users of the value chain;
g) Estimate potential demand, i.e. how much the market can absorb.
h) Ratio of original by-product/waste value to end-product value

So, each partner, collected the information and data request and filled in the matrix for each outlined by-product/waste at REGIONAL level, by inserting the scores in column B, by applying the ranges described in last column of matrix. The matrix automatically weights each parameter and retour the "value" of the targeted chains (column A x B): then it is possible to benchmark the score gained by each outlined by-products/waste and identify the most promising value chain at regional level.

Tab. 1 - Value-chain evaluation matrix

Value-chain evaluation table

New value chains and Existing value chains put forward for upgrading*

ID	Parameter	Basic information**	Parameter weight (A) ***	Evaluation (B) ****	Outcome (A x B)	Score distribution - scale 1 (low) to 5 (high)
1	Scientific and technical reports supporting feasibility and potential of by-product/waste value chain	qualitative	3	5	15,00	Scoring: Scientific publications on applied technology reviews with active and consolidated referees and existing value chains: 5 points; Scientific publications in applied technology reviews with referees: 4 points; Scientific publications on applied technology reviews without referee: 3 points; Scientific publications in reviews with referee: 2 point ; Technical or scientific contributions to popular review: 1 point.
2	Number of feedstock producers with suitable characteristics available (potential impact)	quantitative	1	5	5,00	5 points when > 10.000 producers - 4 point when between 5.000 and 10.000 producers - 3 point 1.000 and 5.000 producers - 2 point 500 and 1.000 producers - 1 points when < 500 producers
3	Number of by-product producers in region (potential impact)	quantitative	1	5	5,00	5 points when > 150 - 4 point when between 100 and 150 - 3 point 50 and 100 - 2 point 25 and 50 - 1 points when < 25
4	Ratio of number of by-product/waste producers in region to total number of enterprises in the food manufacturing sector (potential impact)	quantitative	1	5	5,00	5 points when > 10% - 4 point when between 5% and 10% - 3 point 2,5% and 5% - 2 point 1% and 2,5% - 1 points when < 1%
5	Amount of by-product/waste available each year in region (potential availability)	quantitative	2	5	10,00	5 points when > 100,000 t - 4 point when between 50,000 and 100,000 t - 3 point 25,000 and 50,000 t - 2 point 5,000 and 25,000 t - 1 points when < 5,000 t *****
6	Distribution of by-product/waste production sites across region (potential availability)	qualitative	1	5	5,00	5 points if the production is spread across all the administrative units into which the Region is divided; 4 points if the presence is widespread in 3/4 of the administrative units; 3 points if the presence is widespread in half of the administrative units; 2 points if presence is limited to two administrative units; 1 point if the presence is concentrated in a single administrative unit
7	Continuity of by-product/waste production over the year (potential availability)	qualitative	2	5	10,00	5 points if production is continuous (>10 months); 3 points if the production has a duration of 4 - 10 months, 1 point if it is < 4 months
8	Ratio of end-product that can be obtained by processing by-product to by-product (potential supply)	quantitative	2	5	10,00	5 points when > 50% - 4 point when between 25% and 50% - 3 point 10% and 25% - 2 point 5% a 10% - 1 points when < 5%
9	Potential number of end-product users (potential demand)	quantitative	2	5	10,00	5 points when > 500 - 4 point when between 250 and 500 - 3 point 100 and 250 - 2 point 50 and 100 - 1 points when < 50
10	Ratio of potentially available end-product to potential market need (potential demand);	quantitative	2	5	10,00	5 points when > 25% - 4 point when between 15% and 25% - 3 point 10% and 15% - 2 point 5% a 10% - 1 points when < 5%
11	Ratio of original by-product/waste value to end-product value (%)	quantitative	3	5	15,00	5 points when < 25% - 4 point when between 25% and 40% - 3 point when between 40% and 50% - 2 point when between 50% and 80% - 1 points when > 80%
	Total				100,00	

This ratio is built as follows: (value in € of the final product obtained from a specific quantity of by-products/waste) divided (the value in € of the quantity of by-products/waste used) x 100

* Table evaluates value chain

** Information type used to make evaluation.

*** Importance of parameter to evaluation; the value is moderate and may be 1, 1.5 or 2 points

**** Enter parameter evaluation in this column; from 1 (low) to 5 (high) - "Likert scale".

***** Specify % of dry content (e.g. 30% dry content on a wet basis).

Tab. 2 – List of evaluated value chains for each partner

LIST OF VALUE CHAINS					
	Title or denomination	**Agricultural product**	**By-product**	**Extracted substances or part of by-product used**	**Final product**
LP PP1	High added value products from walnut processing residues	walnut	walnut husk, nutshell	Tannin, whole part	Natural dye, extracts for cosmetics applications, Antioxidants, Antimicrobial & Cytotoxic products, Walnut Husk Liqueur, Fertilizers and biostimulants
	High added value products from chicory processing residues	chicory	chicory leaves and roots	Phytochemicals, nitrogen, inulin, fibres, polyphenols	Fertilizers and biostimulants, extracts for pharma- or cosmetics applications
	High added value products from olive oil processing residues	olives, oil	pomace	Processing water, polyphenols, mineral salts	Livestock feed, extracts for pharma-, food-products or cosmetics applications, Fertilizers and biostimulants
	High added value products from rapeseed oil processing residues	rapeseed	rapeseed cake	Glucosinolates	Biofumigants, organic fertiliser and biostimulants
	High added value products from wine processing residues	grape, wine	pomace, fermentation lees	Ethanol, tartaric acid, polyphenols	Food supplements for human nutrition, livestock feed, Fertilizers and biostimulants
	High added value products from milk processing residues	milk, cheese	whey, wastewater, sludge	Proteins, fats, other carbon based by-products	Ingredients for food products, protein supplements, platform chemicals for bioplastics, Fertilizers and biostimulants
PP2	High added value molecules from wine and fruit processing residues	grape, apple, berries	pomace, seeds, skin, fibrous materials	Phytochemicals, Biopolymers	Natural dye, polyphenols, pectin, oil
	High added value product from oil processing residues	pumpkin, olives, rapesee	oil pressing cake, pomace, seeds, plant residue	Phytochemicals, Biopolymers	Protein flours, biopolymers, polyphenols
	High added value product from wood	wood	chips, shavings, bark	Phytochemicals, Biopolymers	polyphenols, biopolymers, natural aditives
PP3	High added value molecules from apple processing residues	Apple	peels, pomace, seeds	Carbohydrates, proteins, fatty acids	pectin, biopolymers, biomethane
	High added value molecules from wine processing residues	Grape	seeds, stalks, skin	Phytochemicals	polyphenols, biopolymers, biomethane
PP4	High added value products from residues of alcoholic fermentation	Wine, Beer, grapes, hop,	trester, draff, pomace, seeds, skin, fibrous materials	Phytochemicals, Biopolymers, additives	flavoring agents, phenols, biopolymers, biomethane, fertiliser, additives
	High added value products from hemp	hemp	hemp shives, fibres, oil, seed residues	Shives and fibres (cellulose, hemi-cellulose), oil	fibres for technical application (textile, construction), ingredients for cosmetics
	High added value molecules from wood	wood	chips, shavings, bark	lignin, cellulose, hemicellulose	biopolymers, extracts for pharma-, food- or cosmetics applications, biomethane, polyphenols
PP5	Vegetal residues for high quality insect products	wheat grain	wheat bran	carbohydrates, proteins	insect meal, insect oil, fertilisers, chitin
	Vegetal residues for high quality insect products	rye grain	rye bran	carbohydrates, proteins	insect meal, insect oil, fertilisers, chitin
	Vegetal residues for high quality insect products	rapeseed	rapeseed cake/meal	proteins, fat	insect meal, insect oil, fertilisers, chitin
PP6	Agri-food waste bioconversion into animal feed, fuel or other products	plants such as carrots, onion, pea etc.	food waste	whole parts of wasted food	biogas and organic fertilizer
	Agri-food waste bioconversion into animal feed, fuel or other products	grains such as corn and wheat	corn and wheat straws	grains silage	biogas and animal feed and organic fertilizer
	Agri-food waste bioconversion into animal feed, fuel or other products	corn	corn rachis	corn rachis	biogas and organic fertilizer
PP8	High added value product from wood	wood	branches, bark, chips	phytochemicals	pine angel, pine schnapps
	High added value product from pumpkin seeds	pumpkin	pressing cake, seeds	bleaching earth	pumpkin seeds oil, biodiesel, soaps
PP9	High added value products from hemp processing	Hemp stalk	shives and fiber	hemicelulose	biocomposite
	High addeded value Distilled Wine drink (snaps, vinovica, palenka)	wine	yeast after the process of fermentation	sediment after wine bottling	distilled wine

2.2. VALUE CHAINS BY COUNTRY

The value chains evaluated by each partner are presented below, divided by country and partner, with the score obtained by each value-chain.

1.2.1 Italy value chains

LIST OF VALUE CHAINS						
	Title or denomination	**Agricultural product**	**By-product**	**Extracted substances or part of by-product used**	**Final product**	**SCORE**
LP PP1	High added value products from walnut processing residues	walnut	walnut husk, nutshell	Tannin, whole part	Natural dye, extracts for cosmetics applications, Antioxidants, Antimicrobial & Cytotoxic products, Walnut Husk Liqueur, Fertilizers and biostimulants	**64**
	High added value products from chicory processing residues	chicory	chicory leaves and roots	Phytochemicals, nitrogen, inulin, fibres, polyphenols	Fertilizers and biostimulants, extracts for pharma- or cosmetics applications	**66**
	High added value products from olive oil processing residues	olives, oil	pomace	Processing water, polyphenols, mineral salts	Livestock feed, extracts for pharma-, food-products or cosmetics applications, Fertilizers and biostimulants	**63**
	High added value products from rapeseed oil processing residues	rapeseed	rapeseed cake	Glucosinolates	Biofumigants, organic fertiliser and biostimulants	**53**
	High added value products from wine processing residues	grape, wine	pomace, fermentation lees	Ethanol, tartaric acid, polyphenols	Food supplements for human nutrition, livestock feed, Fertilizers and biostimulants	**81**
	High added value products from milk processing residues	milk, cheese	whey, wastewater, sludge	Proteins, fats, other carbon based by-products	Ingredients for food products, protein supplements, platform chemicals for bioplastics, Fertilizers and biostimulants	**79**

LIST OF VALUE CHAINS						
	Title or denomination	**Agricultural product**	**By-product**	**Extracted substances or part of by-product used**	**Final product**	**SCORE**
PP3	High added value molecules from apple processing residues	Apple	peels, pomace, seeds	Carbohydrates, proteins, fatty acids	pectin, biopolymers, biomethane	**70**
	High added value molecules from wine processing residues	Grape	seeds, stalks, skin	Phytochemicals	polyphenols, biopolymers, biomethane	**68**

1.2.2 Slovenia value chains

LIST OF VALUE CHAINS						
	Title or denomination	**Agricultural product**	**By-product**	**Extracted substances or part of by-product used**	**Final product**	**SCORE**
PP2	High added value molecules from wine and fruit processing residues	grape	pomace, seeds, skin, fibrous materials	Phytochemicals, Biopolymers	Natural dye, polyphenols	**48**
		apple, berries			Pectin	**55**
					Pectin	**62**
	High added value product from oil processing residues	pumpkin	oil pressing cake, pomace, seeds, plant residue	Phytochemicals, Biopolymers	Pectin, polyphenols	**49**
		pumpkin seed			Protein flours	**60**
		olives			Pectin, polyphenols	**52**
		rapeseed			Protein flours	**62**
	High added value product from wood	wood	chips, shavings, bark	Phytochemicals, Biopolymers	polyphenols, biopolymers, natural aditives	**70**

1.2.3. Germany value chains

LIST OF VALUE CHAINS						
	Title or denomination	**Agricultural product**	**By-product**	**Extracted substances or part of by-product used**	**Final product**	**SCORE**
PP4	High added value products from residues of alcoholic fermentation	Beer, grapes, hop, barley	trester, draff, pomace, seeds, skin, fibrous materials	Phytochemicals, Biopolymers, additives	Biopolymers for bio-based packaging	**76**
					Biochar	**92**
	High added value products from hemp	hemp	hemp shives, fibres, oil, seed residues	Shives and fibres	fibres for technical application (textile, construction), ingredients for cosmetics	**64**
				Shives and fibres (bio-composite)		**55**
	High added value molecules from wood	wood	chips, shavings, bark	lignin, cellulose, hemicellulose	**biomethane**, biopolymers, extracts for pharma-, food- or cosmetics applications, polyphenols	**84**

1.2.4 Poland value chains

LIST OF VALUE CHAINS						
	Title or denomination	**Agricultural product**	**By-product**	**Extracted substances or part of by-product used**	**Final product**	**SCORE**
PP5	Vegetal residues for high quality insect products	wheat grain	wheat bran	carbohydrates, proteins	dried insect	**77**
	Vegetal residues for high quality insect products	rye grain	rye bran	carbohydrates, proteins	insect pate	**70**
	Vegetal residues for high quality insect products	rapeseed	rapeseed cake/meal	proteins, fat	insect meal	**60**

LIST OF VALUE CHAINS						
	Title or denomination	**Agricultural product**	**By-product**	**Extracted substances or part of by-product used**	**Final product**	**SCORE**
PP6	Agri-food waste bioconversion into animal feed, fuel or other products	plants such as carrots, onion, pea etc.	food waste	whole parts of wasted food	biogas and organic fertilizer	**94**
	Agri-food waste bioconversion into animal feed, fuel or other products	grains such as corn and wheat	corn and wheat straws	grains silage	biogas and animal feed and organic fertilizer	**80**
	Agri-food waste bioconversion into animal feed, fuel or other products	corn	corn rachis	corn rachis	biogas and organic fertilizer	**77**

1.2.5 Austrian value chains

LIST OF VALUE CHAINS						
	Title or denomination	**Agricultural product**	**By-product**	**Extracted substances or part of by-product used**	**Final product**	**SCORE**
PP8	High added value product from wood	wood	branches, bark, chips	phytochemicals	pine angel, pine schnapps	**57**
	High added value product from pumpkin seeds	pumpkin	pressing cake, seeds	bleaching earth	pumpkin seeds oil, biodiesel, soaps	**71**

1.2.6 Slovakia value chains

LIST OF VALUE CHAINS						
	Title or denomination	**Agricultural product**	**By-product**	**Extracted substances or part of by-product used**	**Final product**	**SCORE**
PP9	High added value products from hemp processing	Hemp stalk	shives and fiber	hemicelulose	biocomposite	**62**
PP9	High addeded value Distilled Wine drink (snaps, vinovica, palenka)	wine	yeast after the process of fermentation	sediment after wine bottling	distilled wine	**69**

2.3. VALUE CHAINS BY BY-PRODUCTS SECTOR

The value chains evaluated by each partner are presented below, divided by by-product sector, with the score obtained by each value-chain.

This kind of presentation of value-chains is very interesting, because it shows the different scores gained by the same value-chain in different country at regional level. It's interesting reflect on the cause of that: for example to the wine industries value-chain, it is possible to highlight some main causes, considering the identified parameters and grouping them by type:

- Existence of scientific publication on applied technology (or not) in reviews at international or national level: in some case the score is different from country to country. When this happens, it will be important to transfer knowledge between partners from different countries, this is relatively easy to do and would be a first and simple result of the project;
- Potential impact: about these parameters there are many differences between country too, with a score range between 3 and 15 points. These parameters concern the agricultural structure of each country and they are less modifiable, so the different scores between value-chain are structural;
- Potential aviability: this difference in scores are a direct consequence of the different agricultural structure at the local level and therefore are generally similar to the scores attributed to the potential impact parameters.
- Potential Supply/Demand and Ratio of value: about these parameters there are many differences too, for two reasons: the kind to end-products that can be obtain by original by-product/waste and, consequentially, the kind of potential users. A very specific end-product that can be used by a limited number of users reduces the parameter score, with score range between 8 and 24 points. About the relationship between the value of the original by-product and the final product, if this has low added value, the score will be low. Generally, the score of this parameter is high, but it can be also very low.

Similar evaluation can be made for other value-chain too.

2.3.1 Wine industry

LIST OF VALUE CHAINS						
	Title or denomination	Agricultural product	By-product	Extracted substances or part of by-product used	Final product	SCORE
LP PP1	High added value products from wine processing residues	grape, wine	pomace, fermentation lees	Ethanol, tartaric acid, polyphenols	Food supplements for human nutrition, livestock feed, Fertilizers and biostimulants	81
PP2	High added value molecules from wine and fruit processing	grape	pomace, seeds, skin, fibrous materials	Phytochemicals, Biopolymers	Natural dye, polyphenols	48
PP2	High added value molecules from wine and fruit processing residues		pomace, seeds, skin, fibrous materials	Phytochemicals, Biopolymers	Pectin	55
PP3	High added value molecules from wine processing residues	Grape	seeds, stalks, skin	Phytochemicals	polyphenols, biopolymers, biomethane	68
PP9	High addeded value Distilled Wine drink (snaps, vinovica, palenka)	wine	yeast after the process of fermentation	sediment after wine bottling	distilled wine	69

2.3.2 Fruit and nuts processing residues

LIST OF VALUE CHAINS						
	Title or denomination	Agricultural product	By-product	Extracted substances or part of by-product used	Final product	SCORE
PP2	High added value molecules from wine and fruit processing residues	apple, berries	pomace, seeds, skin, fibrous materials	Phytochemicals, Biopolymers	Pectin	62
PP3	High added value molecules from apple processing residues	Apple	peels, pomace, seeds	Carbohydrates, proteins, fatty acids	pectin, biopolymers, biomethane	70
LP PP1	High added value products from walnut processing residues	walnut	walnut husk, nutshell	Tannin, whole part	Natural dye, extracts for cosmetics applications, Antioxidants, Antimicrobial & Cytotoxic products, Walnut Husk Liqueur, Fertilizers and biostimulants	64

2.3.3 Oil industry

LIST OF VALUE CHAINS						
	Title or denomination	Agricultural product	By-product	Extracted substances or part of by-product used	Final product	SCORE
LP PP1	High added value products from olive oil processing residues	olives, oil	pomace	Processing water, polyphenols, mineral salts	Livestock feed, extracts for pharma-, food-products or cosmetics applications, Fertilizers and biostimulants	63
PP2	High added value product from oil processing residues	pumpkin	oil pressing cake, pomace, seeds, plant residue	Phytochemicals, Biopolymers	Pectin, polyphenols	49
PP2	High added value product from oil processing residues	pumpkin seed	oil pressing cake, pomace, seeds, plant residue	Phytochemicals, Biopolymers	Protein flours	60
PP2	High added value product from oil processing residues	olives	oil pressing cake, pomace, seeds, plant residue	Phytochemicals, Biopolymers	Pectin, polyphenols	52
PP8	High added value product from pumpkin seeds	pumpkin	pressing cake, seeds	bleaching earth	pumpkin seeds oil, biodiesel, soaps	71

2.3.4 Wood industry

LIST OF VALUE CHAINS						
	Title or denomination	**Agricultural product**	**By-product**	**Extracted substances or part of by-product used**	**Final product**	**SCORE**
PP2	High added value product from wood	wood	chips, shavings, bark	Phytochemicals, Biopolymers	polyphenols, biopolymers, natural aditives	**70**
PP4	High added value molecules from wood	wood	chips, shavings, bark	lignin, cellulose, hemicellulose	**biomethane**, biopolymers, extracts for pharma-, food- or cosmetics applications, polyphenols	**84**
PP8	High added value product from wood	wood	branches, bark, chips	phytochemicals	pine angel, pine schnapps	**57**

2.3.5 Cereal and milling industry

LIST OF VALUE CHAINS						
	Title or denomination	**Agricultural product**	**By-product**	**Extracted substances or part of by-product used**	**Final product**	**SCORE**
PP5	Vegetal residues for high quality insect products	wheat grain	wheat bran	carbohydrates, proteins	dried insect	**77**
PP5	Vegetal residues for high quality insect products	rye grain	rye bran	carbohydrates, proteins	insect pate	**70**
PP5	Vegetal residues for high quality insect products	rapeseed	rapeseed cake/meal	proteins, fat	insect meal	**60**
PP6	Agri-food waste bioconversion into animal feed, fuel or other products	grains such as corn and wheat	corn and wheat straws	grains silage	biogas and animal feed and organic fertilizer	**80**
PP6	Agri-food waste bioconversion into animal feed, fuel or other products	corn	corn rachis	corn rachis	biogas and organic fertilizer	**77**

2.3.6 Vegetable processing residues

LIST OF VALUE CHAINS						
	Title or denomination	**Agricultural product**	**By-product**	**Extracted substances or part of by-product used**	**Final product**	**SCORE**
LP PP1	High added value products from chicory processing residues	chicory	chicory leaves and roots	Phytochemicals, nitrogen, inulin, fibres, polyphenols	Fertilizers and biostimulants, extracts for pharma- or cosmetics applications	**66**
PP6	Agri-food waste bioconversion into animal feed, fuel or other products	plants such as carrots, onion, pea etc.	food waste	whole parts of wasted food	biogas and organic fertilizer	**94**

2.3.7 Hemp processing

LIST OF VALUE CHAINS						
	Title or denomination	**Agricultural product**	**By-product**	**Extracted substances or part of by-product used**	**Final product**	**SCORE**
PP4	High added value products from hemp	hemp	hemp shives, fibres, oil, seed residues	Shives and fibres	fibres for technical application (textile, construction), ingredients for cosmetics	**64**
PP4	High added value products from hemp		hemp shives, fibres, oil, seed residues	Shives and fibres (bio-composite)	fibres for technical application (textile, construction), ingredients for cosmetics	**55**
PP9	High added value products from hemp processing	Hemp stalk	shives and fiber	hemicelulose	biocomposite	**62**

2.3.8 Dairy industry

LIST OF VALUE CHAINS						
	Title or denomination	Agricultural product	By-product	Extracted substances or part of by-product used	Final product	SCORE
LP PP1	High added value products from milk processing residues	milk, cheese	whey, wastewater, sludge	Proteins, fats, other carbon based by-products	Ingredients for food products, protein supplements, platform chemicals for bioplastics, Fertilizers and biostimulants	79

2.3.9 Beverage industry

LIST OF VALUE CHAINS						
	Title or denomination	Agricultural product	By-product	Extracted substances or part of by-product used	Final product	SCORE
PP4	High added value products from residues of alcoholic fermentation	Beer, grapes, hop, barley	trester, draff, pomace, seeds, skin, fibrous materials	Phytochemicals, Biopolymers, additives	Biopolymers for bio-based packaging	76
PP4	High added value products from residues of alcoholic fermentation		trester, draff, pomace, seeds, skin, fibrous materials	Phytochemicals, Biopolymers, additives	Biochar	92

2.3.10 Transnational rapeseed oil processing residues

LIST OF VALUE CHAINS						
	Title or denomination	Agricultural product	By-product	Extracted substances or part of by-product used	Final product	SCORE
LP PP1	High added value products from rapeseed oil processing residues	rapeseed	rapeseed cake	Glucosinolates	Biofumigants, organic fertiliser and biostimulants	53
PP2	High added value product from oil processing residues	rapeseed	oil pressing cake, pomace, seeds, plant residue	Phytochemicals, Biopolymers	Protein flours	62
PP4	High added value products from rapeseed oil processing residues	rapeseed	rapeseed cake	Glucosinolates	Biofumigants, organic fertiliser and biostimulants	64
PP5	Vegetal residues for high quality insect products	rapeseed	rapeseed cake/meal	proteins, fat	insect meal	60

3. MAPPING OF VALUE CHAIN

To show better the distribution of companies and quantities of by-product/wastes for the most relevant value-chains, a mapping with graphs or physical maps was realized by each partner.

The “mapping” concern, at least:

- Companies/farm producing by-products (number of actors in a given territory);
- Quantity of by-products available and its distribution across the territory (for administrative unit)

The mapping reports created by each partner are presented below.

3.1. ITALY VALUE CHAINS

3.1.1 Mapping of wine and dairy value chain in Veneto Region

Fig. 1 - Administrative Unit in Veneto Region

Fig. 2 - Percentage distribuction (%) of wine producers by administrative unit

	By-product producers (n.)		Amount of by-product available (t)	
Province	**Dairies**	**Wine producers**	**Whey**	**Pomace**
BELLUNO	21		42.871	0
PADOVA	4	26	191.482	24.211
ROVIGO	2	1	17.838	538
TREVISO	24	149	133.232	142.591
VENEZIA	1	19	39.199	30.453
VERONA	19	114	266.556	80.190
VICENZA	44	19	324.858	22.017
Total	**115**	**328**	**1.016.036**	**300.000**

Source: Chamber of Commerce and database AIDA

A) VC WINE POMACE (LEES)

Fig. 3 - Number (n.) of wine producers by administrative unit

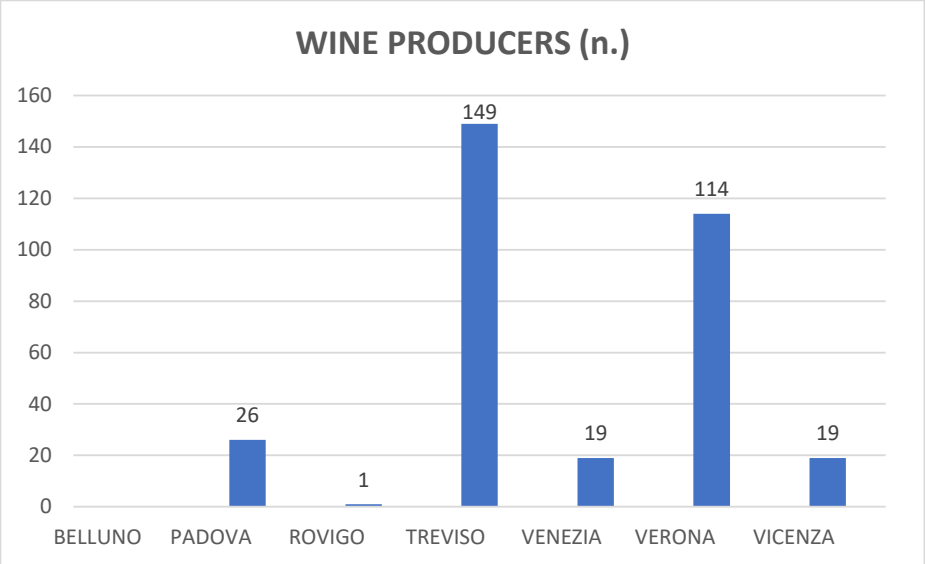


Fig. 4 - Percentage distribuction (%) of wine producers by administrative unit

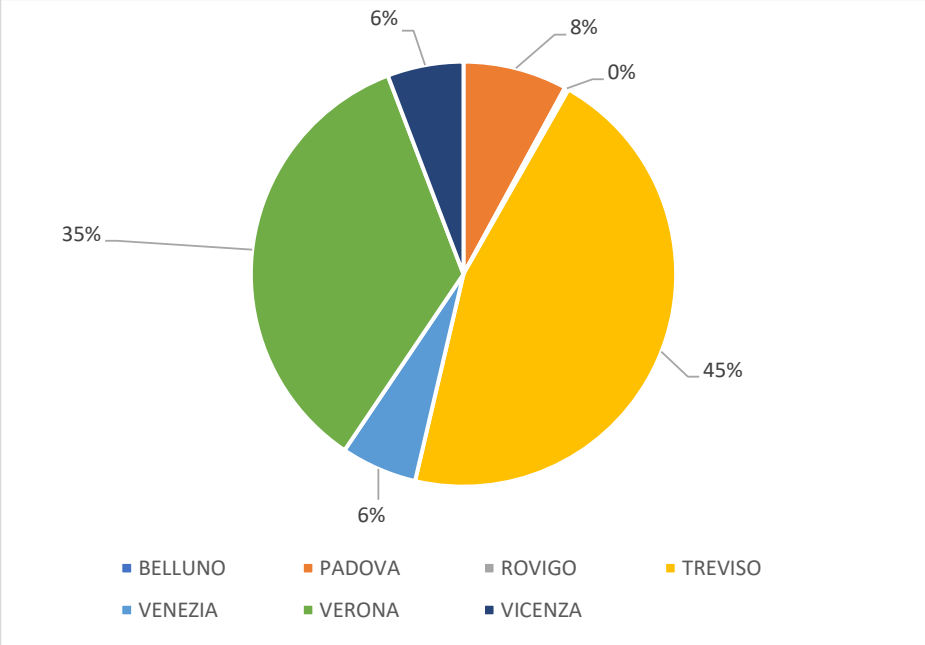


Fig. 5 - Amount of pomace by administrative unit

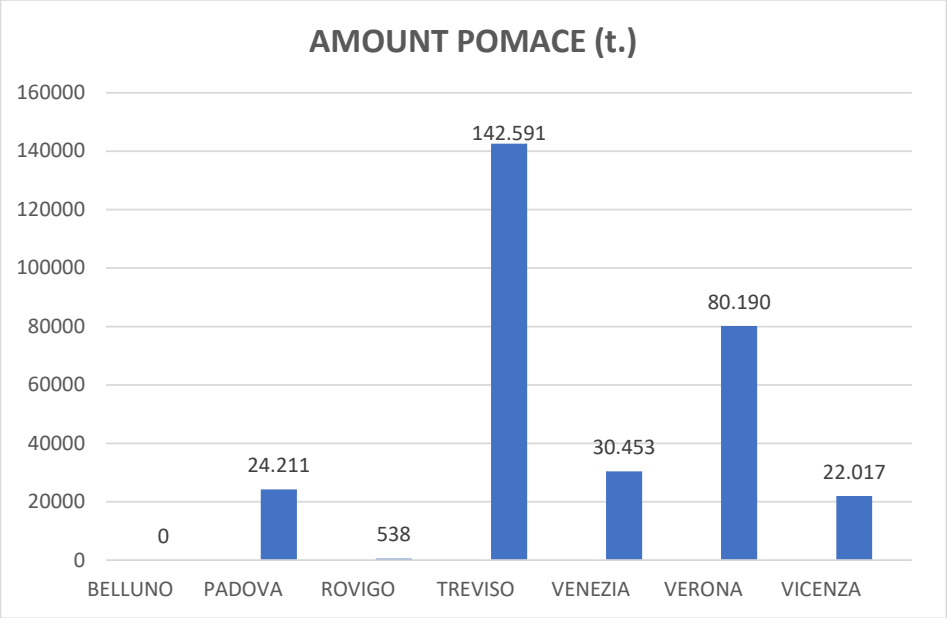
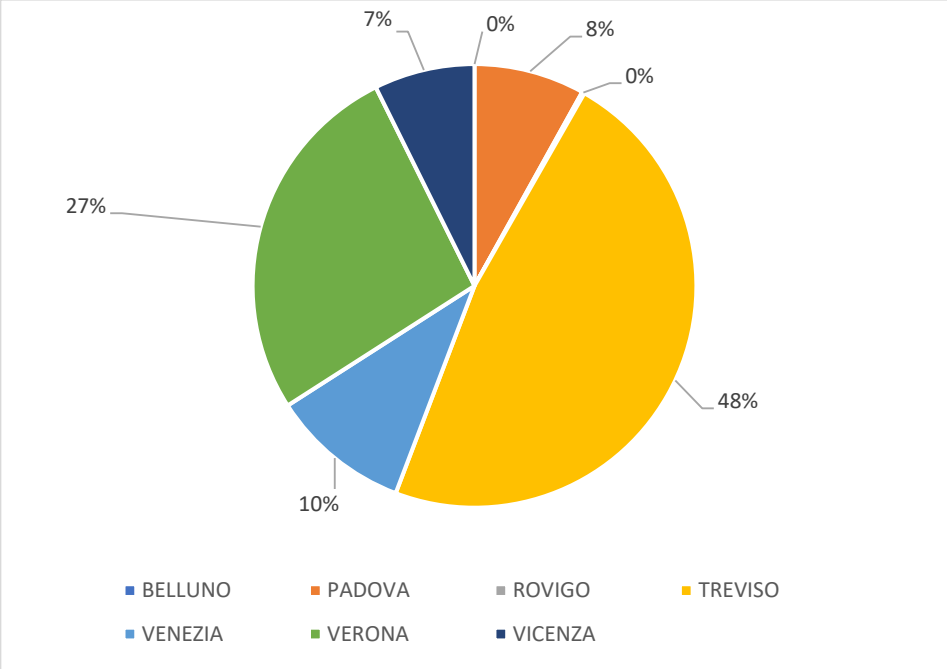
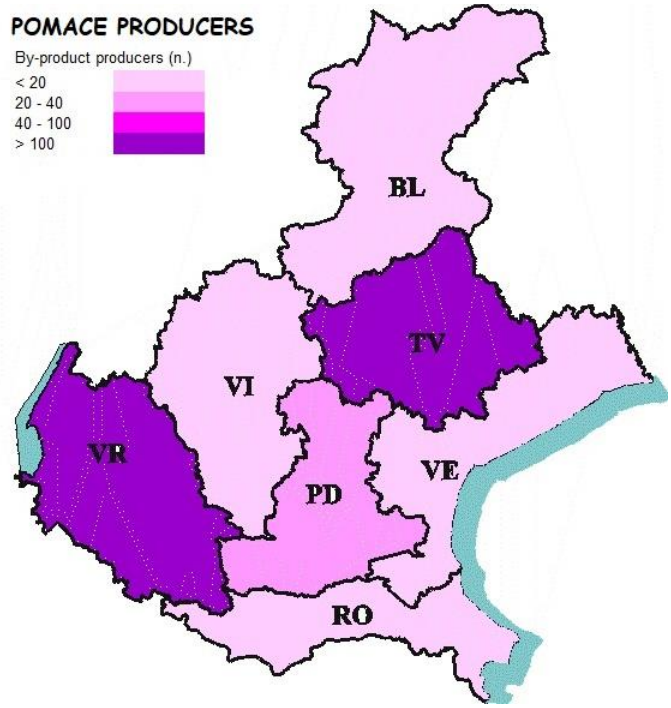


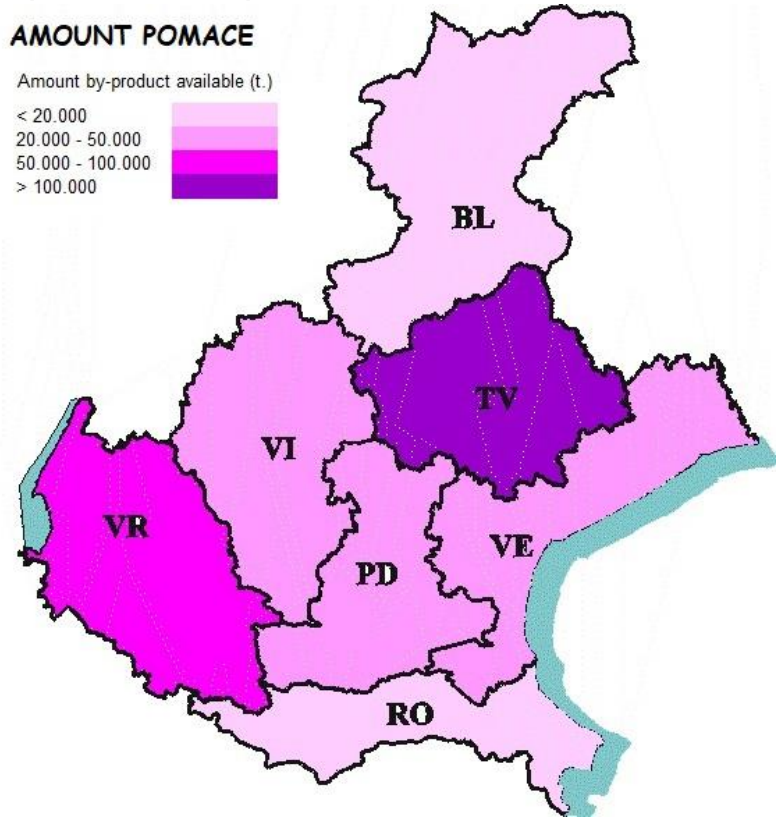
Fig. 6 - Percentage distribution (%) of pomace by administrative unit



Map 1 – Numbers of wine producers by administrative unit



Map 2 –Amount of pomace by administrative unit



B) VC WHEY

Fig. 7 - Number (n.) of dairies by administrative unit

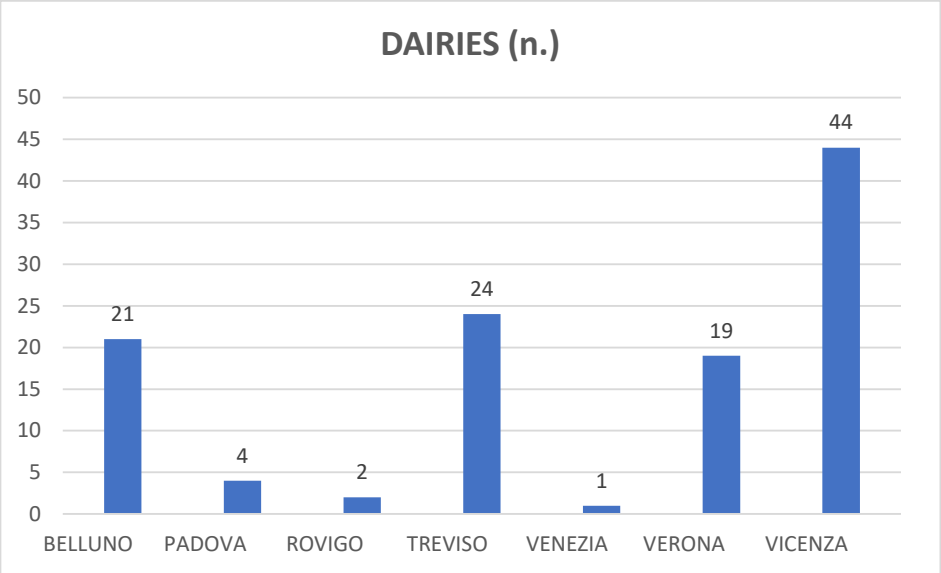


Fig. 8 - Percentage distribution (%) of dairies by administrative unit

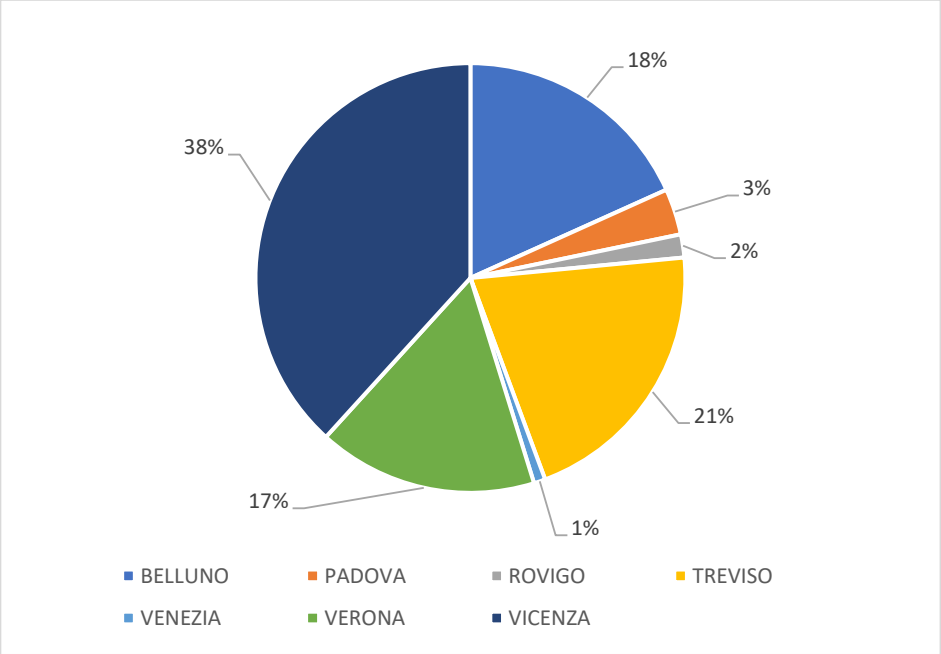


Fig. 9 - Amount of whey by administrative unit

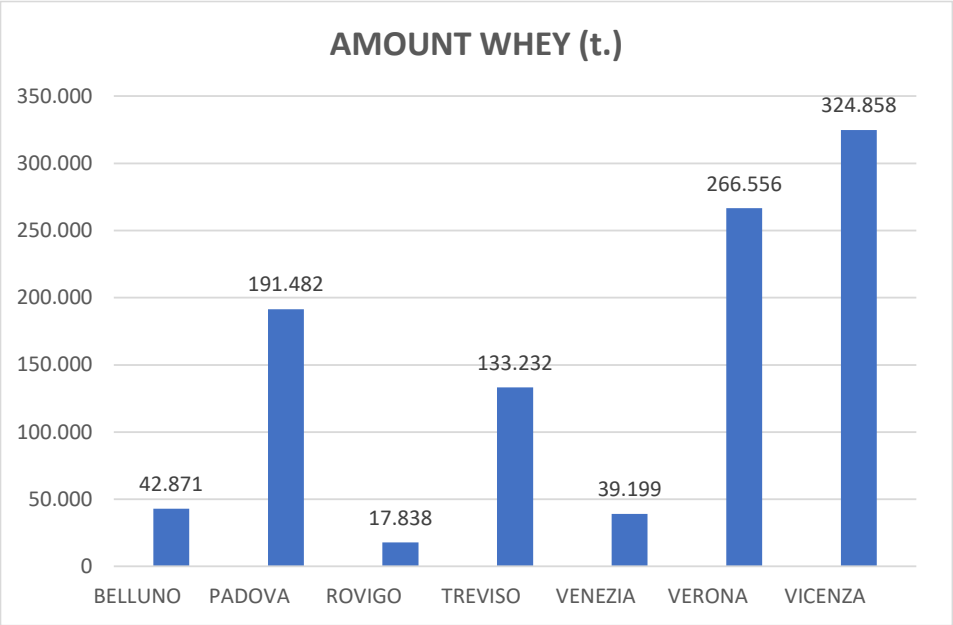
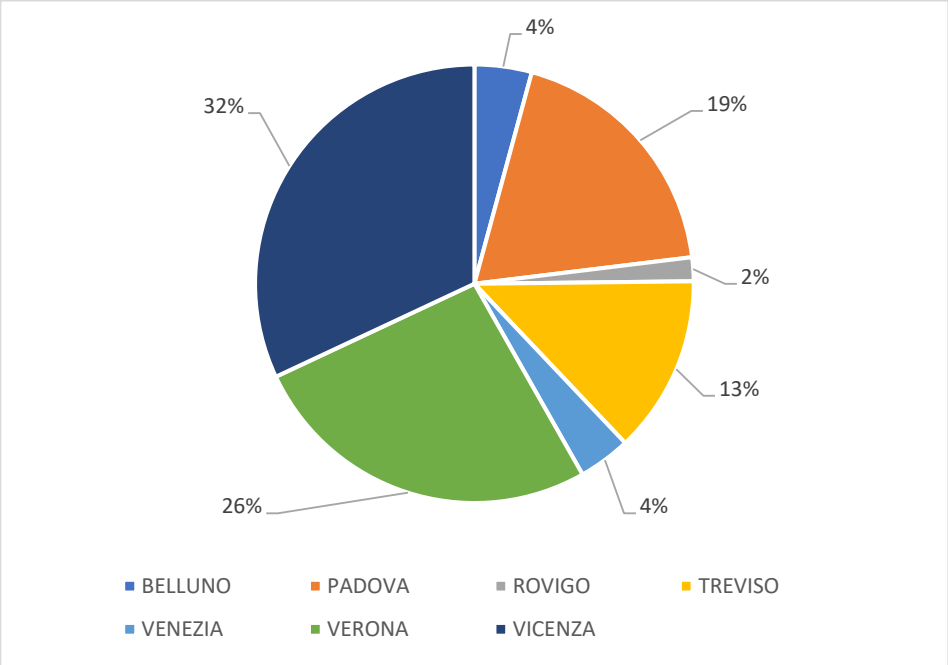
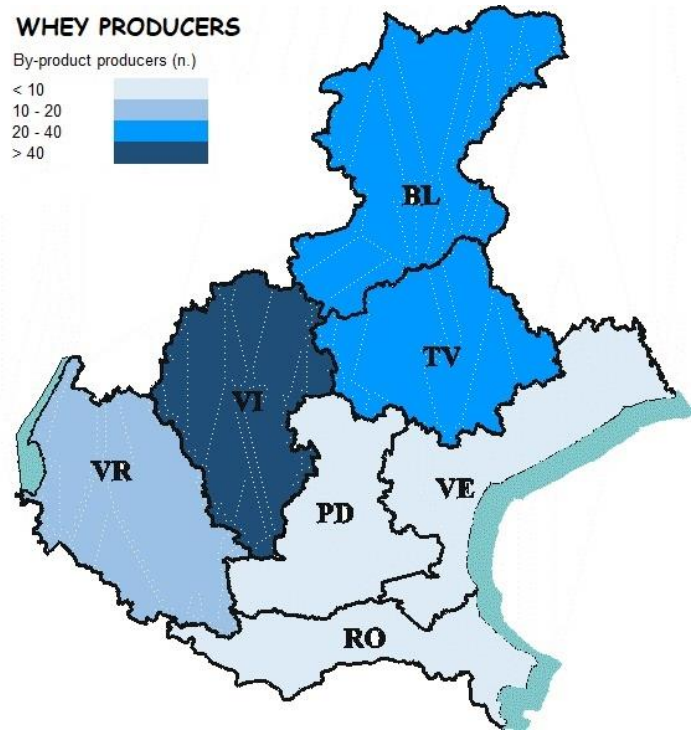


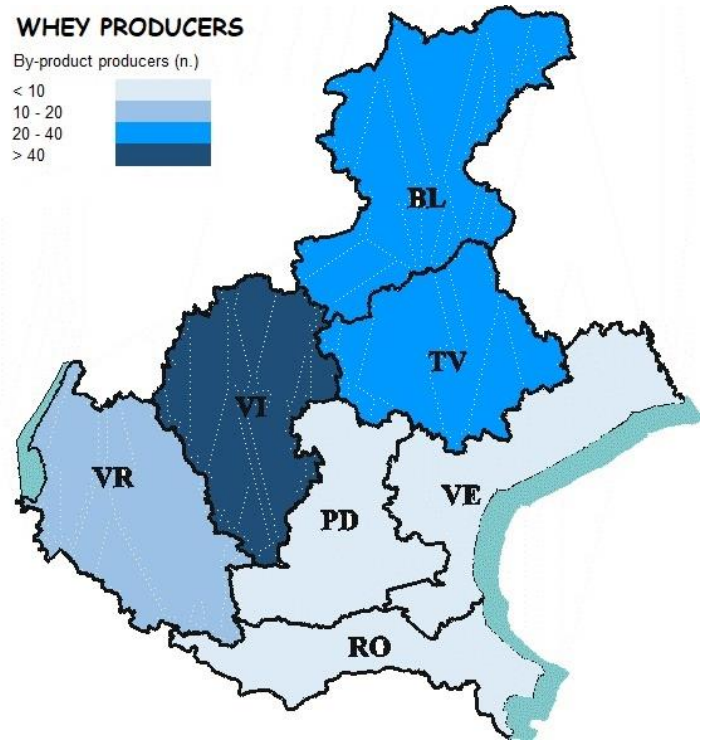
Fig. 10 - Percentage distribuction (%) of pomace by administrative unit



Map 3 – Numbers of dairies by administrative unit

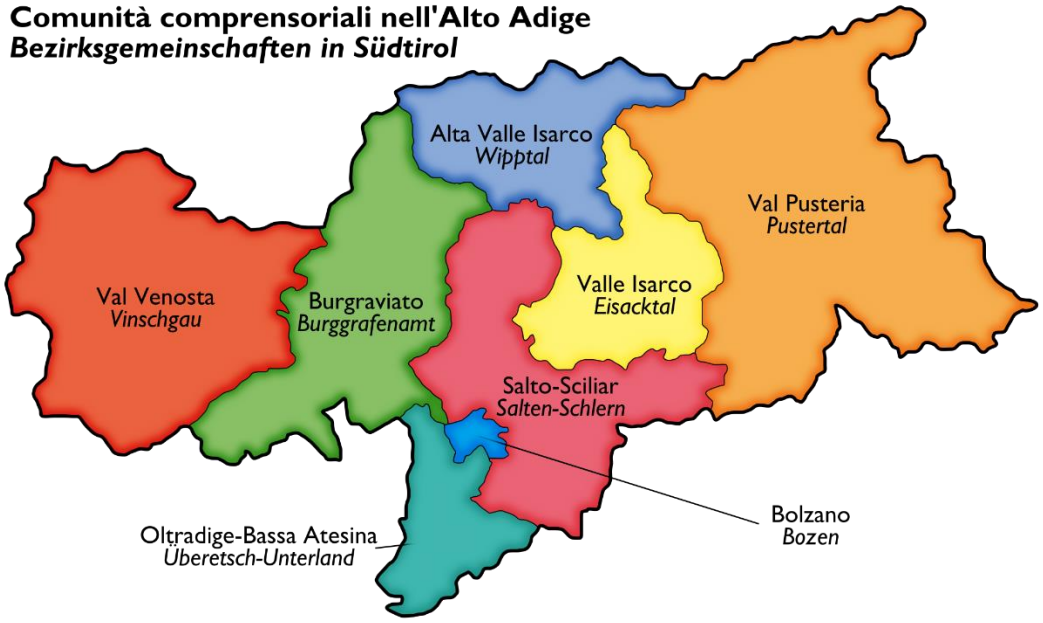


Map 4 –Amount of whey by administrative unit



3.1.2 Mapping of wine and apple value chain in South Tyrol

Fig. 1 - Comprensorial communities in South Tyrol (Italy)



Sources: https://it.m.wikipedia.org/wiki/File:Comunit%C3%A0_comprensoriali_Alto_Adige.svg

A) GRAPES

Grape seeds: 2692.065 tons (calculated considering the total of grape and the fact that the seeds represent the 5% of whole grape), N (producer of by-product): 19. It is possible to produce grape seed oil, nutritional supplements, cosmetic and skin care products.
Wine lees: 1372 tons (calculated considering the total of grape and the fact that the wine lees represent the 0.5 % of whole grape), N (producer of by-product): 19.
Grape pomace: 16152.39 tons, (calculated considering the total of grape and the fact that the pomace represents the 30% of whole grape), N (producer of by-product):19. Used for animal feed, composting, and extraction of polyphenols and antioxidants.
Stems: 2153.652 tons, (calculated considering the total of grape and the fact that the stems represent the 3% of whole grape), N (producer of by-product):19. Mostly used for composting and biofuel.

The producers' distribution can be seen in Fig. 2 and 3.

Fig. 2 - Geolocalization of grape producers in South Tyrol (self-produced graph)

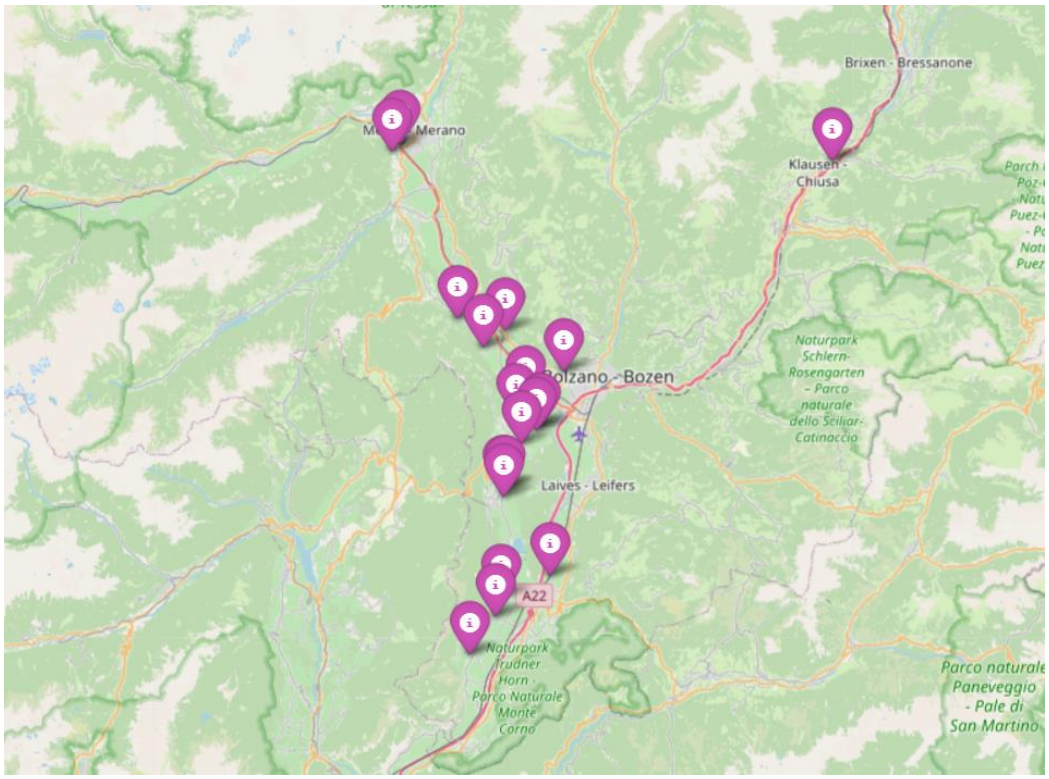
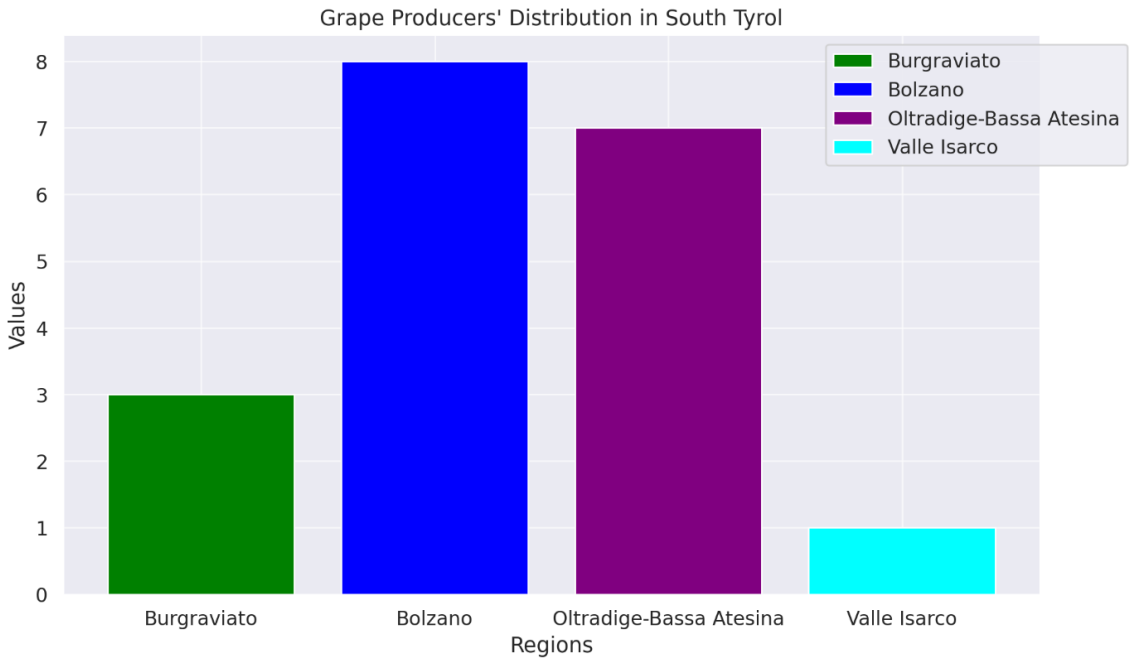


Fig. 3 - Barplot showing grapes producers' distribution (self-produced graph)



Comprensorial community	Number of Producers
Bolzano	8

Burgraviato	3
Valle Isarco	1
Oltradige-Bassa Atesina	7

B) APPLES

Apple pomace: 97913.46 tons, (calculated considering the total of apple and the fact that the stems represent the 57% of whole apple), N (producer of by-product): 22. It is possible to extract elements such as sugar, fibres, proteins, N, moisture, cellulose, hemicellulose, mineral. Often used for animal feed production, composting, pectin extraction, biofuel production and cosmetics.

Apple juice: 120588.20 tons, (calculated considering the total of apple and the fact that the stems represent the 57% of whole apple), N (producer of by-product): 22.

Apple seeds: 39508.94 tons, (calculated considering the total of apple and the fact that the stems represent the 0.23% of whole apple), N (producer of by-product): 22. Useful for obtaining fatty acids and for oil extraction.

Apple skin: 34355.608 tons, (calculated considering the total of apple and the fact that the stems represent the 20% of whole apple), N (producer of by-product): 22. It is possible to extract elements such as Phenols, sugar, proteins, C, N, moisture, cellulose, hemicellulose, lignine.

Apple puree: 7558.20 tons (derived from a company's report), N (producer of by-product): 1. Used for preparing baby food, baking ingredients, smoothies and beverages.

Apple cooked-IQF-frozen: 42945 tons (derived from a company's report), N (producer of by-product): 1.

Apple fresh cut: 687.04 tons (derived from a company's report), N (producer of by-product): 1.

The producers' distribution can be seen in Fig. 4 and 5.

Figure 4 - Geolocalization of apple producers in South Tyrol (self-produced graph)

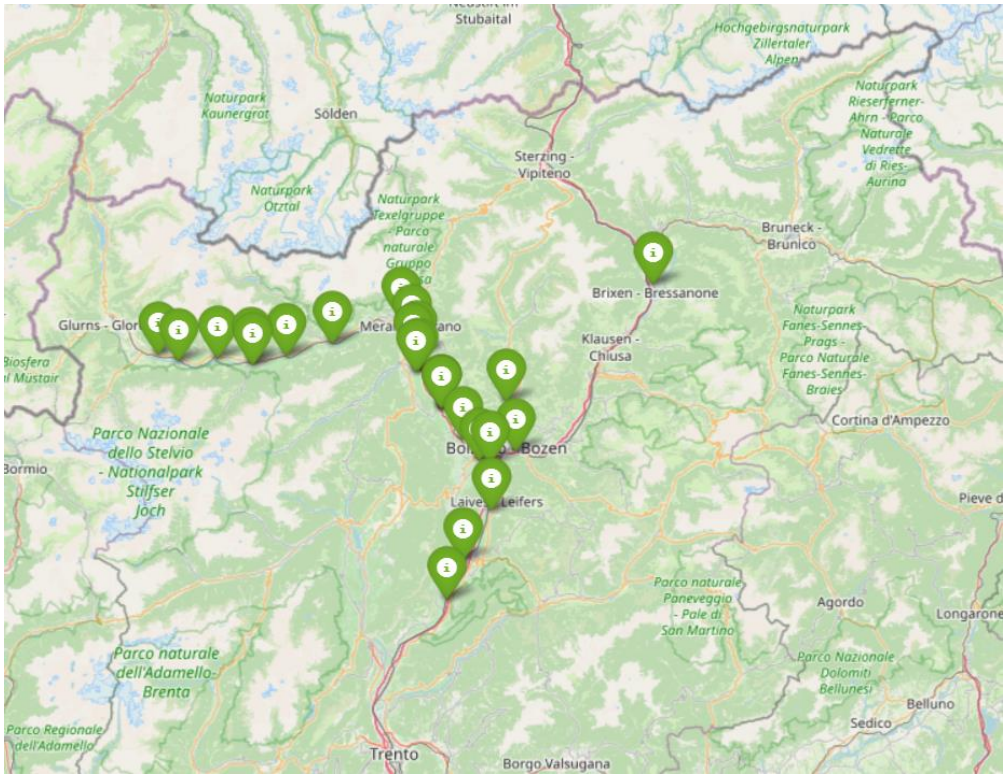
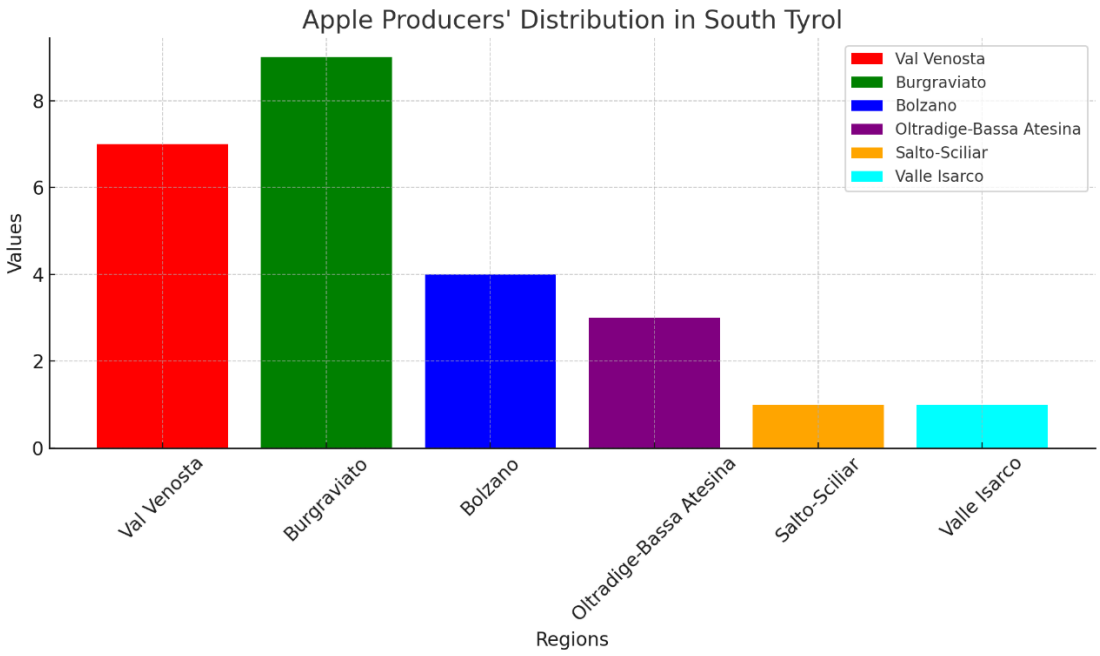


Figure 5 - Barplot showing apples producers' distribution (self-produced graph)



Comprensorial community	Number of Producers
Val Venosta	7

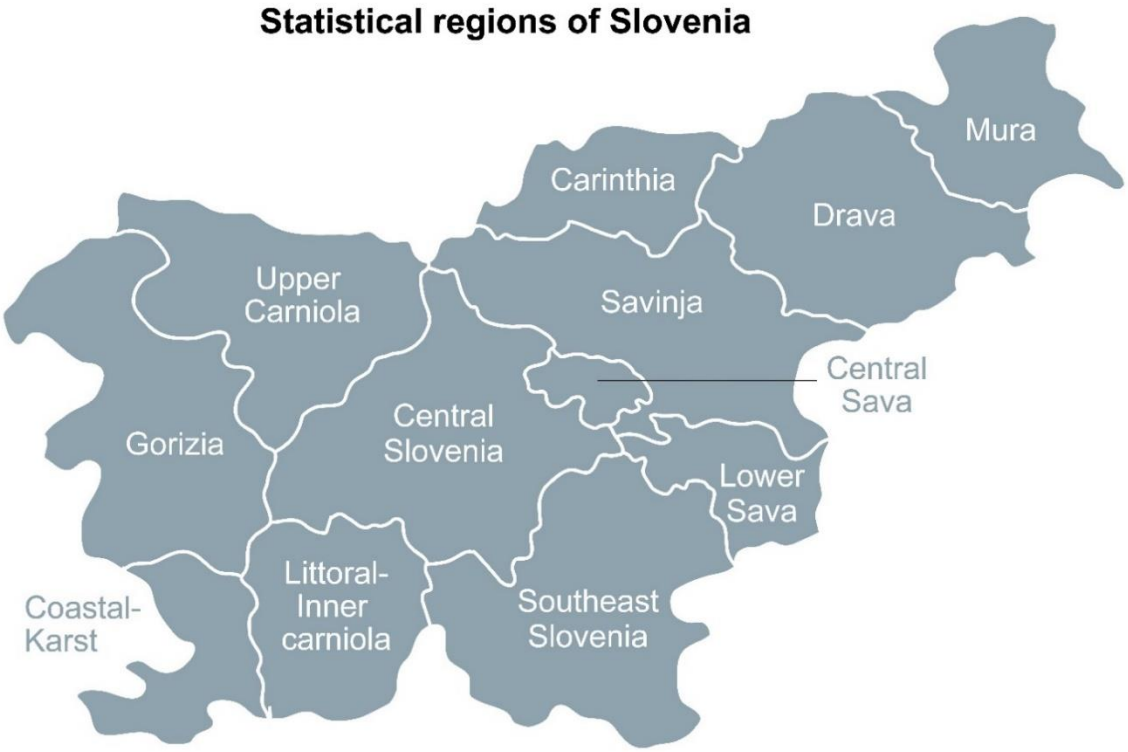
Burgraviato	9
Bolzano	4
Oltradige-Bassa Atesina	3
Salto-Sciliar	1
Valle Isarco	1

3.2. SLOVENIA VALUE CHAINS

Administrative units of Slovenia

Slovenia is divided in two Cohesion regions (NUTS 2), twelve Statistical regions (NUTS 3) and in 212 Operative units (SKTE 5). Figure 1 presents statistical regions of Slovenia. The Slovenian name of regions are explained in Appendix (Table 2). Information presented in report are collected according to the available sources on national level from statistical portal SI STAT (Podatkovna baza SiStat) and national reports.

Fig. 1 - Statistical region of Slovenia (self-produced picture).

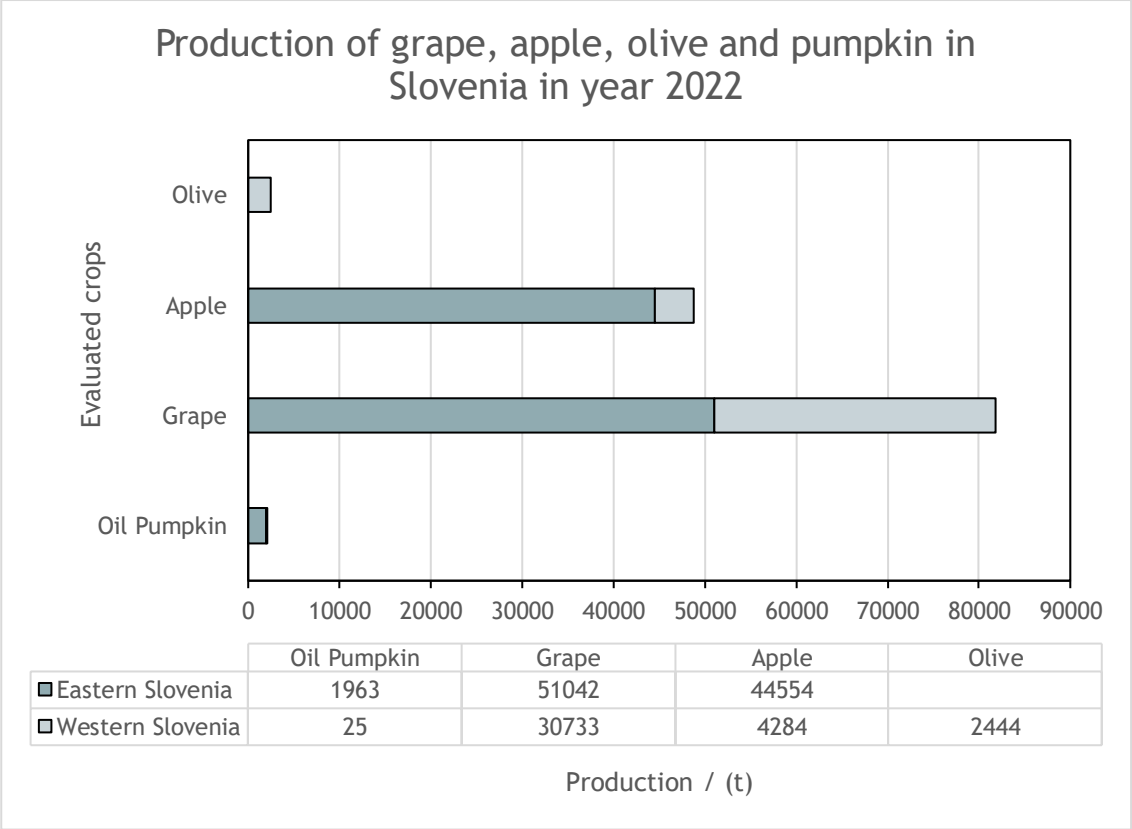


Evaluation of agricultural crops involved in value chain

Slovenia have long and reach tradition of grooving fruits such as grape and apple and oily plants such as olive and pumpkin. processing to wine and oil. Figure 2 presents production of grape, apple, olive and pumpkin in year 2022. Production of grape in 2022 was evaluated over 81.000 t, where production of apple in intensive orchard 48.000 t. Manly produced region is Eastern Slovenia, where are better condition for growing a grape and apple.

The production of oil plants is much smaller; the production of olive in year 2022 was evaluated on 2444 t where production of pumpkin seed was 1988 t. According to the growing condition and climate olive are produced in Western Slovenia in region with Mediterranean climate, where pumpkins are produced mainly in continental region of Slovenia, especially in Drava and Mura region.

Figure 2. Production of evaluated crops in Slovenia in year 2022



	Oil Pumpkin	Grape	Apple	Olive
Eastern Slovenia	1963	51042	44554	
Western Slovenia	25	30733	4284	2444

Source: SI STAT, Pridelava pomembnejših kmetijskih kultur po: KOHEZIJSKA REGIJA, LETO, VRSTE POSEVKOV NA NJIVAH , MERITVE. SiteTitle (stat.si)).

A) VC GRAPE POMACE FOR PECTIN AND NATURAL DYES

Slovenia have three main wine producing regions Podravje, Posavje and Primorska (Figure 3). In table 1 are presents data of the number of grape producers, produced area and amount of produced grape and wine by Slovenia's wine regions.

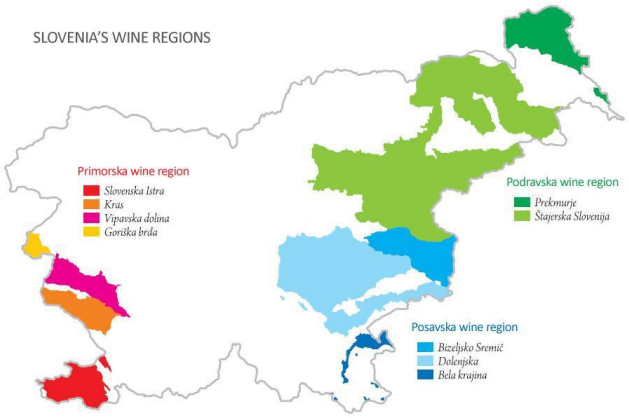
Table 1: in wine growing regions in Slovenia in year 2022: Number of grape producers, produced area and quantity of produced grape and processed wine in Slovenia's wine regions

Wine region	Nu. producers	Area (ha)	Grape (1000 kg)	Wine (1000 L)
Vineyards suma	25582	14195	74350	50677
Podravje	10987	5630	26389	18328
Štajerska Slovenija	8751	5196	24296	16923
Prekmurje	2236	434	2093	1404
Posavje	9717	2308	15456	11009
Bela krajina	1300	303	2012	1429
Dolenjska	6637	1333	9839	7220
Bizeljsko Sremič	1780	673	3605	2359
Primorska	4878	6256	32504	21341
Goriška brda	660	1814	12193	7859
Vipavska dolina	1612	2070	9694	6239

Kras	751	543	2398	1749
Slovenska Istra	1855	1828	8220	5494

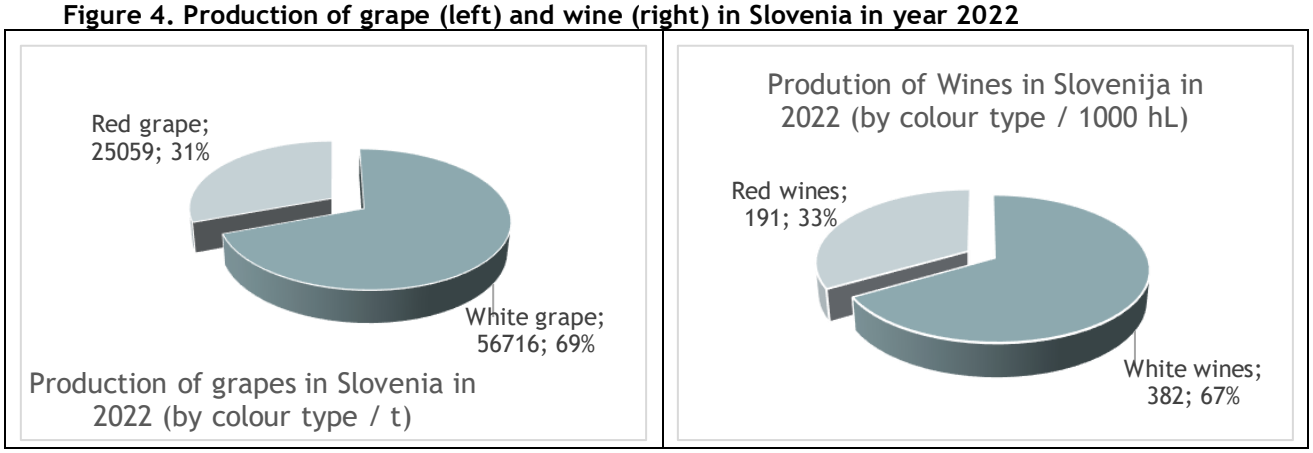
Source: naslovnica_zeleno porocilo_koncne_a4_2022.cdr (kis.si) table 2.9.2 and 2.9.3, page 89, 90.

Figure 3: The vineyard regions in Slovenia (https://maps-slovenia.com/img/1200/slovenia-wine-map.jpg



In Slovenia have two type wine production according to the grape colour type, white wine and red wine production. Figure 4 represent production of grape (left) and wine (right) in Slovenia in year 2022. The main part around 70 % represents white grape and wine where production of red grape and wine represents around 30 % of total production of grape and wine in Slovenia.

Figure 4. Production of grape (left) and wine (right) in Slovenia in year 2022



Source: SI STAT.

B) GRAPE POMACE

Grape pomace: 18100 t

Quantity of grape pomace was evaluated regarding to 50.677 10^3 L of total produced wine (table 2)[1] and information that grape pomace represents the 25% of whole grape[2].

N (producer of by-product): 18

[1] naslovnica_zeleno porocilo_koncne_a4_2022.cdr (kis.si) table 2.9.3, page 90.

[2] http://dx.doi.org/10.1016/j.wasman.2017.07.017

The figure 4 represents number of grape pomace producer in Slovenian (per statistical regions). In number of producers are included grape producers and wine producers. Producers are mostly located in a vineyard region in Slovenia (statistical regions): Southeast Slovenia, Drava, Mura, Gorizia, Coastal-Karst and Lower Sava.

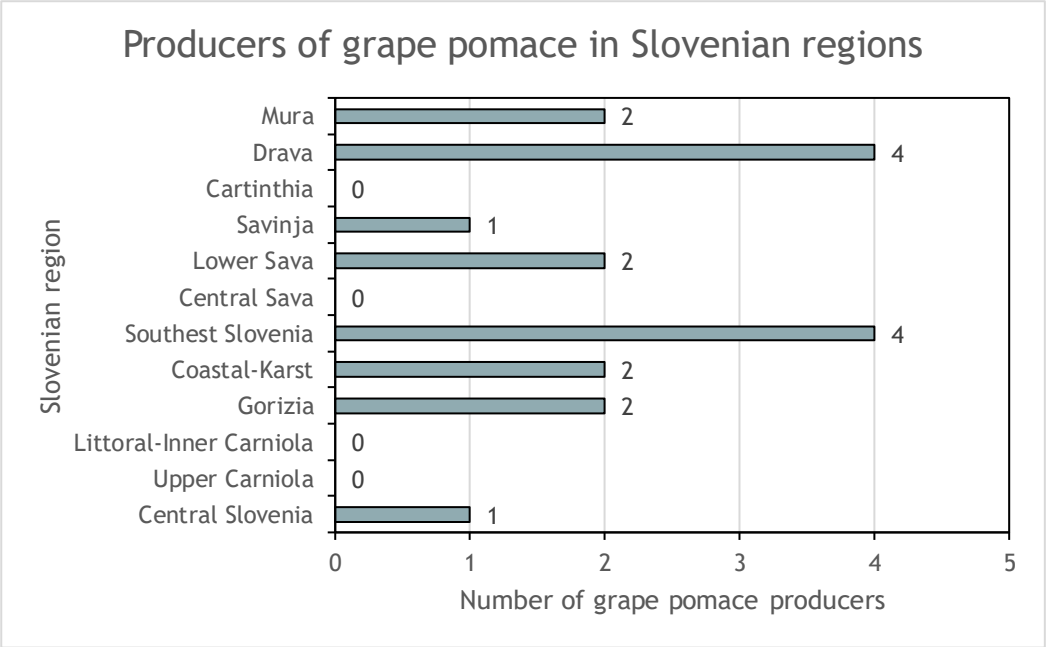
Red grape pomace: 6265 t

Quantity of red grape pomace was evaluated from 25059 t of red grape[3] and information that grape pomace represents the 25% of whole grape[4].

N (producer of by-product): 5

The figure 5 represents number of red grape pomace producer in Slovenian. Producers are mostly located in a tree vineyard region in Slovenia (statistical regions): Gorizia, Coastal-Karst, Southeast Slovenia.

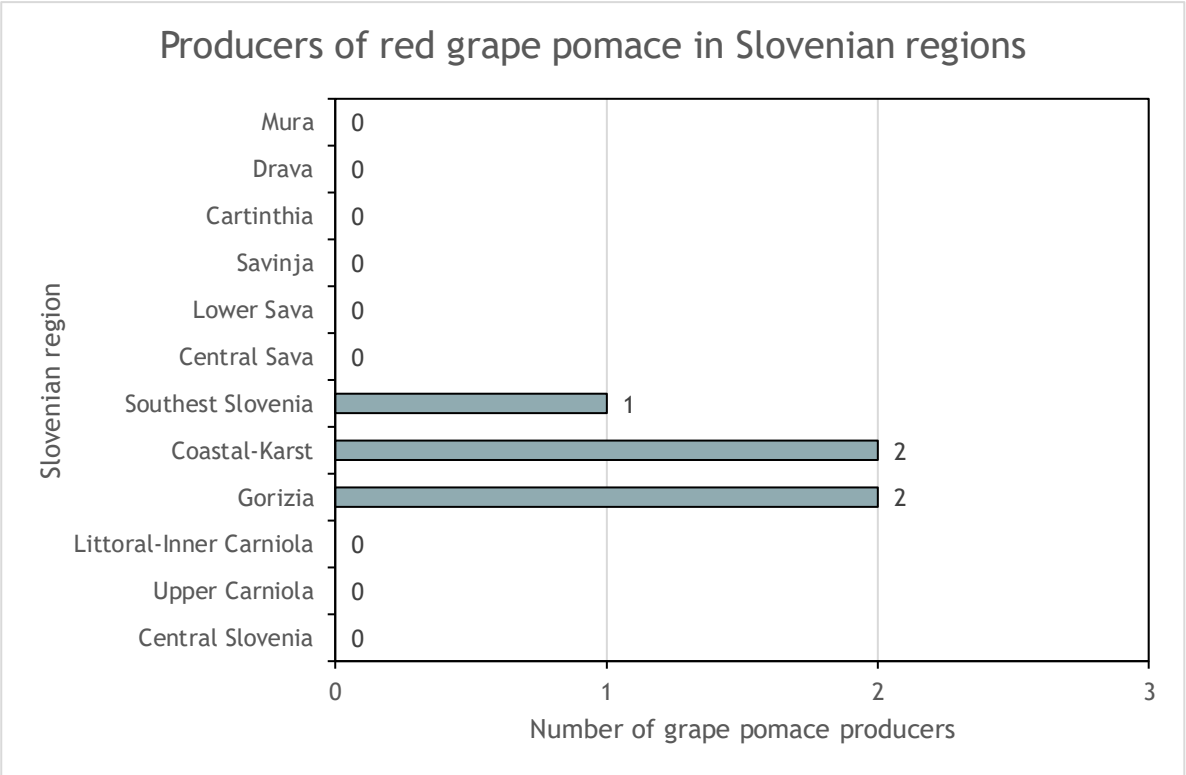
Figure 4. Distribution of grape pomace producer per Slovenian regions.



[3] naslovnica_zeleno porocilo_koncne_a4_2022.cdr (kis.si) table 2.9.1, page 88.

[4] http://dx.doi.org/10.1016/j.wasman.2017.07.017

Figure 5. Distribution of red grape pomace producer per Slovenian regions.



C) VC APPLE POMACE FOR PECTIN

Most of apples are grown and processed in Eastern part of Slovenia (figure 1). Apples are mainly grown for food, only small pert are processed in apple juice and other products. Apples are grown manly in small intensive and extensive plantation by farmer, who usually process apple lover quality to apple juice and other products.

Apple pomace: 1336 t

Quantity of apple pomace was evaluated from 4452 t of apples for processing[5]. Apple pomace as residue represent 30 % of processed apples [6]

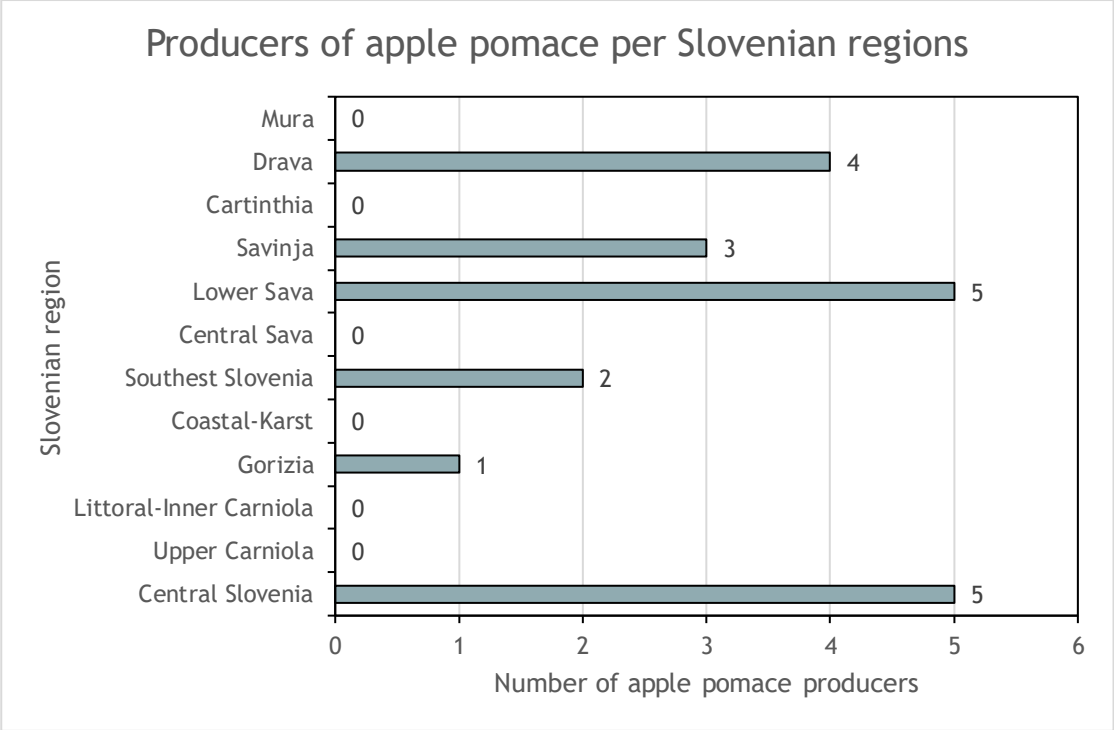
N (producer of by-product): 20

Figure 6 represents producers of apple pomace by Slovenian regions. In number of producers are included apple producers, fruit juice producers and fruit and vegetable processing industry. Producers are mostly located in Central Slovenia, Lower Sava, Drava, Savinja, and Southeast Slovenia.

[5] naslovnica_zeleno porocilo_koncne_a4_2022.cdr (kis.si) table 2.7.4, page 76.

[6] https://doi.org/10.1080/07388550802368895

Figure 6. Distribution of apple pomace producer in Slovenian geographical units (per statistical regions).



D) VC OLIVE POMACE FOR PECTIN

Olive pomace: 955 t

Quantity of olive pomace was evaluated from 2388 t of olive fruit production[7] . Olive pomace represents 40 % of olive fruits [8].

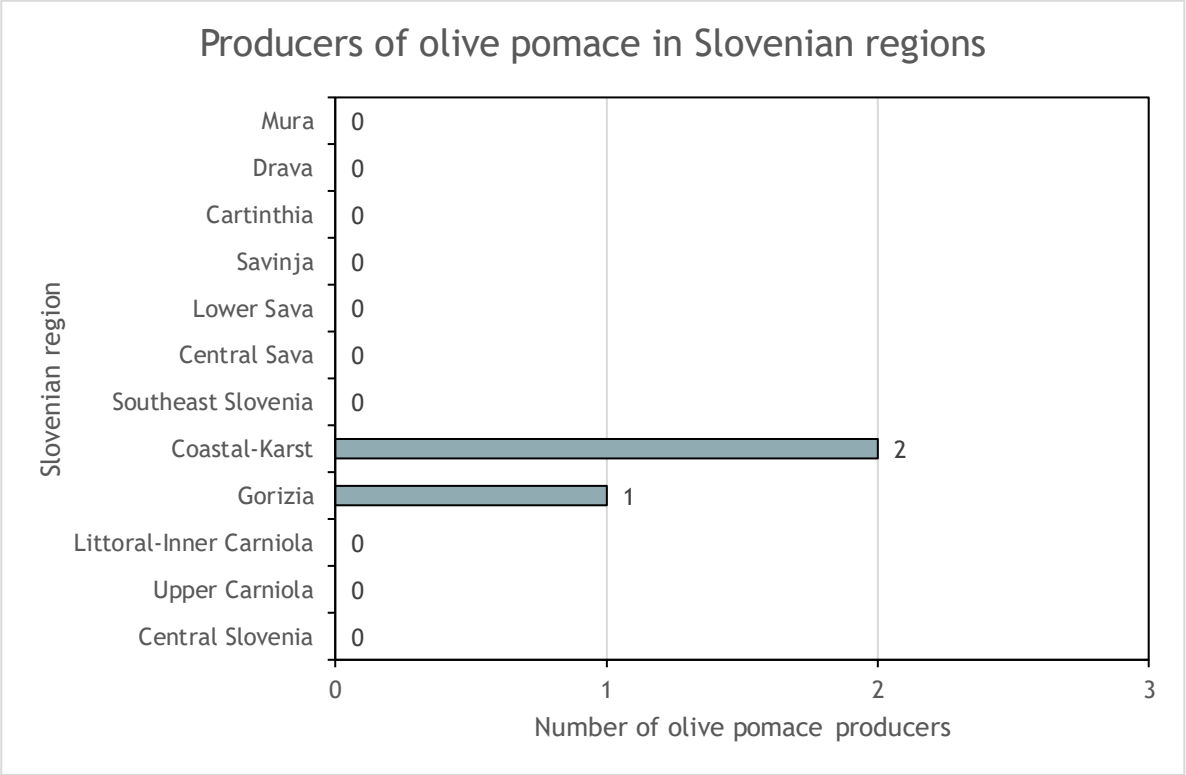
N (producer of by-product): 3 (37)

The costal part of Slovenia (Gorizia, Coastal-Karst) are the main region where olives are grown and processed in olive oil. The main producers of olive pomace are farmers who produce olive and also process. In Slovenia are 37 registries olive oil producer from whom only 3 are ranged in Micro producers. All other producers are farmers with additional agricultural activity, production of olive oil. Producers are mostly located in Western Slovenia region: Gorizia and Coastal-Karst.

[7] naslovnica_zeleno porocilo_koncne_a4_2022.cdr (kis.si) table 14, page 80.

[8] https://doi.org/10.1016/j.ifset.2018.07.001

Figure 7. Distribution of olive pomace producer in Slovenian (per statistical regions).



E) VC PUMPKIN SEED CAKE FOR PROTEINE FLOUR

<u>Pumpkin seed cake</u>: 232 t

Quantity of pumpkin seed cake was evaluated based on 464 t of purchased pumpkin seeds for processing (production of pumpkin seed: 1988 t) [9]. Pumpkin seed cake represent residue of 50 % of pumpkin seeds = the average % of residue in pumpkin seed processing in to oil.[10]

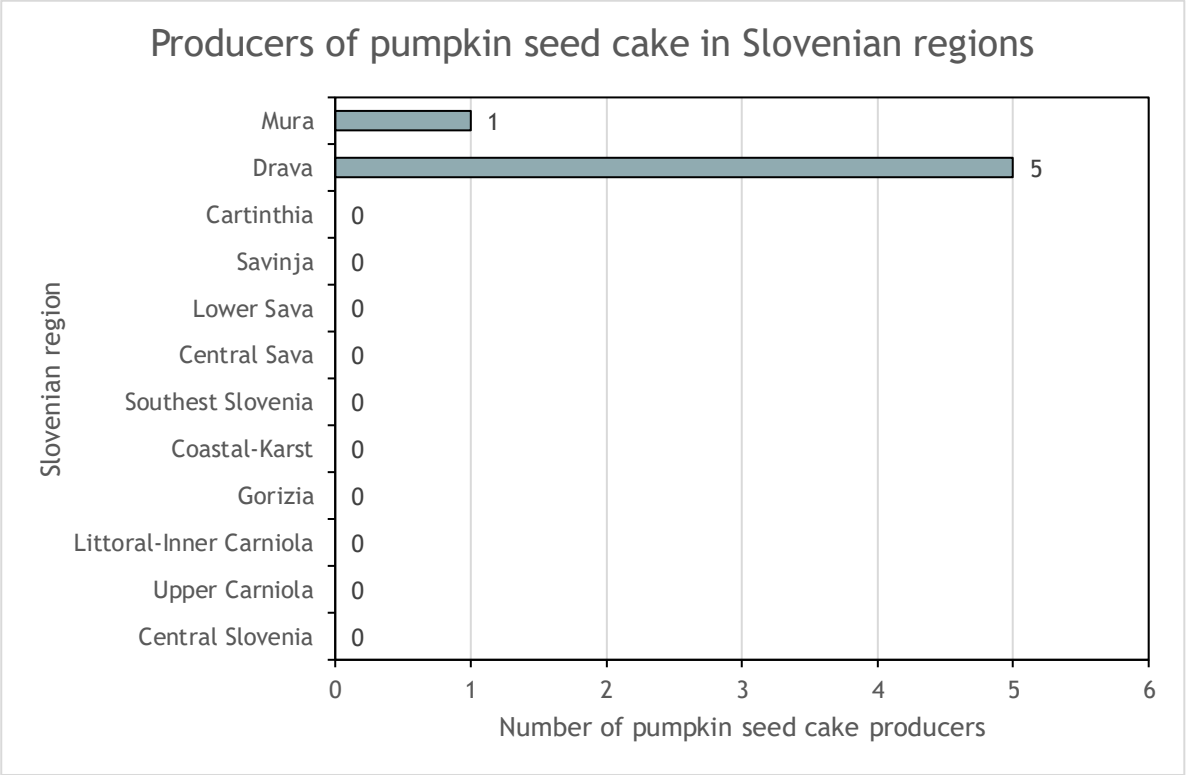
N (producer of by-product): 6 (23)

In Slovenia are 23 registries pumpkin seed oil producer from whom only one is 6 are ranged as SME (1) and Micro (5) producers. Figure 8. Represent distribution of pumpkin seed cake producer in Slovenian regions. All other producers are farmers with additional agricultural activity, production of pumpkin seeds oil. Producers are mostly located in Eastern Slovenia region Drava and Mura.

[9] naslovnica_zeleno porocilo_koncne_a4_2022.cdr (kis.si) table 5, page 25,27.

[10] Buče in herbicidi (kgzs-ms.si)

Figure 8. Distribution of pumpkin seed cake producer in Slovenian (per statistical regions).



F) VC WOOD BARK FOR TANNIN PRODUCTION

Wood (bark): 27000 t

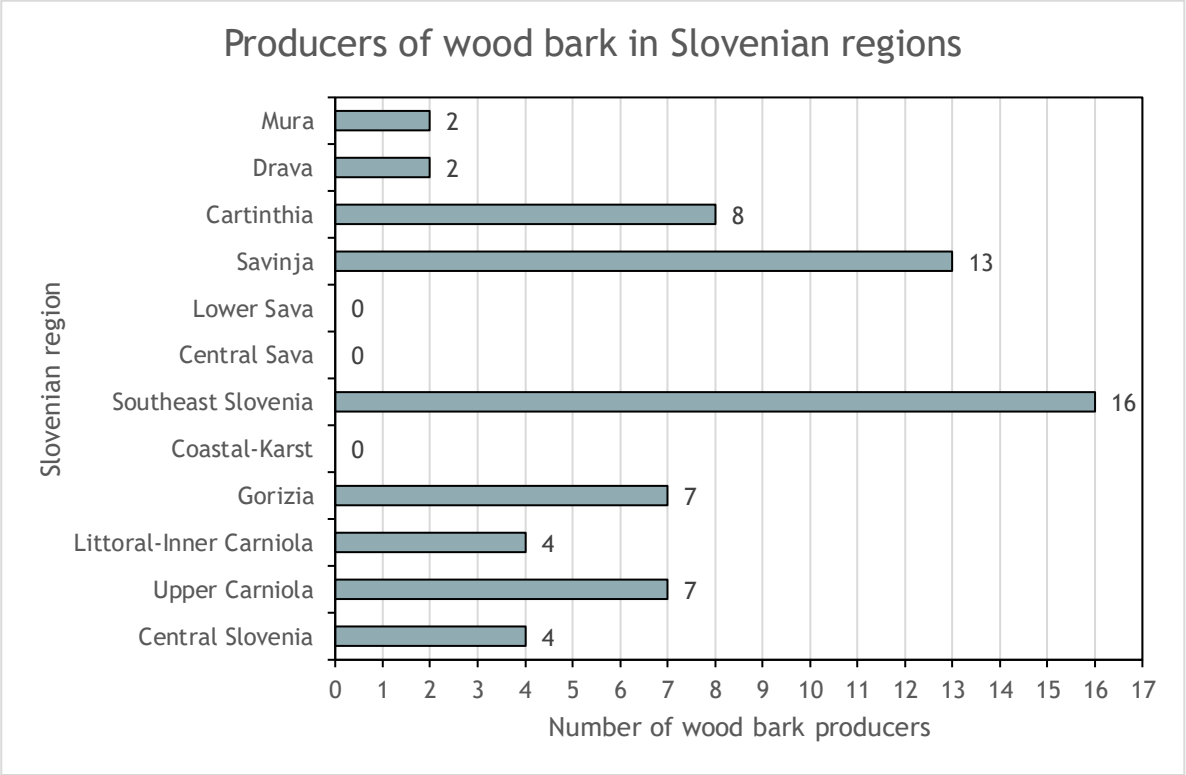
Quantity evaluated based on 193 M m^3 of deciduous trees used for processing; bark represent around 20 % of the deciduous tree. The average density of wood is 700 kg/m3; used for calculation.[11]

N (producer of by-product): 63 (103) 63 SME,

In Slovenia are 63 SME producers of wood bark (103 SME with micro). Producers are manly located in Southeast Slovenia, Savinja, Carinthia, Upper Carniola and Goriška region. Figure 9 represents distribution of wood bark producer per Slovenian regions.

[11] ZP_2022_splosno__priloge_2.pdf (kis.si) page 177-192.

Figure 9. Distribution of wood bark producer in Slovenian (per statistical regions).



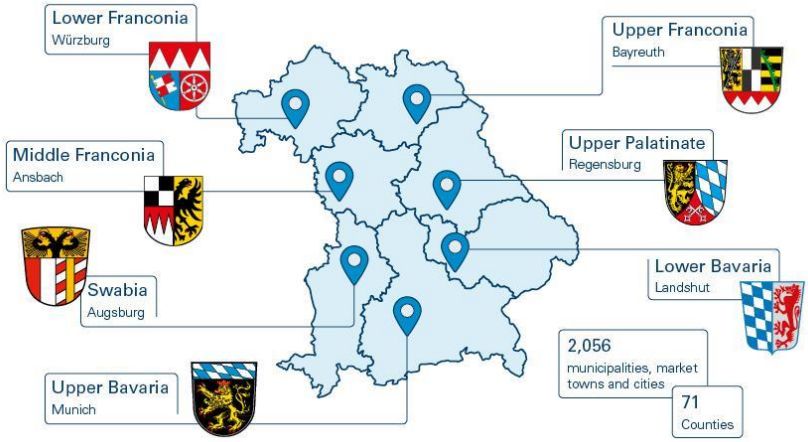
Appendix

Table 2. Table of administrative units of Slovenia (source: SI STATA)

Cohesion regions	Statistical regions	Slovenian name of the region
Eastern Slovenia		Vzhodna Slovenija
	Mura	Pomurska
	Drava	Podravska
	Carinthia	Koroška
	Savinja	Savinjska
	Central Sava	Zasavska
	Lower Sava	Posavska
	Southeast Slovenia	jugovzhodna Slovenija
	Littoral-Inner Carniola	primorsko-notranjska
Western Slovenia		Zahodna Slovenija
	Central Slovenia	osrednjeslovenska
	Upper Carniola	Gorenjska
	Gorizia	Goriška
	Coastal-Karst	obalno-kraška

3.3. GERMANY VALUE CHAINS

Fig. 1 - Administrative Districts in Bavaria



Source: [The Free State of Bavaria – Bayerisches Landesportal (bayern.de)]

Fig. 2 - Administrative Districts in Baden-Wuerttemberg

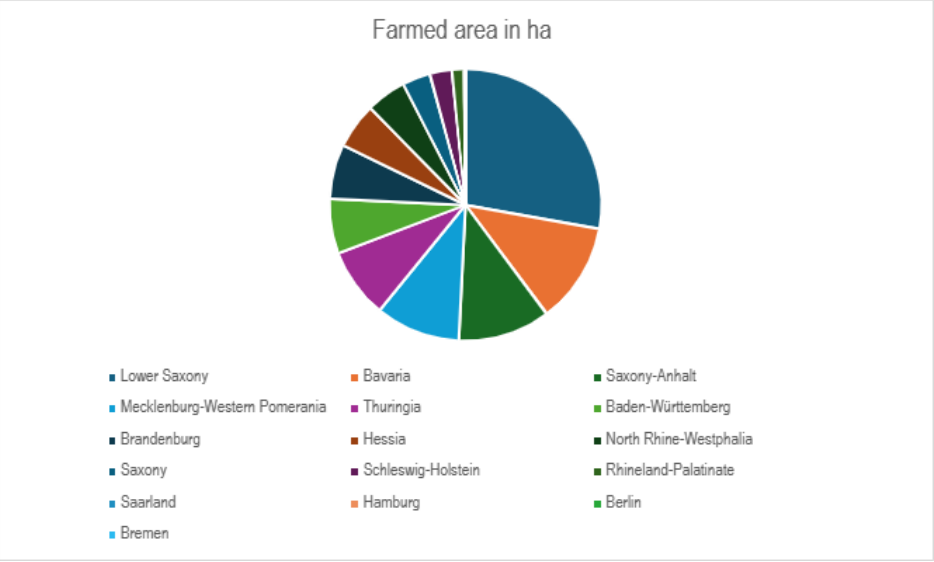
Source: [Landratsämter - Infodienst - Landwirtschaft, Ernährung, Ländlicher Raum (landwirtschaft-bw.de)]

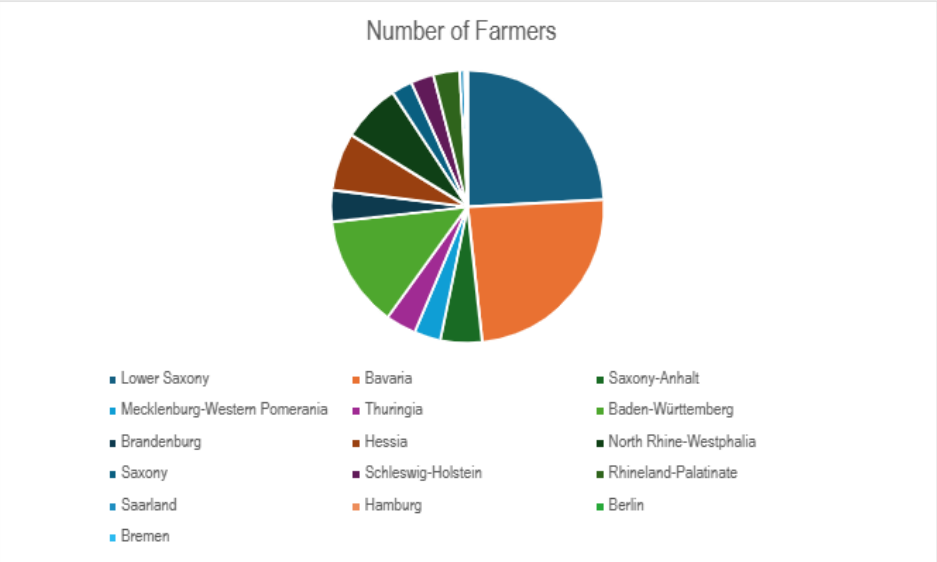
A. VC: Hemp

As hemp is a reemerging arable crop, data is only accessible on the level of federal units in Germany at this moment. However, it can be assumed that the distribution follows the general distribution of agricultural producers (Figure 1)

	Farmed Area in ha	Number of Farmers
Lower Saxony	1932	215
Bavaria	832	214
Saxony-Anhalt	763	44
Mecklenburg-Western Pomerania	700	28
Thuringia	578	32
Baden-Württemberg	453	118
Brandenburg	452	33
Hessia	376	61
North Rhine-Westphalia	333	62
Saxony	230	22
Schleswig-Holstein	182	24
Rhineland-Palatinate	102	28
Saarland	6	5
Hamburg	3	1
Berlin	1	2
Bremen	0	0

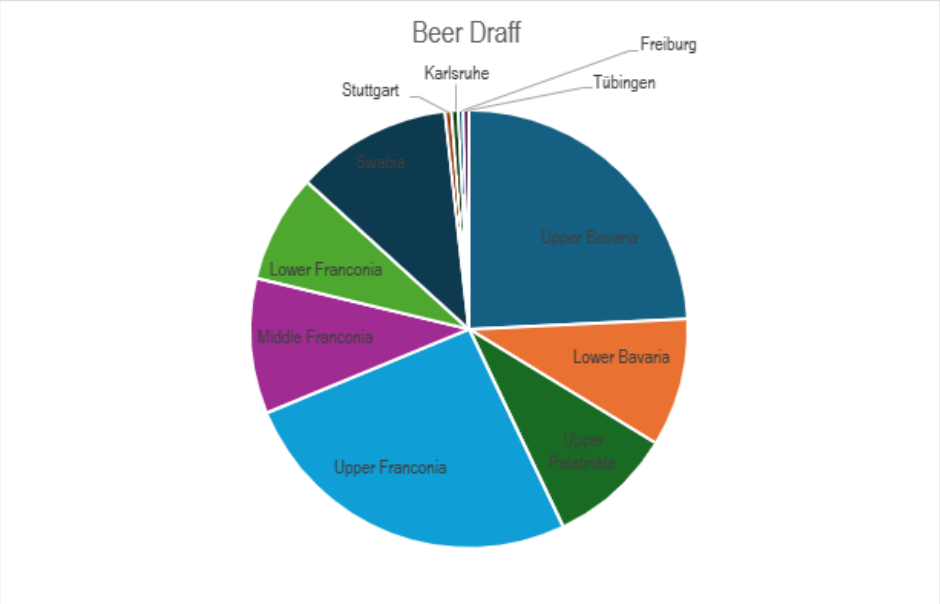
Sources: BLE - Pressemitteilungen - Nutzhanf auf fast 7.000 Hektar angebaut





B. VC: BEER DRAFF

	Breweries	Beer Draff wet mass in t
Upper Bavaria	170	117467
Lower Bavaria	67	45843
Upper Palatinate	65	44533
Upper Franconia	182	125119
Middle Franconia	70	48462
Lower Franconia	56	38639
Swabia	81	55666
Stuttgart	57	2352
Karlsruhe	58	2385
Freiburg	44	1825
Tübingen	48	1970



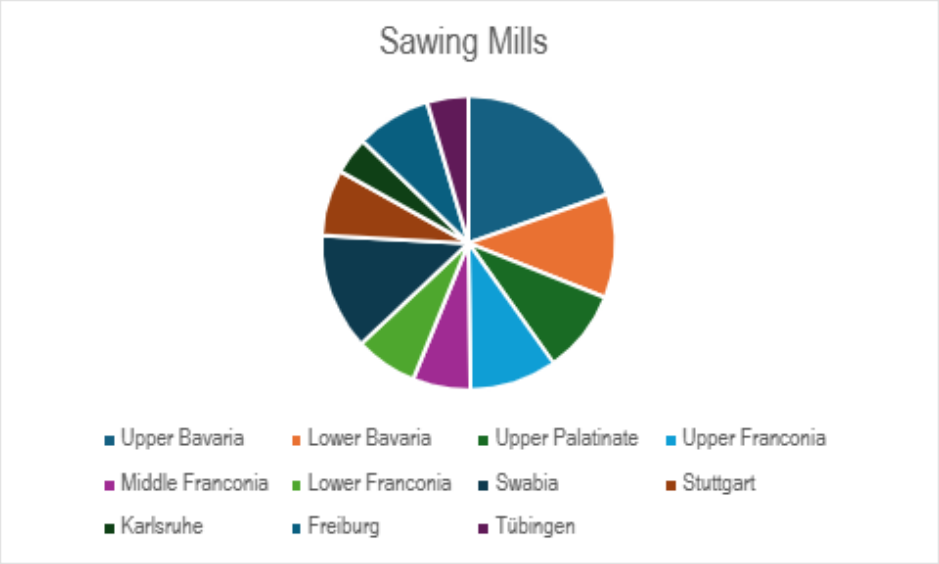
C. VC: WOOD

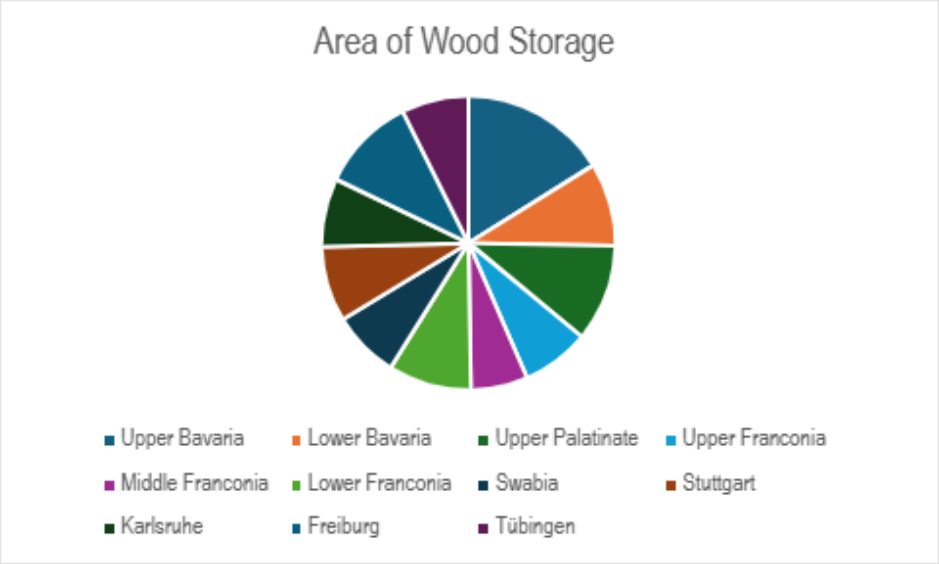
To give an estimate about the distribution of wood residues, sawing mills were used as a benchmark. Additional wood processing manufacturers represent further potential suppliers of wood waste to use in new circular value chains. These manufacturers are supplied by sawing mills, therefore those were used as a well-documented data base.

	Producers of Wood	Area of Wood Storage in 1000 ha
Upper Bavaria	43	634
Lower Bavaria	25	360
Upper Palatinate	20	420
Upper Franconia	21	293

Middle Franconia	14	246
Lower Franconia	15	360
Swabia	28	292
Stuttgart	16	325
Karlsruhe	9	296
Freiburg	18	411
Tübingen	10	290

Sources: Sägewerke aus Baden-Württemberg (saegewerke-baden-wuerttemberg.de)
Sägewerke aus Bayern (saegewerke-in-bayern.de)
lwfspezial_240914_lay.pdf (bayern.de)
Bundeswaldinventur_3_Auswertung_BW_Gesamt.pdf (forstbw.de)

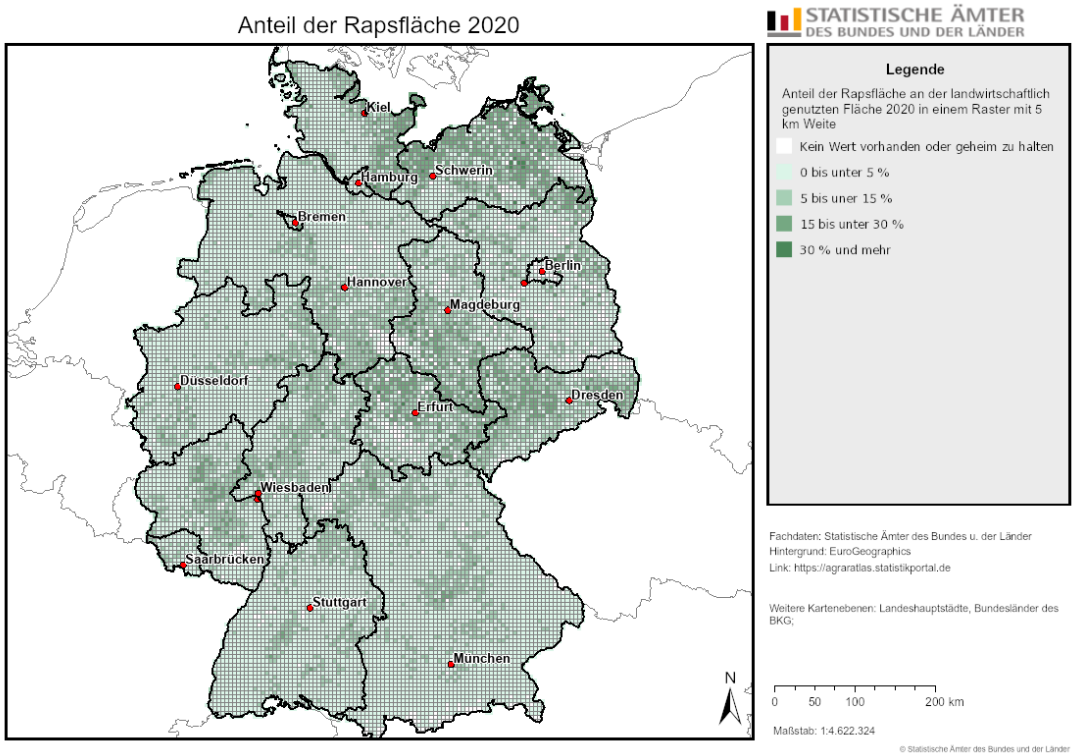


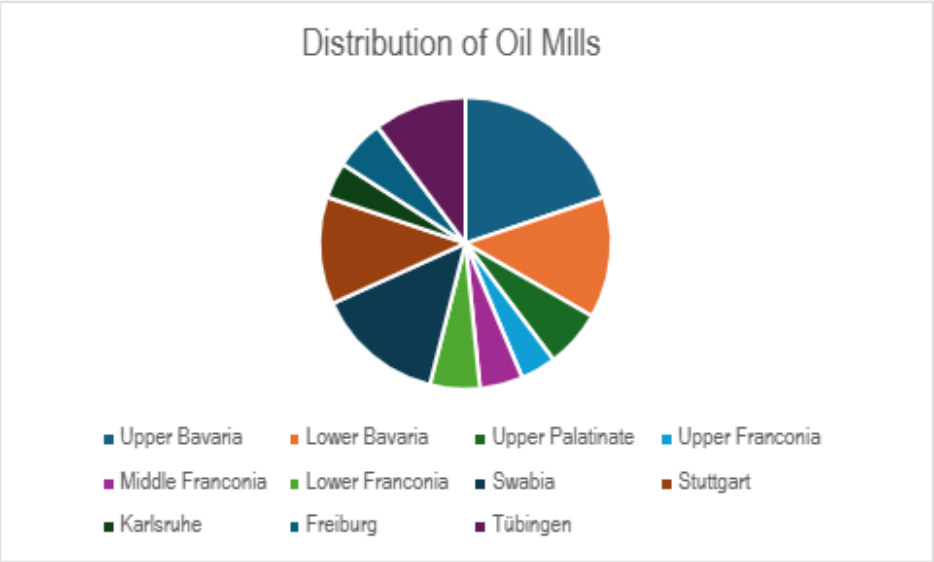


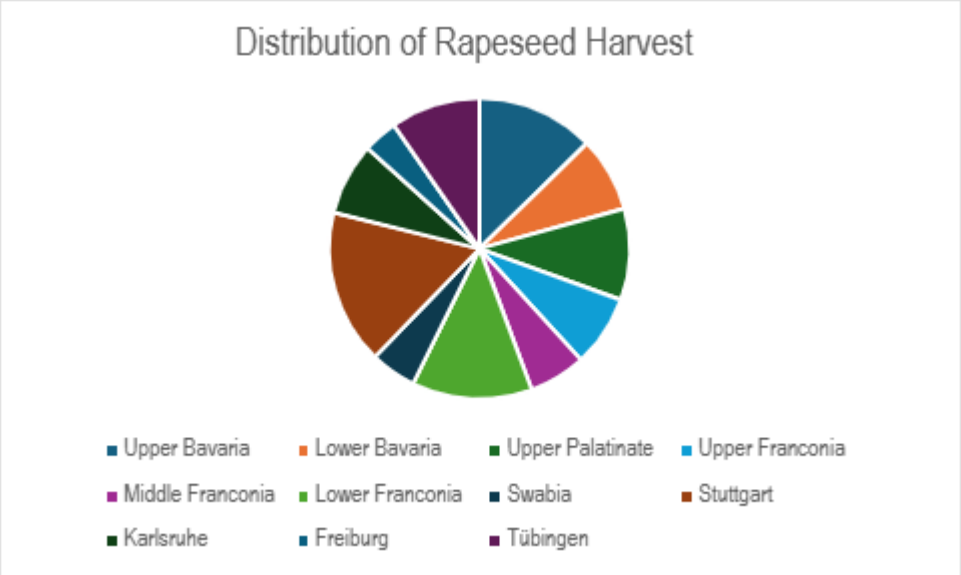
D VC: RAPESEED AS AN INSECTICIDE

	Oil Mills	Rapeseed Harvest in tons
Upper Bavaria	29	89.384
Lower Bavaria	20	56.636
Upper Palatinate	9	69.327
Upper Franconia	6	54.317
Middle Franconia	7	43.254
Lower Franconia	8	91.318
Swabia	21	34.914
Stuttgart	17	117.507
Karlsruhe	6	54.688
Freiburg	8	26.263
Tübingen	15	67.992

Figure 2: Distribution of area used for rapeseed production in Germany.







Sources:
Land- und Forstwirtschaft, Fischerei (bayern.de)
Ernte der Hauptfeldfrüchte in Baden-Württemberg 2022 (statistik-bw.de)
daten_fakten_dezentrale_oelgewinnung (ufop.de)

3.4. POLAND VALUE CHAINS

3.4.1 Mapping of wine and apple value chain in Voivodships

Figure 1. Voivodships' in NUTS 1 - Northern Macroregion of Poland

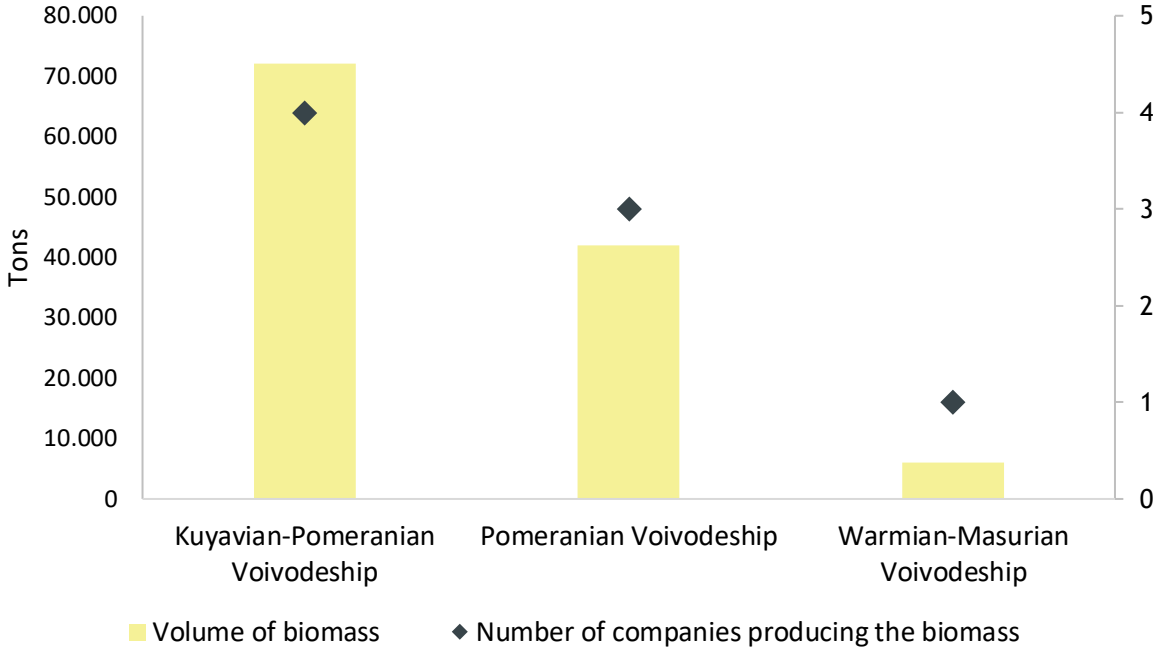
A) VC - WHEAT BRAN – DRIED INSECT

a) quantity: **120 000 tons**;
and quality:

By-product	Moisture (%)	Ash (% DM)	Protein (% DM)	Fiber (% DM)	Fat (% DM)
Wheat bran	12.46	5.63	17.34	8.29	4.12

b) the continuity of availability of biomass in order to consider the possible seasonality of the production: **by-product available during whole year**
c) the actors producing the biomass: **8**
d) the existing value chains able to valorise by-products: **food market (high quality bran) and feed market (lower quality bran with impurities);** Current market price: **162 Euro/t**

Figure 2. Volume end number of companies produced the wheat bran (VC1)



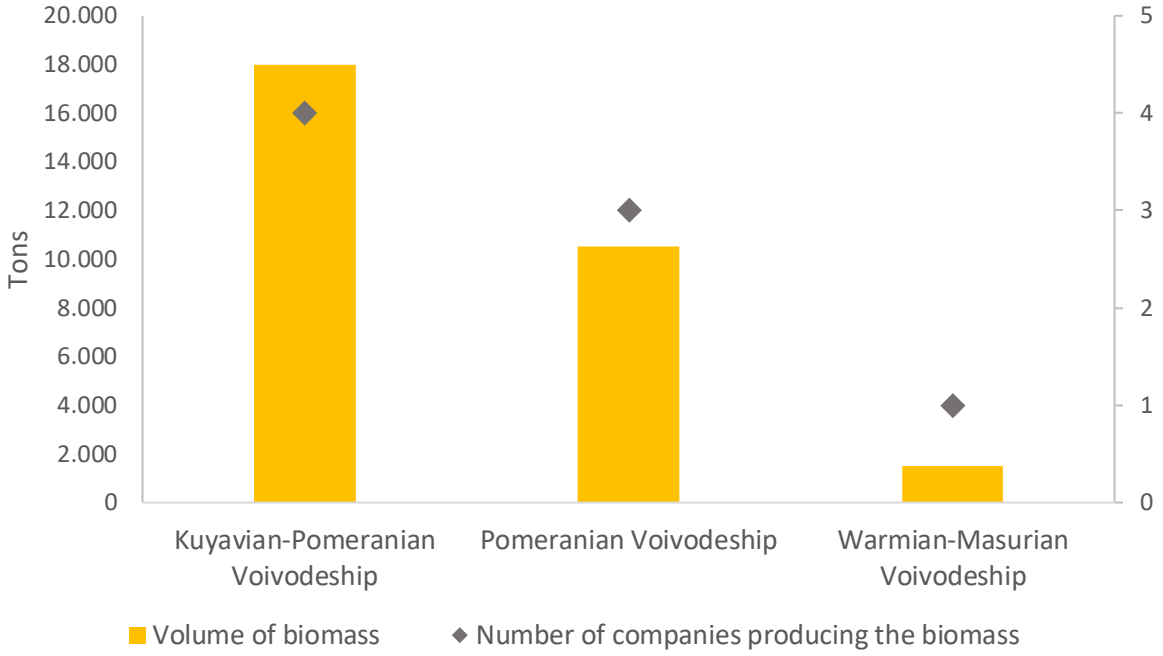
B) VC RYE BRAN - INSECT PATE

a) quantity: **30 000 tons**
and quality:

By-product	Moisture (%)	Ash (% DM)	Protein (% DM)	Fiber (% DM)	Fat (% DM)
Rye bran	**11.41**	**4.16**	**15.04**	**3.79**	**2.76**

b) the continuity of availability of biomass in order to consider the possible seasonality of the production: **by-product available during whole year**
c) the actors producing the biomass: **8**
d) the existing value chains able to valorise by-products: **food market (high quality bran) and feed market (lower quality bran with impurities);** Current market price: **139 Euro/t**

Figure 3. Volume end number of companies produced the rye bran (VC2)



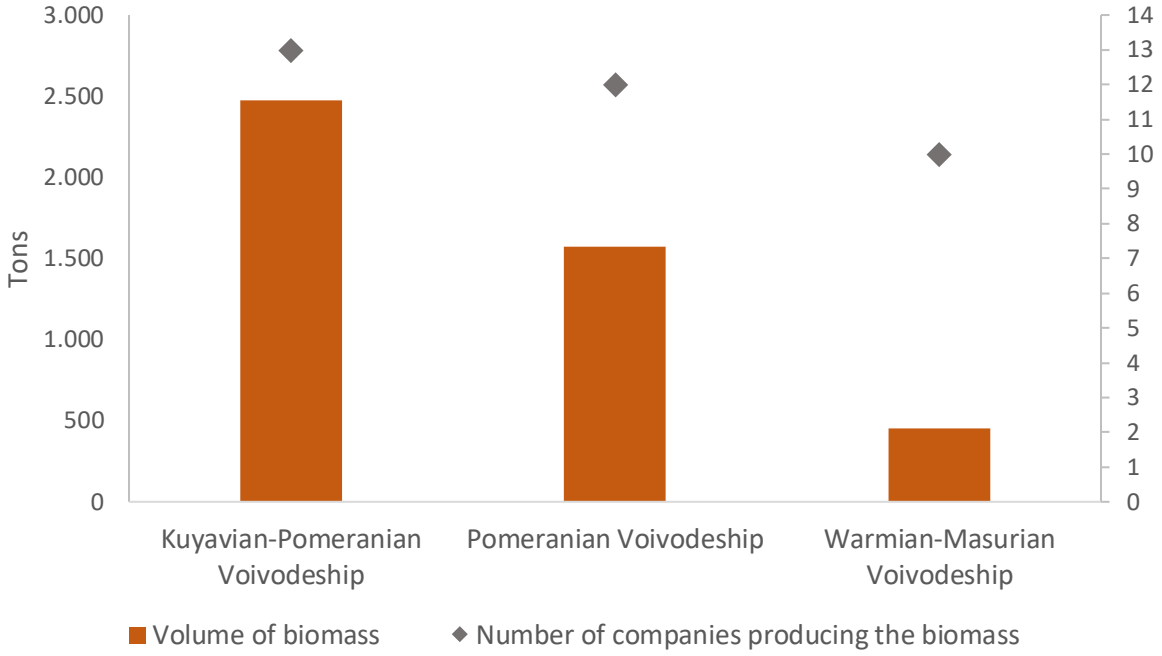
C) VC - SEED RESIDUES - INSECT MEAL

a) quantity: **4500 tons**;
and quality:

By-product	Moisture (%)	Ash (% M)	Protein (% DM)	Fiber (% DM)	Fat (% DM)
Cereal seeds (mean value for barley, oat, rye and wheat)	**12.25**	**2.68**	**10.53**	**6.25**	**2.80**

b) the continuity of availability of biomass in order to consider the possible seasonality of the production: **by-product available during a half year**
c) the actors producing the biomass: **35**
d) the existing value chains able to valorise by-products: **feed market, lower quality with inpurities;** Current market price: **100 Euro/t**

Figure 4. Volume end number of companies produced cereal seeds (mean value for barley, oat, rye and wheat) (VC3)



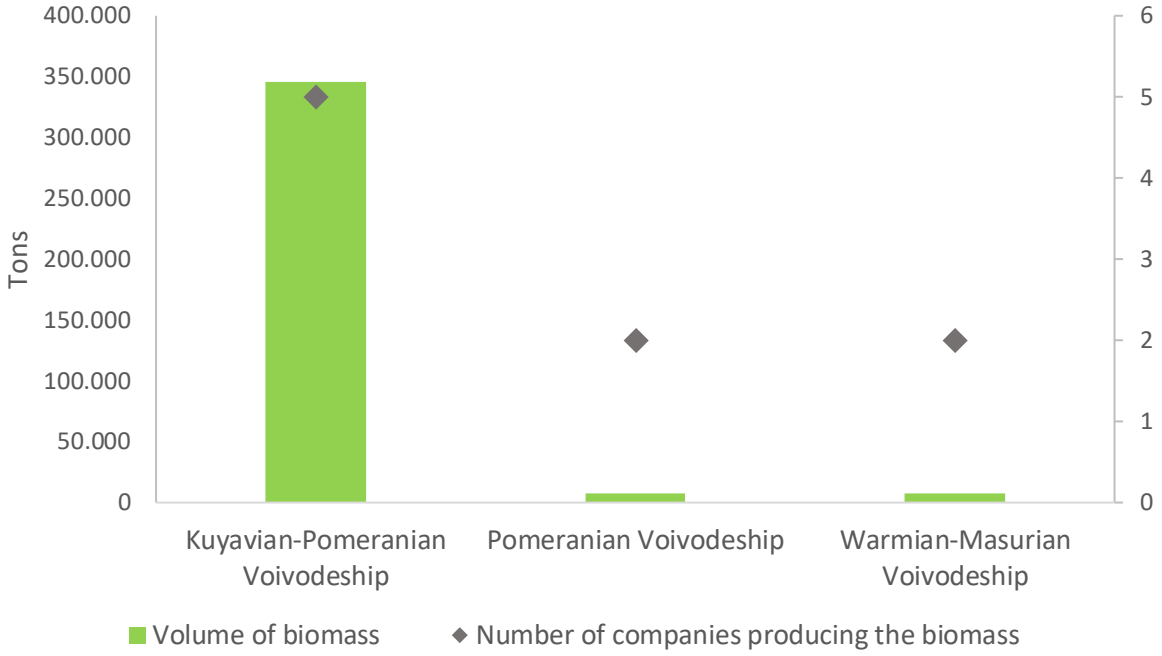
D) VC4 - CAKES AND MEALS FROM OIL EXTRACTION - DRIED INSECT

a) quantity: **360 000 tons**;
and quality:

By-product	Moisture (%)	Ash (% DM)	Protein (% DM)	Fiber (% DM)	Fat (% DM)
Rapeseed meal	**11.88**	**7.33**	**35.41**	**10.57**	**1.88**
Rapeseed cake	**9.88**	**5.83**	**27.68**	**16.74**	**16.58**

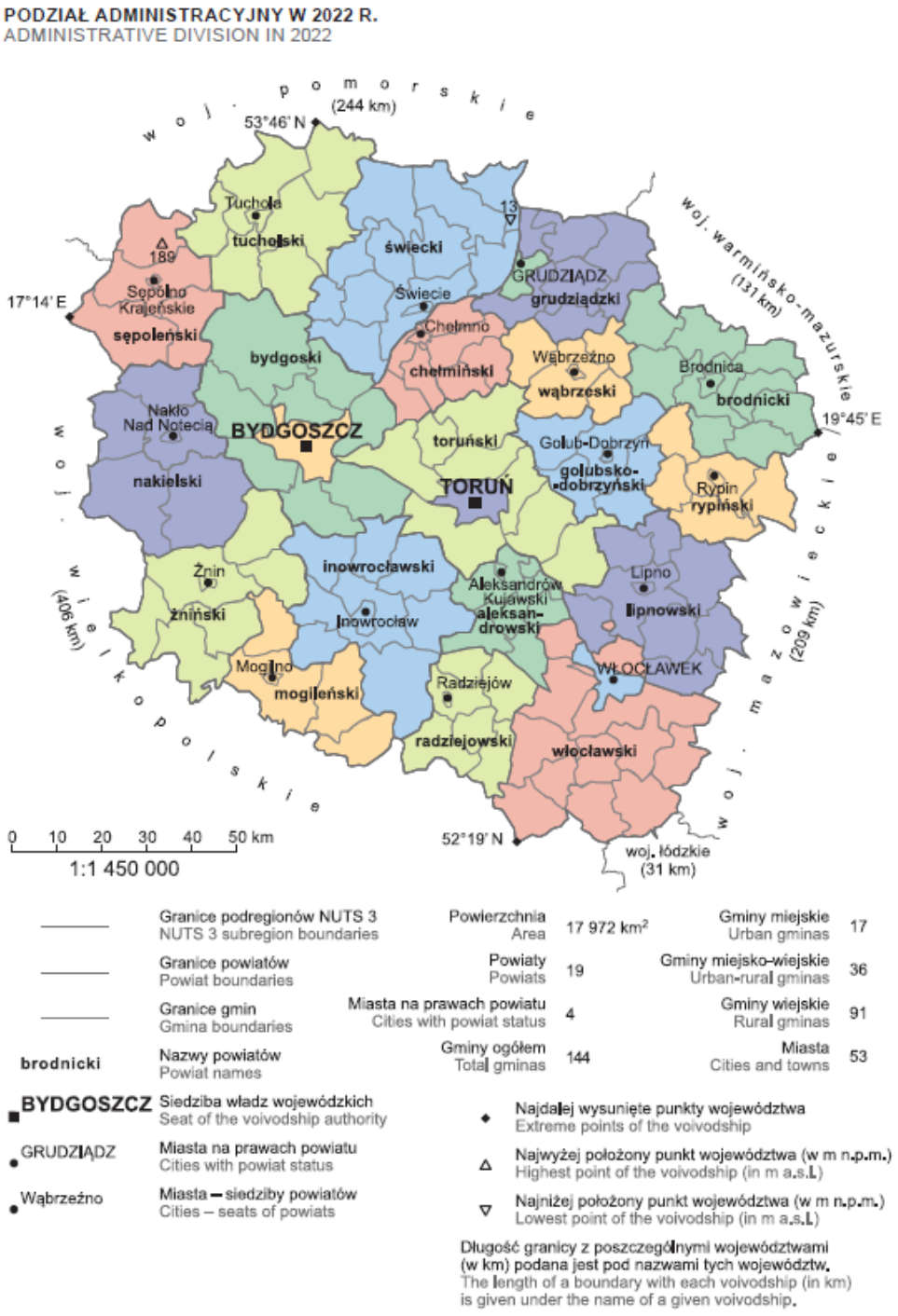
b) the continuity of availability of biomass in order to consider the possible seasonality of the production: **by-product available during whole year**
c) the actors producing the biomass: **9**
d) the existing value chains able to valorise by-products: **feed market (used as feed material for protein feeds);** Current market price: **300 Euro/t**

Figure 5. Volume end number of companies produced rapeseed meals and cakes (VC4)



3.4.2 Mapping of wine and apple value chain in Kujawsko-Pomorskie Voivodship

Fig. 6 - Kujawsko-Pomorskie Voivodship in Poland - administrative division



Source:
Statistical Yearbook of Kujawsko-Pomorskie Voivodship, Statistical Office in Bydgoszcz, Bydgoszcz 2023

A) VALUE CHAIN: CEREALS

Fig. 7 - Area and number of farms growing selected cereals in the Kujawsko-Pomorskie Voivodeship

Table 3. Agricultural holdings cultivating selected cereals and area under them in 2020

Wyszczególnienie Specification	Powierzchnia w tys. ha Area in thousand ha	Liczba gospodarstw w tys. Number of holdings in thousands	Udział gospodarstw uprawiające wybrane zboża w liczbie gospodarstw z uprawą zbóż w % Share of holdings cultivating selected cereals in the number of holdings cultivating cereals in %
Pszenica ozima Winter wheat	203,3	24,6	48,9
Pszenicę jarą Spring wheat	12,0	3,6	7,1
Żyto Rye	59,9	13,8	27,5
Jęczmień ozimy Winter barley	14,6	3,3	6,6
Jęczmień jary Spring barley	46,0	13,6	27,1
Owies Oat	11,9	4,3	8,5
Pszenżyto ozime Winter triticale	90,1	20,0	39,9
Pszenżyto jare Spring triticale	3,6	1,2	2,3
Mieszanki zbożowe ozime Winter cereal mixtures	6,1	1,3	2,7
Mieszanki zbożowe jare Spring cereal mixtures	28,0	8,8	17,4
Kukurydza na ziarno Grain maize	131,0	14,3	28,4

- Winter wheat and grain maize crops occupy the largest sowing areas in the Voivodeship
- Number of actors which produce cereals in the region

Source:The Agricultural Census 2020 Characteristics of agricultural holdings in Kujawsko-Pomorskie Voivodship in 2020, Statistical Office in Bydgoszcz, Bydgoszcz 2022

B) VALUE CHAIN: VEGETABLES

In the Kujawsko-Pomorskie Voivodeship, the vegetable harvests rank third in the country.

Fig. 8 - Vegetable production in 2021

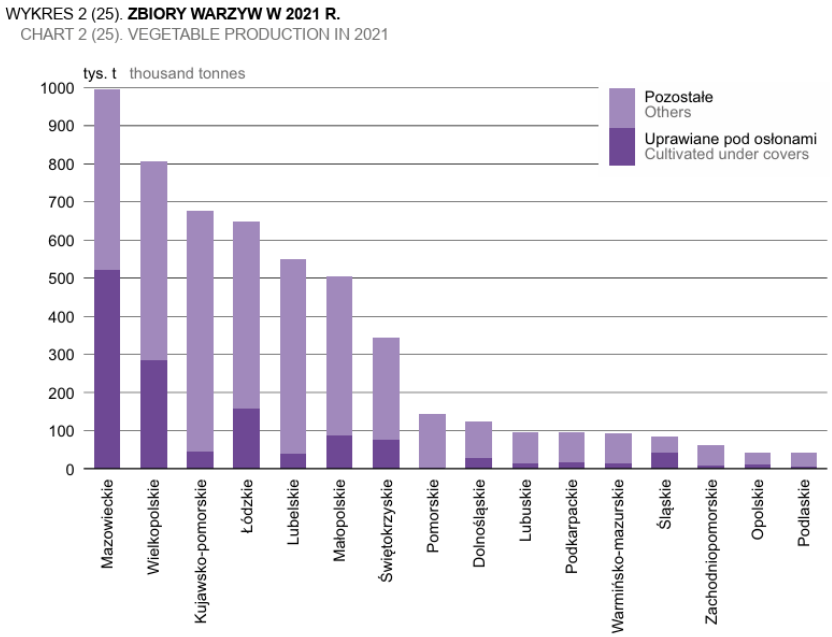


Fig. 9 – Area, production and yields of ground vegetables

TABL. 6 (104). **POWIERZCHNIA, ZBIORY I PLONY WARZYW GRUNTOWYCH[a]**
AREA, PRODUCTION AND YIELDS OF GROUND VEGETABLES[a]

WYSZCZEGÓLNIENIE	2015	2019	2020	2022	SPECIFICATION
POWIERZCHNIA w tys. ha – stan w czerwcu AREA in thousand hectare – as of June					
O G Ó Ł E M	**24,5**	**24,0**	**26,1[b]**	**24,8**	**T O T A L**
Kapusta	1,5	1,5	0,6[b]	0,8	Cabbages
Kalafiory	1,5	1,4	0,8[b]	0,9	Cauliflowers
Cebula	5,8	6,4	8,9[b]	8,6	Onions
Marchew jadalna	3,0	2,9	3,7[b]	3,3	Carrots
Buraki ćwikłowe	0,9	0,9	0,9[b]	0,8	Beetroots
Ogórki	1,4	1,2	0,3[b]	0,3	Cucumbers
Pomidory	2,1	1,9	0,9[b]	1,1	Tomatoes
Pozostałe[c]	8,4	7,8	9,9[b]	9,0	Others[c]
ZBIORY w t PRODUCTION in tonnes					
O G Ó Ł E M	**538686**	**541296**	**709281**	**647785**	**T O T A L**
Kapusta	54423	51699	27375	29988	Cabbages
Kalafiory	22926	23899	17414	15814	Cauliflowers
Cebula	138941	159460	278841	271204	Onions
Marchew jadalna	105522	100489	153734	120514	Carrots
Buraki ćwikłowe	24833	22749	30184	25963	Beetroots
Ogórki	18576	16748	10316	7301	Cucumbers
Pomidory	68173	68349	42231	33219	Tomatoes
Pozostałe[c]	105293	97903	149187	143782	Others[c]
PLONY z 1 ha w dt YIELDS per hectare in decitonnes					
Kapusta	365	365	430	400	Cabbages
Kalafiory	157	157	218	185	Cauliflowers
Cebula	241	241	314	315	Onions
Marchew jadalna	347	347	411	360	Carrots
Buraki ćwikłowe	273	273	334	320	Beetroots
Ogórki	130	130	337	230	Cucumbers
Pomidory	326	326	454	310	Tomatoes
Pozostałe[c]	126	126	151	160	Others[c]

a W 2015 r. łącznie z ogrodami przydomowymi. b Dane Powszechnego Spisu Rolnego 2020. c Pietruszka, pory, selery, rzodkiewka, sałata, rabarbar itp.
a Including kitchen gardens in 2015. b Data of the Agricultural Census 2020. c Parsley, leeks, celeries, radish, letucce, rhubarb etc.

Source: Statistical Yearbook of Kujawsko-Pomorskie Voivodship, Statistical Office in Bydgoszcz, Bydgoszcz 2023

C) VALUE CHAIN: BIOGAS AND DIGESTATE PRODUCERS

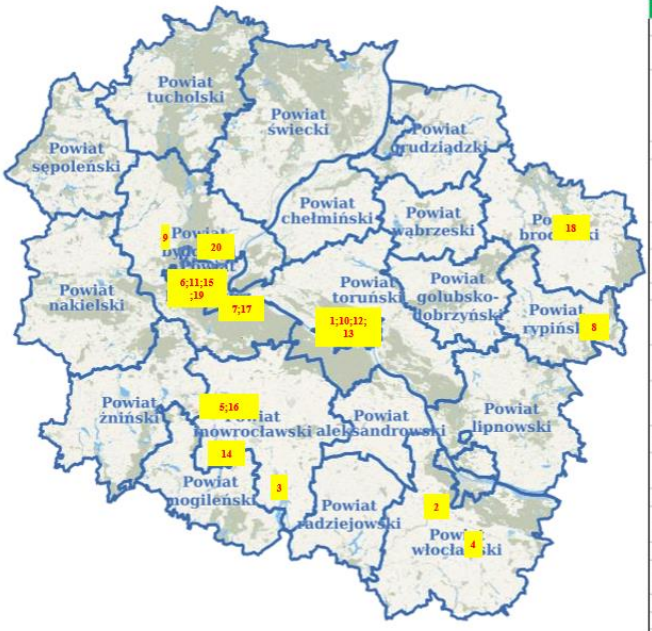
Fig. 10 - Quantity and distribution

Name	Localization
Bioutil sp. z o.o.	Buczek 10 86-131 Jeżewo
PRIMA FARMS sp. z o.o.	Krąplewice 86-130 Laskowice
Allter Power sp. z o.o.	Mełno 1 B 86-330 Mełno
Biogazownia Rypin Sp. z o.o.	Starorypin Prywatny 51 87-500 Rypin
ENEA NOWA ENERGIA sp. z o.o.	Liszkowo 87-93 88-180 Złotniki Kujawskie
EKOLOG KUJAWSKI sp. z o.o. sp. k.	Radojewice 88-101 Inowrocław

Source of map: www.geoportal.gov.pl

D) VALUE CHAIN: FOOD AND CROPS PRODUCERS

Fig. 11 - Quantity and distribution



No	Official comapny name	City
1	ekoflorka	Torun
2	BRZEŚĆ SIPA SP. J.	Brzesc Kujawski
3	PRZEDSIĘBIORSTWO PRZEMYSŁU ZIEMNIACZANEGO BRONISŁAW SPÓŁKA AKCYJNA	Bronislaw
4	CK FROST SP. Z O.O.	Smilowice
5	CUIAVIA OKRĘGOWA SPÓŁDZIELNIA MLECZARSKA W INOWROCŁAWIU	Inowroclaw
6	CUKIERNIA SOWA SP. Z O.O.	Bydgoszcz
7	P.D. DROBEX SP. Z O.O.	Solec Kujawski
8	EMIX SP. Z O.O.	Rypin
9	GRUPA PRODUCENTÓW OWOCÓW GALSTER SP. Z O.O.	Wierzchucice
10	HENKELL FREIXENET POLSKA SP. Z O.O.	Torun
11	FABRYKA WYROBÓW CUKIERNICZYCH JAGO JAN GOGOLEWSKI	Bydgoszcz
12	FABRYKA CUKIERNICZA KOPERNIK S.A.	Torun
13	KRAJOWA GRUPA SPOŻYWCZA S.A.	Torun
14	ZPZM KRUSZWICA	Kruszwica
15	Spółdzielnia Mleczarska „MLEKPOL" w Grajewie	Bydgoszcz
16	PIEKUŚ SP. Z O.O. SP. K.	Inowroclaw
17	SWEET & MORE SP. Z O.O.	Solec Kujawski
18	VOBRO SP. Z O.O. SP. K.	Brodnica
19	Polmass SA	Bydgoszcz
20	PROFEED STANISŁAW BRUŹDZIŃSKI	Dobrcz

Source of map: www.geoportal.gov.pl

3.5. AUSTRIAN VALUE CHAINS

A) VALUE CHAIN: PUMPKIN

Distribution of pumpkin seed cake production across Austria

Figure 1: Distribution of pumpkin seed cake production across Austrian federal states for the year 2016 (Map created by the author using data from https://www.kuerbiskernoel.cc/blog/zahlen-daten-fakten-oelkuerbis-produktion)

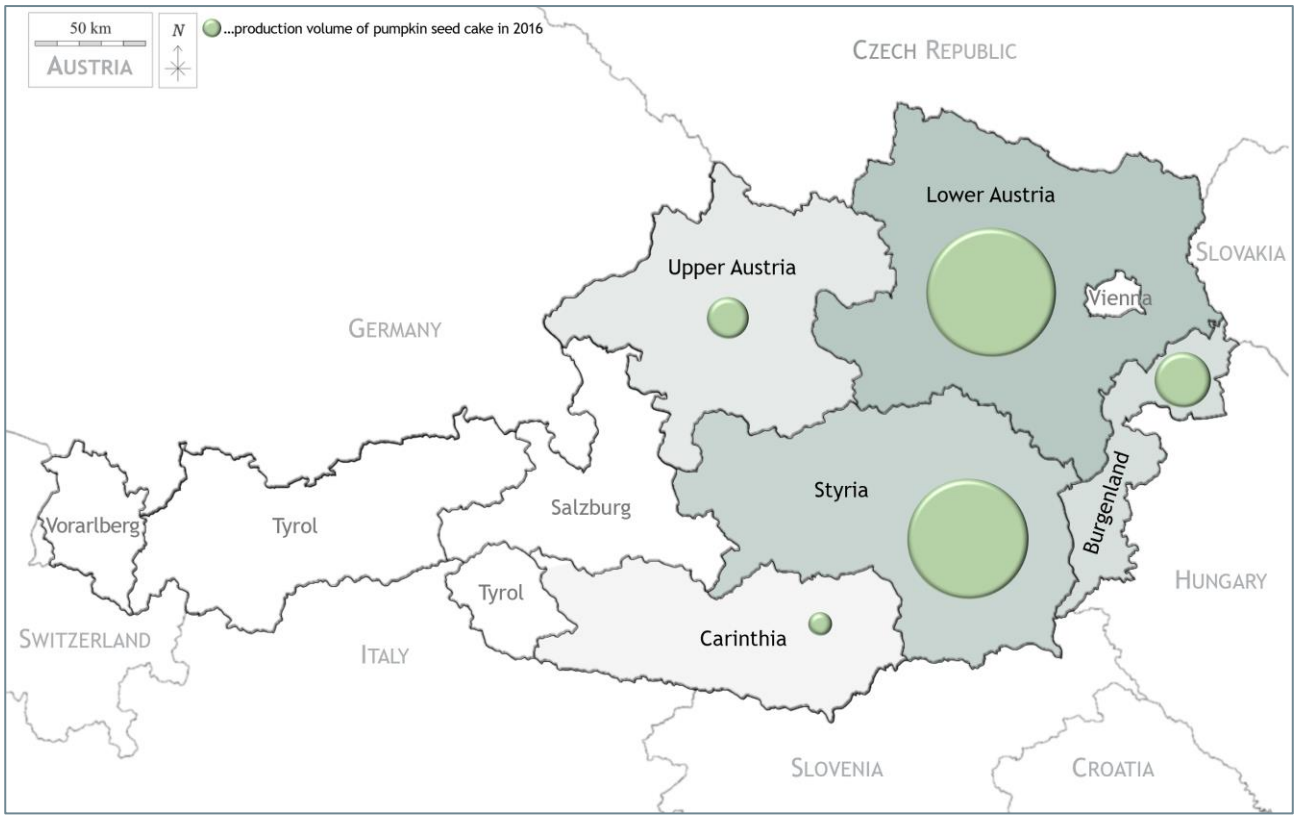


Table 1: Pumpkin seed cake produced throughout Austria in 2016 (derived from data from https://www.kuerbiskernoel.cc/blog/zahlen-daten-fakten-oelkuerbis-produktion)

Austrian federal state	produced pumpkin seed cake (metric tons)
Lower Austria	2.400
Styria	2.200
Burgenland	400
Upper Austria	200
Carinthia	100

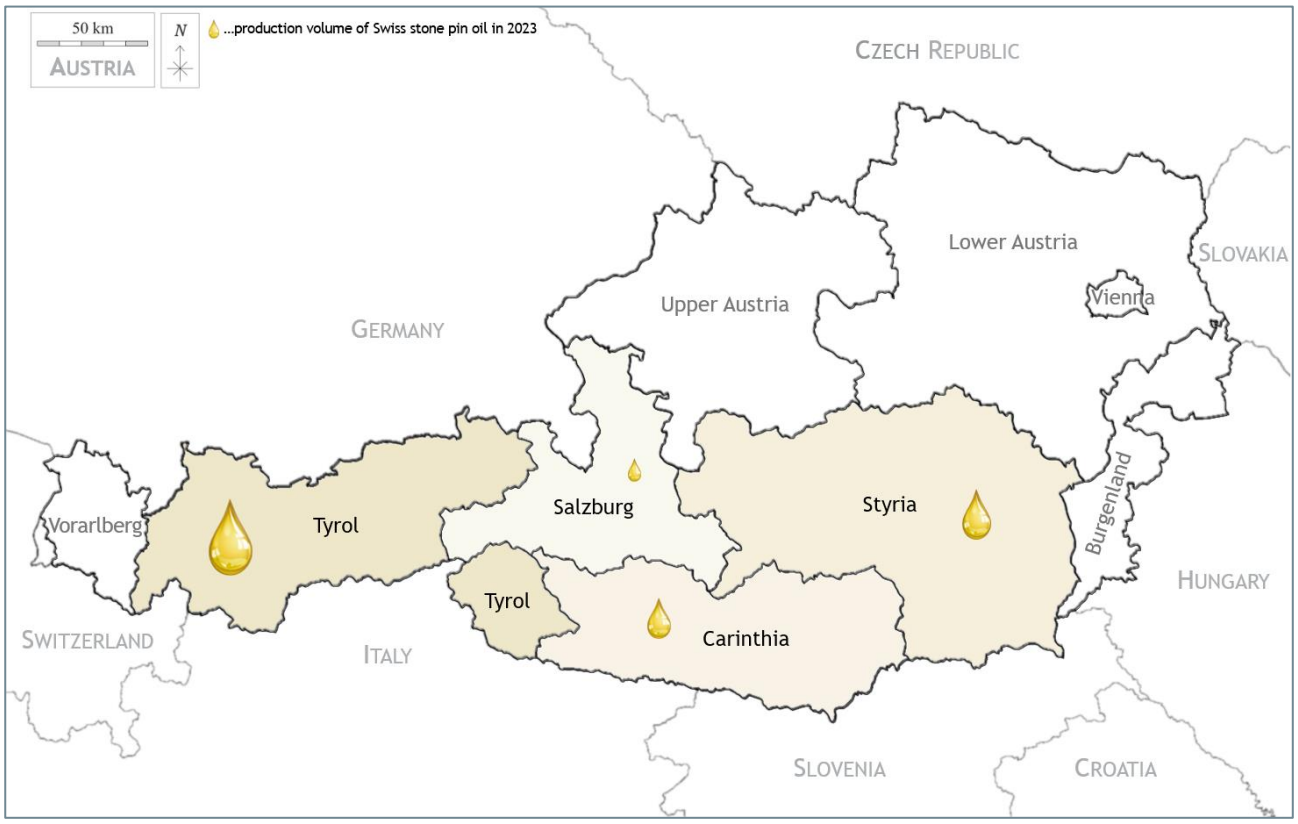
Table 2: Production of pumpkin seed cake in Styria

year	produced pumpkin seed cake (metric tons)	number of (registered) producers	value chains able to valorise pumpkin seed cake
2021	4.200	36	• food market: high-quality, organic, (partially) de-oiled flour/meal → average price (n=23): **13 €/kg** • animal feed market (e.g., as a substitute for soybean meal): lower quality, coarsely grounded meal → average price (n=6): **1,3 €/kg**
2022	3.450	36	
2023	3.360	40	

VALUE CHAIN: WOOD

Distribution of Swiss stone pin oil production across Austria

Figure 2: Distribution of Swiss stone pine oil production across Austrian federal states for the year 2023 (Map created by the author using data from producers)



In Austria, there are five Swiss stone pine oil manufacturers known to produce approximately 1.300 litres annually at an average price of 1.000 EUR/l.

Table 3: Production of Swiss stone oil in Austria (2023)

Austrian federal state	no. of producers	produced Swiss stone pine oil (litre)	price per litre (EUR)

Carinthia	1	300	1.000
Salzburg	1	10	1.250
Styria	1	400	1.200
Tyrol	2	600	730

3.6. SLOVAKIA VALUE CHAINS

Evaluation of by-product quantity for evaluation VC and number of producers of by-product in Slovakia.

A) VC HEMP SHIVES

shives: 1080 t (evaluated from the 1800 tons of hemp, shives represent the 60 % of hempstem)

Producers of biomass by-product: 6

The existing value chains able to valorise by-products: building, furniture, design, biocomposites

Current market price: 450 Euro/ton

Comment: Producers located in every region of SK. Short description: The hemp "woody" component has fundamental importance for the eco-efficiency of the development of industrial production, since the cellulose content in hemp-stem is 50-60% higher than in wood and the lignin content is up to 6-8% (for wood 20-30%), which places less demands on nature during production, significantly less energy, chemicals and water are consumed.

B) VC HEMP FIBER

fiber: 630 t (evaluated from the 1800 tons of hemp, fiber represent the 35 % of hempstem)

Producers of biomass by-product: 6

The existing value chains able to valorise by-products: special paper, biocomposites for shaping, lamination and panels

Current market price: 550 Euro/ton

Comment: Producers located in every region of SK. Short description: Hemp fiber belongs to the group of bast fibers, where it stands out for its properties and despite the fact that it can be the softest, it shows high tensile strength - it is the strongest plant fiber ever (up to 700 mN/tex), i.e. many times more durable than other plant fibers (8 times as Cotton). It contains

75% of cellulose and is very resistant to heat, moisture, mold and rot.

C) VC MICRO-PARTS S&F

microparts S&F: 90 t (evaluated from 1800t of hemp, microparts represent the 5% of hempstem)

Producers of biomass by-product: 6

The existing value chains able to valorise by-products: biocomposites for 3D-printing

Current market price: N/A

Comment: Producers located in every region of SK. Short description: The mixture of shives and fiber microparticles gives, in combination of the properties of both and 500% absorbency, a great base for applied research of 100% Compostable 3D filament or granulate, with best balance between printing convenience and environmental friendliness.

4. CONCLUSIONS

The analysis related to different value chains and the mapping of biomass distribution clearly emphasised the unexpressed or only partially expressed potential in terms of mass flows and value of by-products from the Central Europe Regions involved in the TeBiCe project.

Two production sectors, in particular, emerged as pivotal for the Central Europe are and could be found in different Regions: wine and oil (from different vegetables, olives, pumpkins).

Beside these, the value chains related to fruit and its processing are of particular interest.

From the point of view of the variety of matrices, it is clear that several Regions converge on supply chains linked to the production of goods through fermentation processes (wine, beer, apples), or on materials with a strong protein base (dairy industry). Furthermore, residual lignocellulosic materials are present in almost all the administrative units considered.

From the point of view of value chains, the final products recovered range from very high added value molecules like intermediate products for the pharmaceutical, cosmetic and nutraceutical industries, to materials to be used, alone or in composite, for the production of components related to structural materials or simply protective packaging. The residual parts of biomass, after high added value molecules recover, can be further exploited for energy conversion: wet biomass, for example, can be used as feedstock in anaerobic digesters, typically present in these Regions of Central Europe. Produced biogas can be used in CHP groups or upgraded to biomethane, to also obtain a system for conveying carbon to the soil through the production of quality compost using the digested effluent.

An important possible bottleneck to be considered to implement these strategies at territorial level is that much more advanced unit operations must be considered compared to those used in the agricultural sector, a typical asset of the pharmaceutical and nutraceutical industry, such as membrane ultrafiltration, supercritical extraction using CO2 or water as fluids, thermal hydrolysis. A separate discussion then concerns the application of anaerobic processes, which will necessarily have to consider the fermentative part separate from the methanogenic one, in order to intercept platform chemicals of interest and relegate only the longer chain matrix to energy production.

Clearly, also the geographical “density” of biomass in the different targeted Regions is a fundamental aspect.

In this sense, it is very interesting to note that all the considered value chains are characterized by reasonable quantity of organic material and industrial actors in the same geographical area. This is a fundamental prerequisite to justify the creation of new value chains in a given area.