Ukrainian Case Study: Agronomic and Techno-economic feasibility

Workshop – The contribution of the FORBIO project to the sustainable Development of bioenergy

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No691846.

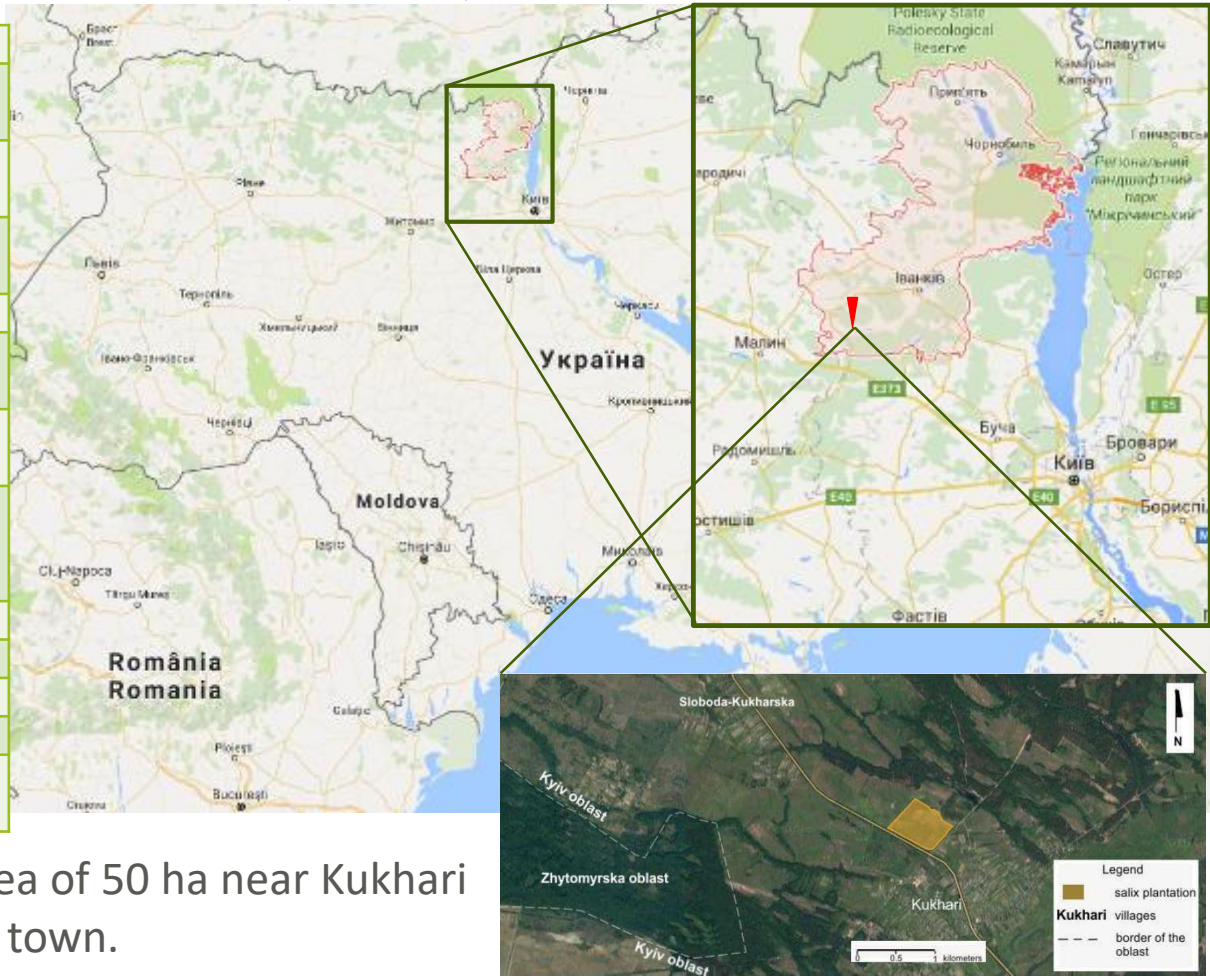
Case study site location description

Country: Ukraine

Region: Kyiv oblast

Province: Ivankiv region (362 th. ha, 12.8% of the Kyiv oblast)

Climate	moderately continental
Average temperature in January	– 6 °C
Average temperature in July	+19.5 °C
Annual average temperature	6.9 °C
Average altitude	131 m
Duration of vegetation period	198-204 days
The annual radiation balance	45 kcal/cm^2
Moisturizing factor (the ratio of precipitation to evaporation)	1.0-1.2
Annual precipitation	550-650 mm
Relief	flat
Annual air humidity	80 %
Wind direction	north-west
Soils types	sandy, sandy loam, sod-podzolic



Case study site is located at the area of 50 ha near Kukhari village approx. 25 km from Ivankiv town.

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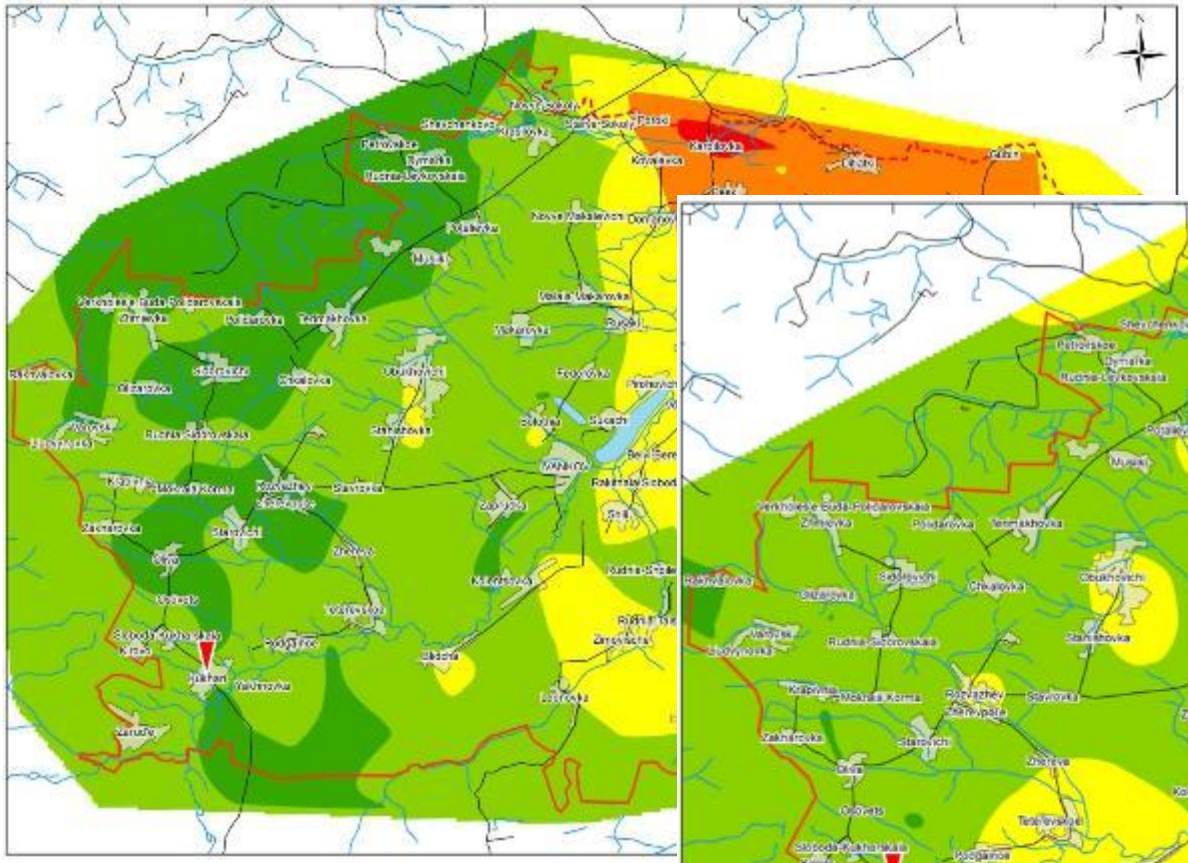
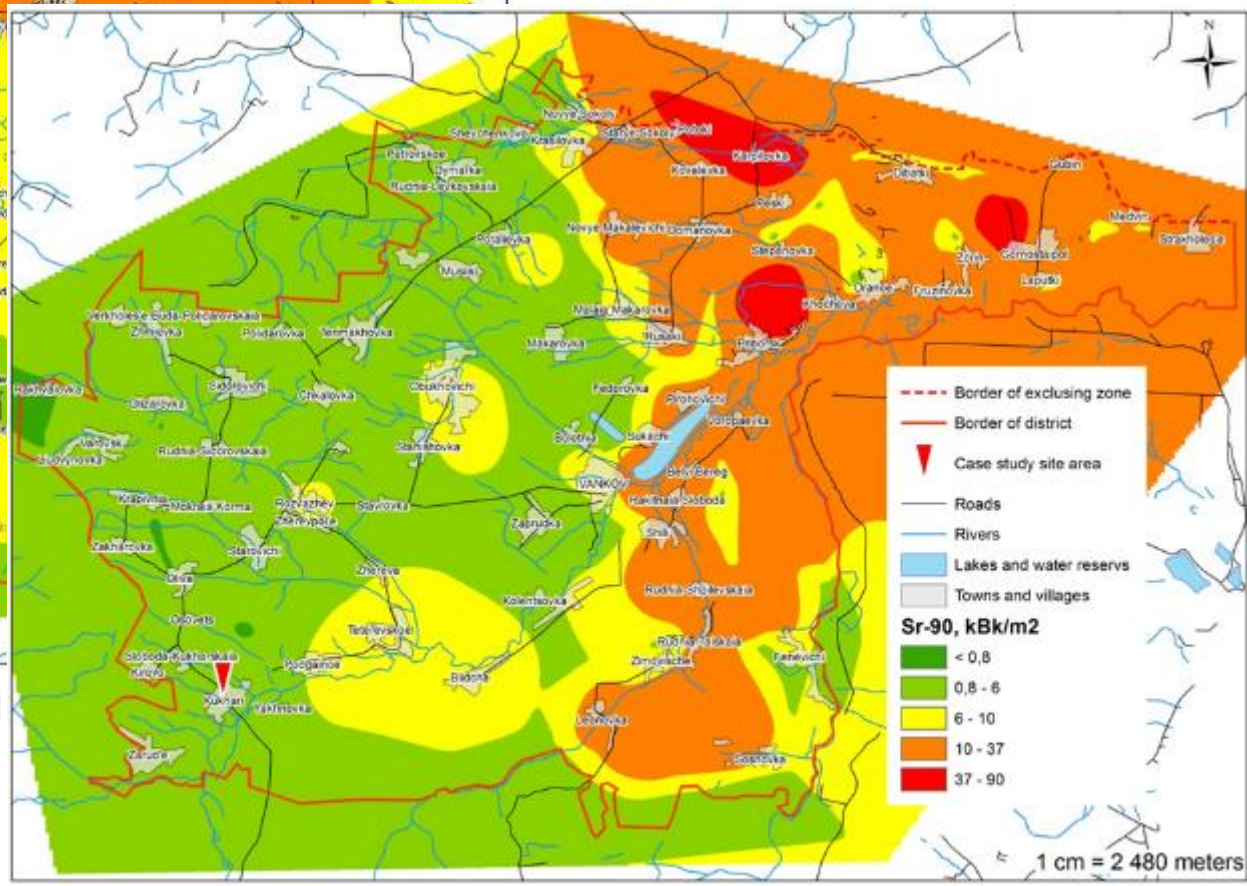
Radiological description of the investigated territory



Isolated anomalies of the local the integrated channel ^{137}Cs



Isolated anomalies of the local component of the integrated channel ^{90}Sr

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Willow field trials

Experimental field: 50 ha mother plantation is located near Kukhari village of the Ivankiv municipality.

Agricultural lands with sandy, sandy loam soils that were abandoned >10 years ago.

Chemical elements

N	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	Mo	B	Na
26	**169**	**43**	**725**	**75**	**11**	**610**	**90**	**2,9**	**1,3**	**0,05**	**0,3**	**10**

pH_{KCl} : 5,20

EC mS/cm (electroconductivity): **0,39**

- low - high

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Promising energy crops (selection)

	Energy crop	Soil pH	Annual precipitation, mm	Temperature, °C	Life cycle, years	Frequency of harvest	Biomass yield (Mg DM ha^{-1} yr^{-1})
	Salix Viminalis L.	5-7	650 -700	15-26	20-25	1 per 3 years	6.2-11.3
	Miscanthus x giganteus	5.5 – 7.5	500-700	25-32, frost-resistant	20	annually	15-20 (after 2nd year)
	Panicum virgatum L.	5.5-7	380-760	drought-resistant	10-15	annually	7-14
	Columbian grass	5-8.5	460-760	drought-resistant	8-10	annually	10-17
	Silphium perfoliatum	5.5-7.5	Resistant to floods	5-40, frost-resistant	15-20	annually	15-20
	Populus sp. L.	6-7	≥600	15-25	20-25	1 per 2-3 years	10-20 (after 3-4 years)

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First year willow plantation, Kukhari

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First month plantation

Second month plantation

Third month plantation

First year plantation

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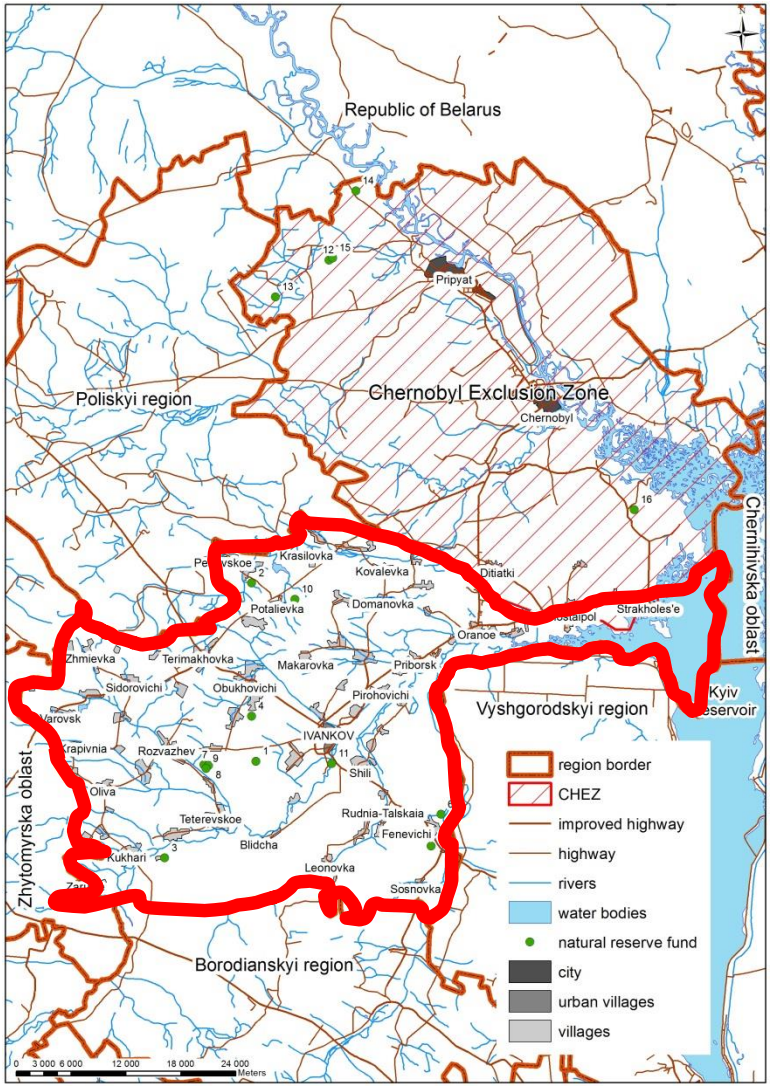
Three different high-yielding varieties of *Salix viminalis* L.: “Tora”, “Tordis”, “Inger”

Ivankiv region land fund

Ivankiv region land fund structure (thousand hectares)		
Total area	361.6	
Chornobyl exclusion zone	181.9	
Agricultural lands	80.9	
Arable lands (FAOSTAT) **, including**	**39.12**	
NON-Contaminated		25.99
Contaminated		13.12
Permanent crops	0.9	
Permanent meadows and pastures	24.3	
Underutilized agricultural land (free arable land + lay land)	**16.72**	
Forest, including	**78.28**	
Natural Forest or underutilized forest	35.62	
Managed Forest	42.66	
Other lands	**26.52**	
Urban areas	7.2	
Water fund land (wetlands)	13.43	
Other	5.97	



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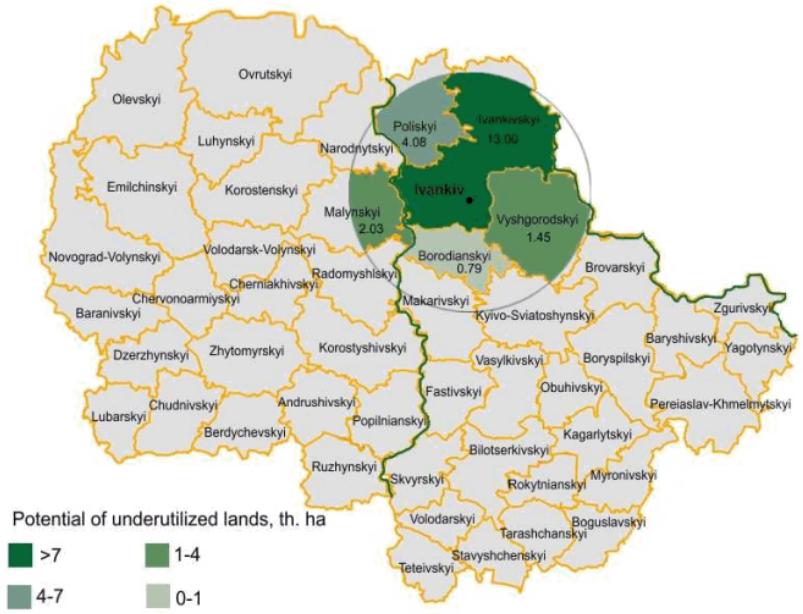
Underutilized land availability and potential for energy crops

Two categories of land are considered as underutilised in the assessment:

- Abandoned agricultural land, i.e. land that is not needed any more for the production of food and feed crops or for other purposes;
- Degraded or low productive land, i.e. land that is not suitable or no longer suitable for conventional commercial agriculture.

Regions	Distance* from Ivankiv town to the remotest points of the region, km	Underutilised land within 50 km zone, thousand ha
Ivankivskyi	40	13.00
Poliskyi	52	4.08
Malynskyi	85	2.03 (part of the region)
Vyshgorodskyi	55	1.45
Borodianskyi	49	0.79
Potential in the regions located in 50 km radius from Ivankiv		**21.35**



* Measured by roads

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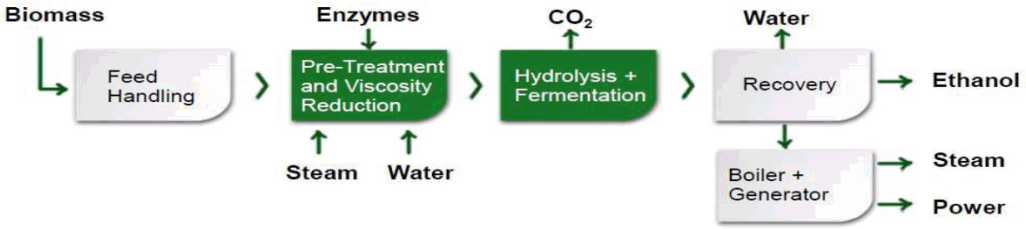
Value chain: *Salix* for 2G ethanol
Estimation of chips cost at plant gate (10 years)

Input data	
Plant Capacity	40,000 tons/year
Mean biomass productivity	10 Mg DM ha^{-1} yr^{-1}
Area needed for biomass production	21,350 ha
Collection radius from the plant	50 km
Annual potential of biomass feedstock	200 Mg DM /year

Process flow diagram for lignocellulosic ethanol production



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Value chain: *Salix* for 2G ethanol
Estimation of chips cost at plant gate (10 years)

Costs	€/ha year	€/Mg DM year
Establishment of plantation	123.4	12.34
Landowner fee	13	1.3
Fertilization costs	32	3.2
Harvesting (single pass for one row)	32	3.2
Eradication of plantation	15.7	1.57
Capital remuneration (2.5%)	35	3.5
Biomass handling and transport (50 km)	35	3.5
FINAL COST AT PLANT GATE		**28.7**

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Conclusions

- *Salix viminalis* L. is the most suitable for growing in the climatic conditions of the Case study region according to literary analysis and review of field trials.
- **21,350 ha** of underutilized agricultural land is available in 50 km radius from Ivankiv town, where potential biorefinery can be located.
- Total final cost of willow chips delivered at a plant gate and collected within a 50 km radius is **28.7 Euro/dry ton**.

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THANK YOU !

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