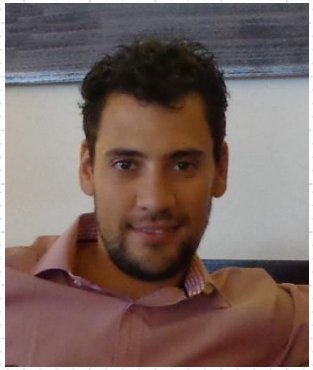
AGRICULTURAL WASTES AVAILABILITY & MAPPING IN THE EU



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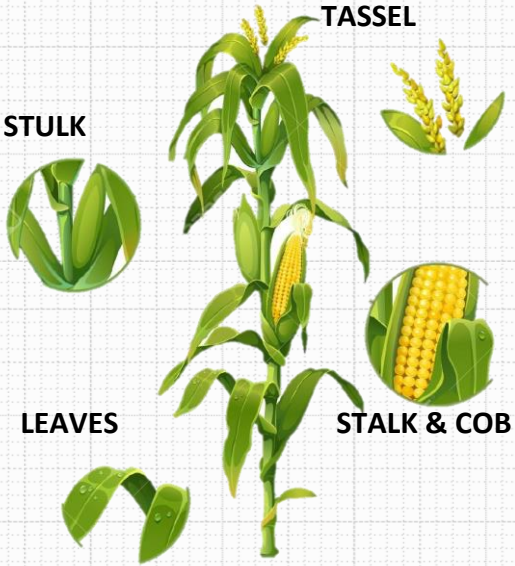
AGRICULTURAL WASTES CO- & BY-PRODUCTS

- Europe produces more than 1.300 Mton per year of solid wastes
- Half of this quantity (700 Mton) originates from agricultural sector[1]
- Agricultural Wastes Co- & By-Products (AWCB) refer to the non-usable or of low-value product/streams of agricultural commodities (even more than 100%)



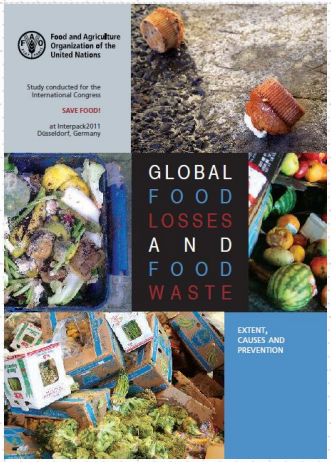
[1]Pavwelczyk A. (2005). XIIth International Congress, ISAH, Warsaw, Poland.

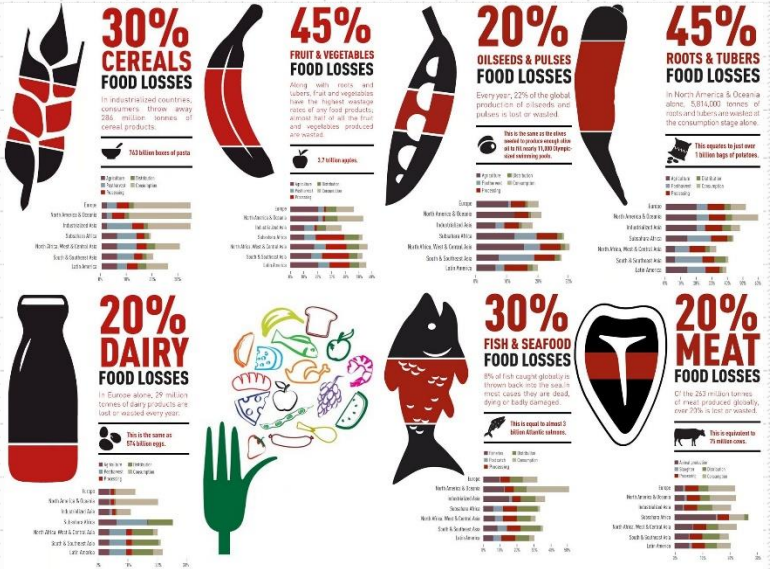
AGRICULTURAL WASTES CO- & BY-PRODUCTS

- AWCB is a very wide term including many different kind of streams
- AWCBs are produced throughout the whole supply chain (production--> processing --> consumption)
- AWCBs may be solid (e.g. twings, straw etc.), sludgy (e.g. manure, wine lees etc.) or liquid (olive pomace, wastewaters etc.)
- Food waste can be considered part of AWCBs

AWCBs MAPPING UP TODAY

- Much data are already available concerning the availability of agricultural or solid wastes in EU28
- Focus has been paid mainly on:
  - Food Waste (143 Mtons per year)





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- Much data are already available concerning the availability of agricultural or solid wastes in EU28
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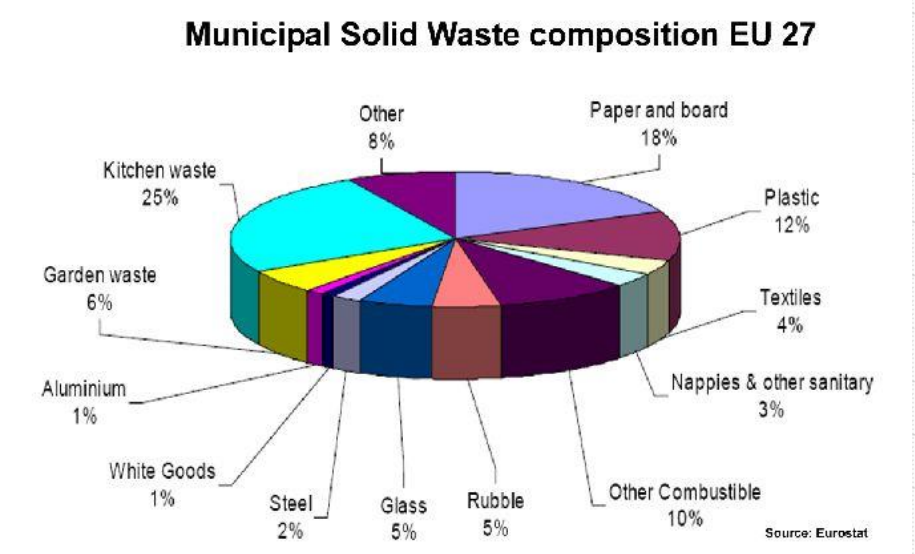
  - Municipal Organic Wastes (44 or 75 Mtons per year)



AWCBs MAPPING UP TODAY

- Much data are already available concerning the availability of agricultural or solid wastes in EU28
- Focus has been paid mainly on:
  - Food Waste (140 Mtons per year)
  - Solid Residues used for Bio-energy (139 + 40 Mtons per year)
  - Municipal Organic Wastes (44 or 75 Mtons per year)
  - Cellulosic Waste Material (122 + 40 + 38 Mtons per year)

Table 1. Present and future (2030) sustainable availability of wastes and residues in the EU.

Category	Subcategory	Current availability (Mtonnes/yr)	2030 Availability (Mtonnes/yr)
Waste	Paper	17.5	12.3
	Wood	8	5.6
	Food and garden	37.6	26.3
Crop residues		122	139
Forestry residues		40	40
	Sum	225	223

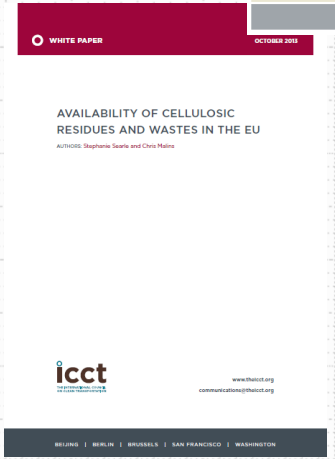


Table 6. Calculation of total agricultural residue production in Europe.

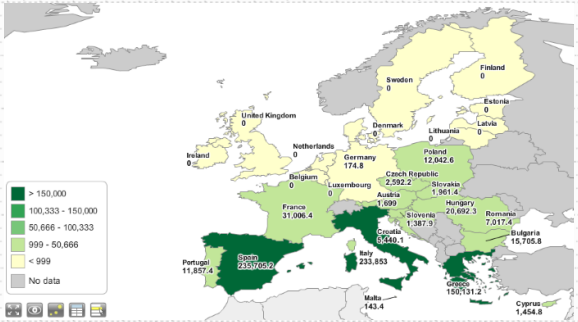
Crop type	Crop production (Mtonnes)	Field residue production ratio*	Proccessing residue production ratio	Total residue production (Mtonnes)
Barley	55.2	0.94	0.24	65
Maize	48.6	0.80	0.47	62
Oats	8.0	1.07	0.24	10
Olives	8.4	0.12		1
Rapeseed	16.4	1.08		18
Rice	1.3	1.32	0.27	2
Rye	8.0	1.13	0.24	11
Soybeans	0.5	2.50	1.00	2
Sunflower	5.2	1.77		9
Triticale	9.9	1.04	0.24	13
Wheat	122.1	0.94	0.24	144
Sugar beet	111.3	0.27		30
Sum	394.9			367

WHAT CAN WE LEARN FROM AWCBs MAPPING?

- AWCBs location, quantity, availability and characteristics critical data for developing viable exploitation methodologies
- Seasonal production, Spatial distribution, different physicochemical properties, differences in the production and processing practices.
- AWCBs mapping is necessary to decide on the valorization methodology, techno-economic viability, and “bio-refineries” or “valorization facilities” location.
- To prepare successful valorization policies.

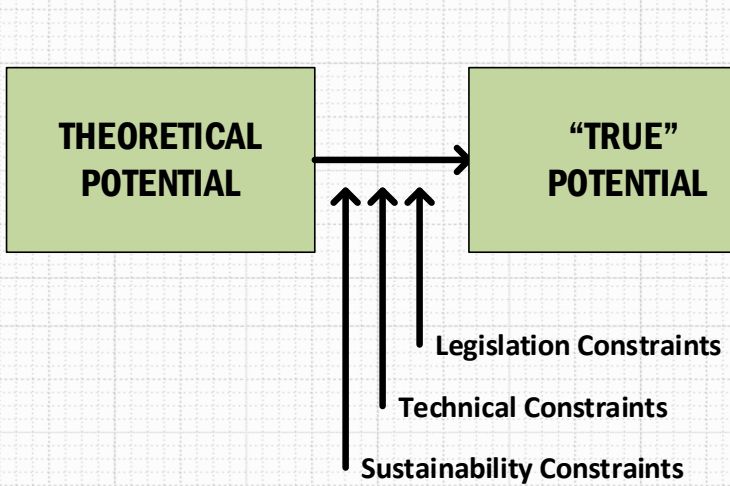
WHAT CAN WE FURTHER DO?

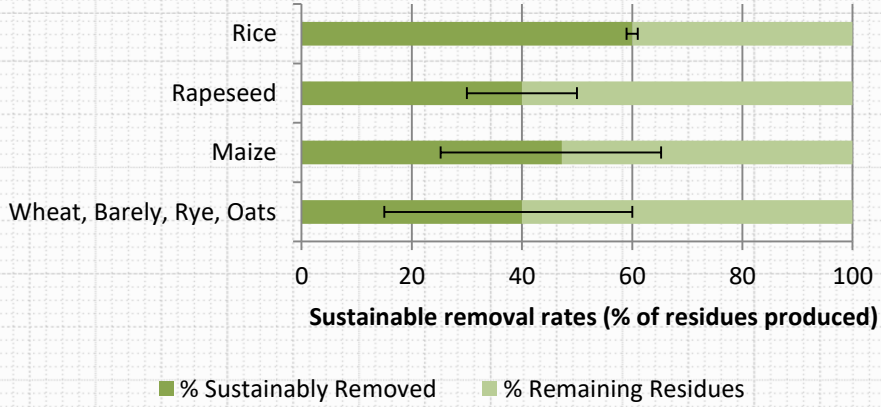
- Develop/adopt a uniform methodology/terminology
- Significant quantities are produced during processing of commodities
- Limited data on liquid waste streams (wastewaters)
- No or little data on commodities with regional interest (e.g. peaches)
- Little data on country level



A COUPLE OF WORDS ON AVAILABILITY…

Modified from M.W. Vis and D. van den Berg (2010), Harmonization of biomass resource assessments, Volume I: Best Practices and Methods Handbook, FP7 GRANT AGREEMENT No 213417





- The 1/3 "golden rule"
- 1/3 to field;
  1/3 to existing uses;
  1/3 diverted to new processes

Scarlat, N., et al., 2015. The role of biomass and bioenergy in a future bioeconomy: Policies and facts. Environmental Development, Vol 15 pp. 3-34.

THE "AGROCYCLE" POINT OF VIEW

Waste-7-2015

AGROCYCLE

Table 3.1a: Work package description

Work package number	1	Start date or starting event:										M1	
Work package title	Agricultural Waste Value Chain Assessment												
Participant number	1	2	3	4	5	6	7	8	9	10	11	12	
Short name of participant	UCD	UGENT	HAU	FRAU	CNR-IPCF	CERTH	SDEWES	DEMETER	CREA	NNFCC	CAU	NJ	
Person/months per participant													
Participant number	13	14	15	16	17	18	19	20	21	22	23	24	25
Short name of participant	IRIS	TOMSA	EXE	AXEB	AGRII	RESET	CG	M&S	EUBIA	RABDF	CEMA	CIBE	EK
Person/months per participant													

Objectives

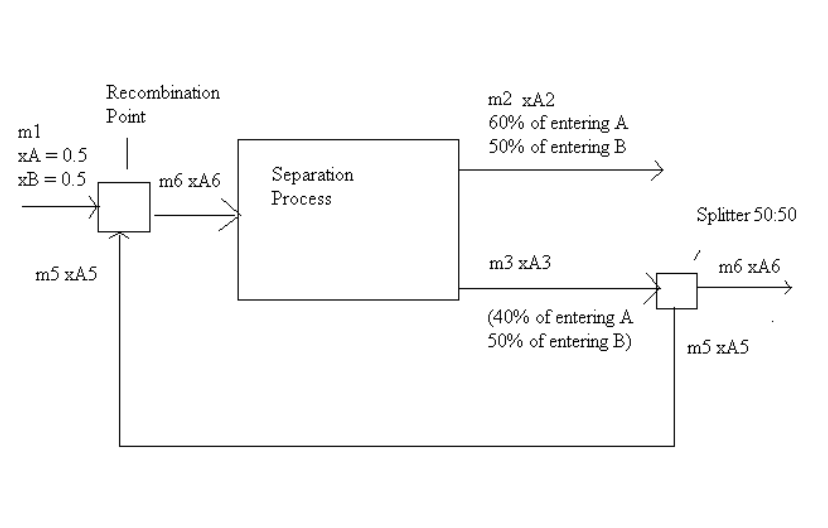
- **To map, characterise and quantify the available agricultural AWCB**

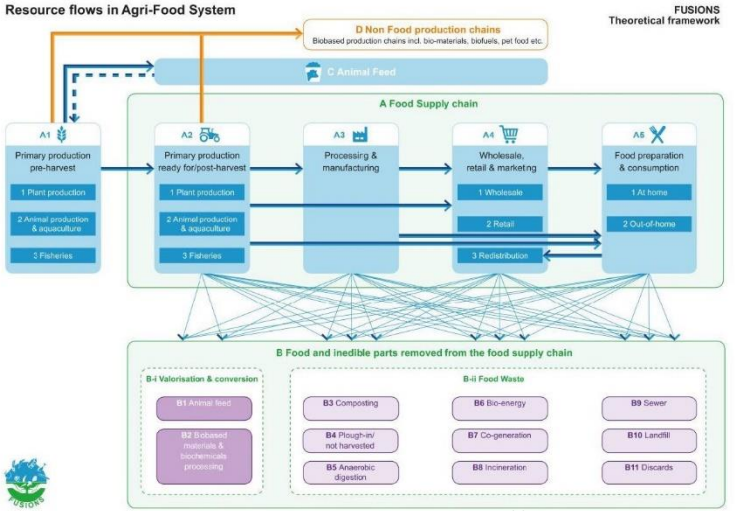
In order to address this over-arching objective, this WP will undertake an integral analysis of the agricultural v
including assessment of waste distribution, composition, relevance to current agricultural systems, value chain
current regulatory requirements. The WP team will:

- Map the AWCB value chains across Europe.
- Characterise the AWCBs in terms of energy, nutrient and water contents.
- Quantify the AWCBs that can be removed without adversely affecting current agricultural production systems or environment.
- Assess the logistics required for AWCB valorisation systems.
- Assess the current regulatory framework governing AWCBs.

AWCBs MAPPING AS A CHEMICAL ENGINEERING PROBLEM…

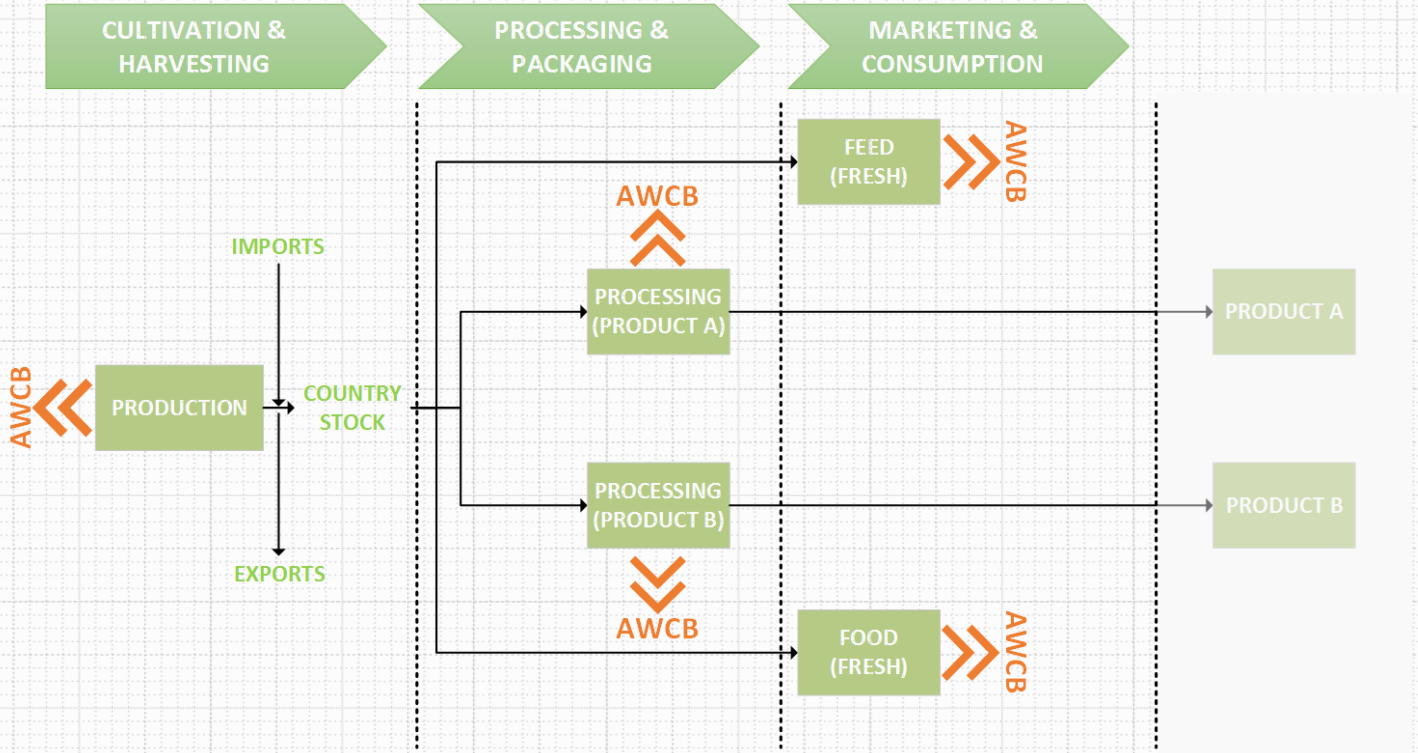
- AWCBs quantification and mapping can be considered a classical mass balance problem (different time scale)





https://www.eu-fusions.org

METHODOLOGICAL APPROACH



METHODOLOGICAL APPROACH

I. System boundaries

- Waste streams directly related to agricultural commodities
- No processed foods
- Time frame: yearly production

II. Main assumptions

- Spatial distribution on country level
- Non-processed agricultural commodities are consumed within the year of production
- No differences in properties of commodities throughout Europe

METHODOLOGICAL APPROACH

III. Data sources

- EUROSTAT (http://ec.europa.eu/eurostat/data/database)
- FAOSTAT (http://www.fao.org/faostat/en/#data)
- International Trade Center (http://www.intracen.org/itc/market-info-tools/trade-statistics/)
- Farmer and food associations
- Literature

MAIN AGRICULTURAL COMMODITIES

Table 2.1: Top 10 agricultural commodities in the EU28 countries in terms of quantities

COUNTRY	COMMODITIES									
Austria	Sugar beet	Milk cow	Maize	Wheat	Barley	Potatoes	Pigs	Apples	Grapes	n.a.
Belgium	Sugar beet	Milk cow	Potatoes	Wheat	Pigs	Chicken	Carrots	Turnips	Pears	Chicory
Bulgaria	Wheat	Maize	Sunflower	Milk cow	Barley	Rapeseed	Grapes	Potatoes	Tomatoes	Chicken
Croatia	Maize	Sugar beet	Wheat	Milk cow	Barley	Grapes	Potatoes	Sunflower seed	Apples	Soybeans
Cyprus	Milk cow	Potatoes	Pigs	Tangerines	Oranges	Milk goat	Grapes	Chicken	Milk sheep	Grapefruit
Czech Republic	Wheat	Sugar beet	Milk cow	Barley	Rapeseed	Maize	Potatoes	Chicken	Triticale	Pigs
Denmark	Milk cow	Wheat	Barley	Sugar beet	Pigs	Potatoes	Rapeseed	Rye	Chicken	Cattle
Estonia	Milk cow	Barley	Wheat	Rapeseed	Potatoes	Oats	Pigs	Peas	Cabbages	Rye
Finland	Milk cow	Barley	Oats	Wheat	Potatoes	Sugar beet	Pigs	Chicken	Cattle	Rapeseed
France	Wheat	Sugar beet	Milk cow	Maize	Barley	Potatoes	Grapes	Rapeseed	Pigs	Triticale
Germany	Milk cow	Wheat	Sugar beet	Barley	Potatoes	Rapeseed	Rye	Pigs	Maize	Triticale
Greece	Maize	Olives	Wheat	Tomatoes	Grapes	Potatoes	Oranges	Milk cow	Milk sheep	Peaches
Hungary	Maize	Wheat	Milk cow	Sunflower	Barley	Sugar beet	Apples	Maize green	Rapeseed	Grapes
Ireland	Milk cow	Barley	Cattle	Wheat	Potatoes	Pigs	Oats	Chicken	Mushrooms	Cabbages
Italy	Milk cow	Grapes	Maize	Wheat	Tomatoes	Olives	Apples	Sugar beet	Oranges	n.a.
Latvia	Wheat	Milk cow	Rapeseed	Barley	Potatoes	Oats	Rye	Cabbages	Pigs	n.a.
Lithuania	Wheat	Milk cow	Sugar beet	Barley	Rapeseed	Triticale	Potatoes	Oats	Pigs	Rye
Luxembourg	Milk cow	Wheat	Barley	Triticale	Potatoes	Rapeseed	Cattle	Grapes	Pigs	Oats
Malta	Milk cow	Wheat	Potatoes	Tomatoes	Onions	Cauliflowers	Broccoli	Pigs	Lettuce	Chicory
Netherlands	Milk cow	Potatoes	Sugar beet	Pigs	Onions	Chicken	Tomatoes	Carrots	Turnips	Cucumbers
Poland	Milk cow	Sugar beet	Wheat	Potatoes	Triticale	Maize	Rye	Apples	Barley	n.a.
Portugal	Milk cow	Tomatoes	Grapes	Olives	Potatoes	Chicken	Apples	Pigs	Oranges	n.a.
Romania	Maize	Wheat	Milk cow	Potatoes	Sunflower	Barley	Cabbages	Sugar beet	Grapes	Tomatoes
Slovakia	Wheat	Sugar beet	Maize	Milk cow	Barley	Rapeseed	Sunflower	Potatoes	Rye	n.a.
Slovenia	Milk cow	Maize	Wheat	Apples	Barley	Grapes	Potatoes	Chicken	Cattle	Pigs
Spain	Olives	Wheat	Grapes	Milk cow	Tomatoes	Pigs	Oranges	Sugar beet	Potatoes	Tangerines
Sweden	Milk cow	Sugar beet	Barley	Wheat	Oats	Potatoes	Rapeseed	Pigs	Rye	n.a.
United	Milk cow	Wheat	Sugar beet	Barley	Potatoes	Rapeseed	Chicken	Oats	Cattle	Pigs

MAIN AGRICULTURAL COMMODITIES

- Ranking of agricultural commodities (1-10)
- Summing up their ranking in EU28 level
- Sorting
- Adding some of specific interest (peaches, rice)

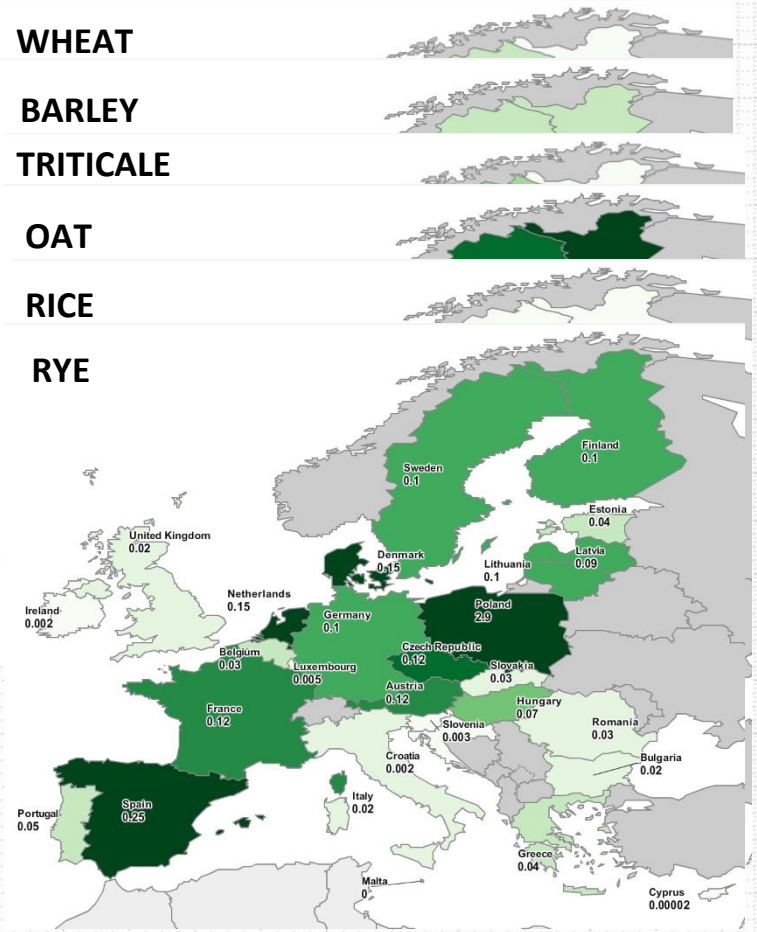
RANKING	COMMODITY
1	Milk cow
2	Wheat
3	Potatoes
4	Barley
5	Sugar beet
6	Maize
7	Pigs
8	Grapes
9	Tomatoes
10	Chicken
11	Oats
12	Olives
13	Sunflower seed
14	Apples
15	Triticale
16	Rye
17	Cattle
18	Oranges
19	Onions
20	Cabbages
21	Tangerines
22	Carrots
23	Cauliflowers
24	Rapeseed
25	Peaches
26	Rice

INDICATIVE RESULTS

Average Straw production in EU28 between 2010-2014

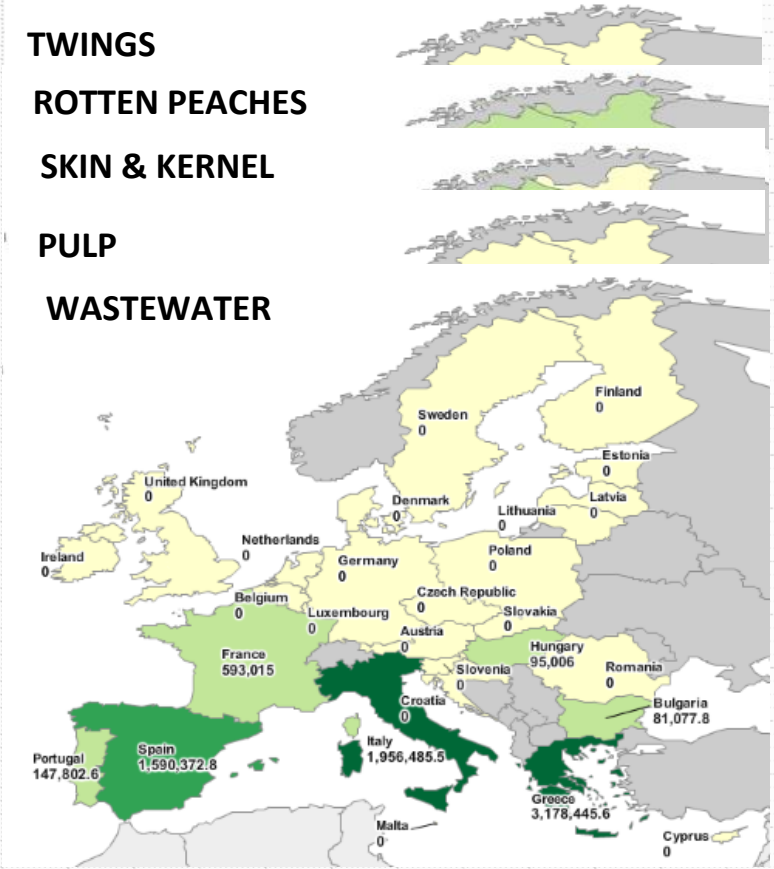
RANKING	COMMODITY	STRAW (Mtons/y)
1	Wheat	77.0
2	Barley	57.0
3	Triticale	30.8
4	Oat	11.8
5	Rice	3.95
6	Rye	3.04
		183.6

- Available data on year base; e.g. min & max during 2010-2014
- Variation of data (risk analysis); e.g. SD is from 3% (GR) to 51% (CY) for wheat, from 4% (ES) to 14% (RO) for rice, and from 7% (FR) to 54% (ES) for triticale



INDICATIVE RESULTS

- Interesting results concerning fruit commodities
- Solid AWCB are produced during cultivation (e.g. twings) and consumption (e.g. rotten peaches, kernels)
- Sludgy/liquid AWCB are produced during processing (peach pulp, wastewater)
- Liquid AWCBs are significantly more (7.6 Mtons/y) compared to solid AWCBs (3.1 Mtons/y)



CONCLUSIONS FROM AWCBs MAPPING

- Significant quantities of AWCBs are produced throughout the EU28, exhibiting serious valorization potential
- Solid AWCBs mainly occur during the cultivation and consumption stage
- Sludgy/liquid AWCBs are produced almost exclusively (apart from manures) during commodities processing

CONCLUSIONS FROM AWCBs MAPPING

- Temporal variations can be considered low to moderate due to changes in the cultivated areas and the annual yields;
- Spatial differences between north and south EU28 countries (e.g. fruit AWCBs mainly in south Europe)
- Comparably lower quantities of solid AWCBs produced during the processing stage; nevertheless high spatial concentration compared to cultivation/harvesting stage

RECOMMENDATIONS

- Selection of specific agricultural commodities and generation of data on a smaller spatial scale; especially for production stage
- Focus on AWCBs from processing stage; found in specific sites with high availability
- Quantification and mapping of AWCBs requisite for development of economic viable exploitation strategies

THANK YOU FOR YOUR ATTENTION

My deepest gratitude to all people and colleagues involved in WP1 of «AGROCYCLE - Sustainable techno-economic solutions for the agricultural value chain», Project ID: 690142. Special acknowledgements to Dr. Boris Cosic (SDEWES) for its contribution.