Biochar for agroforestry in Poland

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Introduction

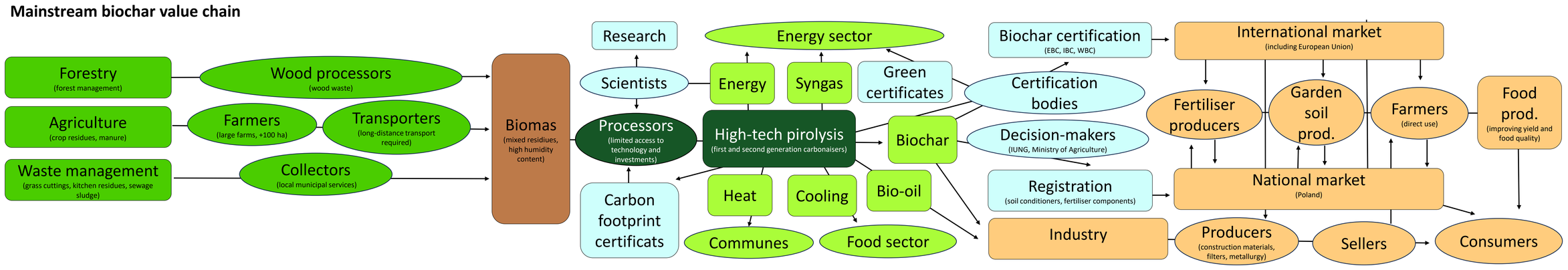
Agroforestry, like any tree-related cropping system, has a problem with surplus wood and tree waste from pruning, harvesting and dead stock. Often this type of material finds neither a buyer nor a use on the farm. Storing it takes a lot of space, composting it takes a lot of time and disposing of it as waste would be a loss of its potential. The ideal solution would be to convert it into biochar and use it to improve soils or as charcoal to generate additional income. In fact, the carbonization of biomass is a complex and costly process. Professional first and second generation pyrolysis installations require a large investment, often involving a loan. They also demand a large and constant supply of biomass and connection to an infrastructure that will be a consumer of electricity, heat or cooling. In other words, such installations need an advanced degree of value chain organization, which may be out of reach of the just developing agroforestry in Poland. The strength of such systems is the possibility to produce large quantities of high quality biochar with standardized parameters, which would allow its registration as a soil improving product, or certification and sale on the national and European market. Another solution is low-tech charcoal and biochar production in retorts and flame curtain kilns. The disadvantages of this solution are the lack of energy recovery and legal restrictions in individual EU countries. The low scale of production also makes it unprofitable to register and certify the product, so sales opportunities are limited. In this case, the remaining options are to use the produced biochar locally or to sell the material as charcoal. However, under certain conditions, this can be a very good solution.

Methods

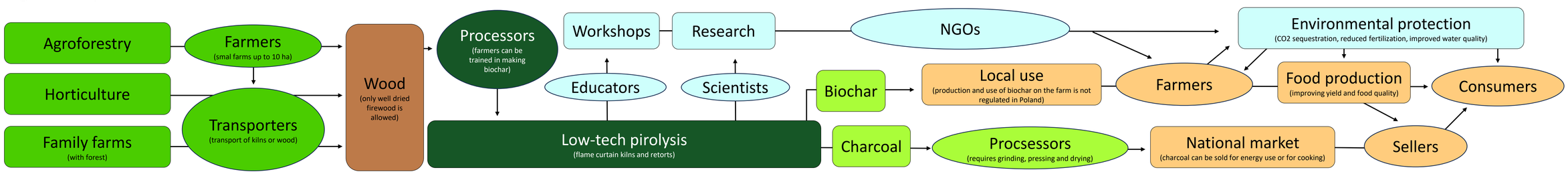
Based on cooperation and consultations with experts from Biochar Europe, a value chain model for biochar production for agroforestry farms was presented and compared to the mainstream biochar value chain. In order to prove the feasibility of biochar and charcoal production on small agroforestry farms, we tested the flame curtain method at several locations in Poland. The wood came from young tree pruning, withered branches and dead saplings, dead forest wood and the control of invasive species such as American cherry. The entire process was documented, the time and other parameters were measured or estimated. The result was expressed in man-hours spent and materials used.

Results

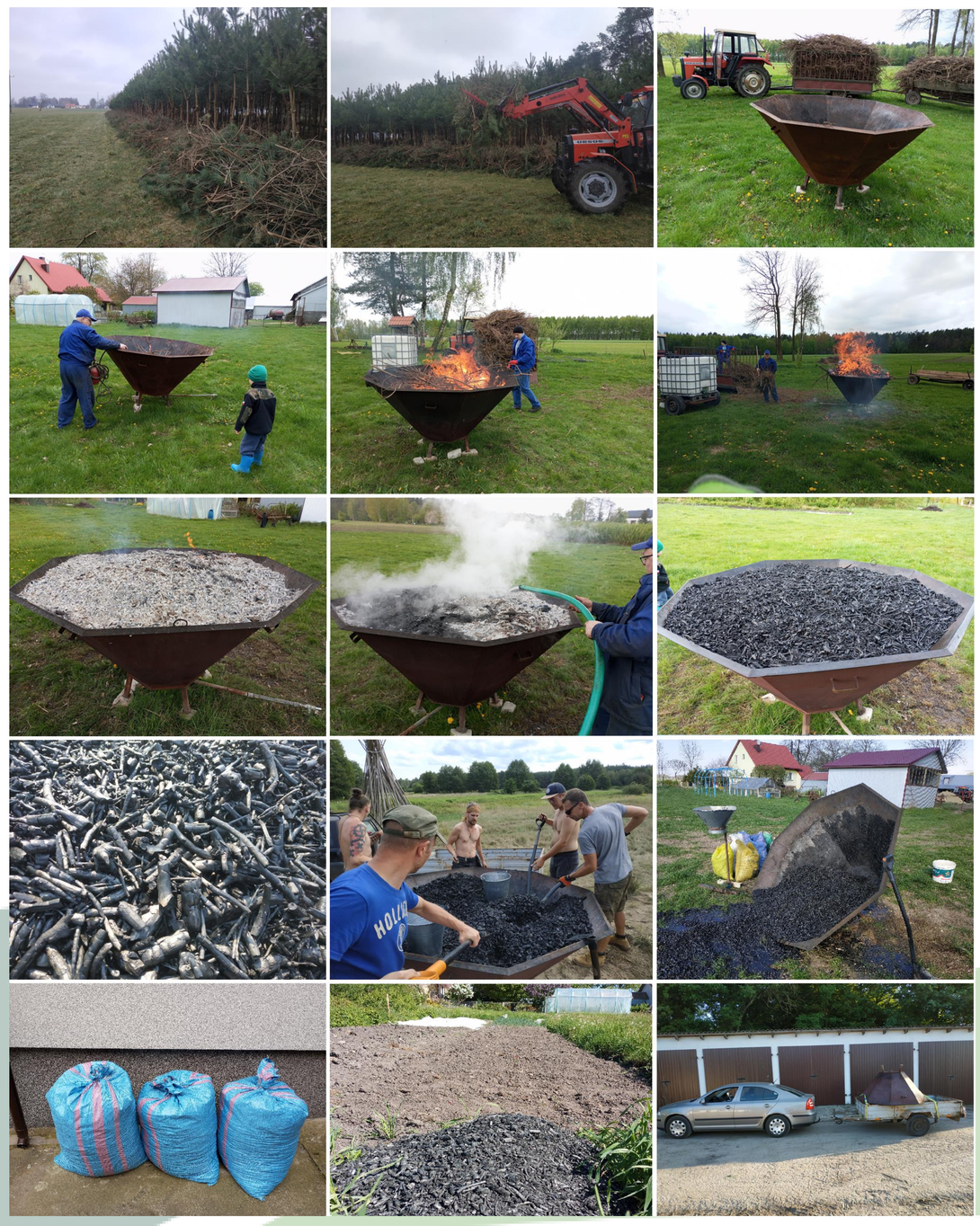
Mainstream biochar value chain



Agroforestry biochar value chain



Practising biochar production in different locations in Poland



Results of testing the simplified value chain in different locations in Poland

Parameters		Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
Basic data	Date	18.08.2022	20.08.2022	29.04.2023	27.05.2023	02.03.2024	20.04.2023
	Location (Poland)	Mroczki, 08-112 Wiśniew	Gapinin, 26-315 Poświętne	Mroczki, 08-112 Wiśniew	Osiny, 24-103 Żyrzyn	Mroczki, 08-112 Wiśniew	Mroczki, 08-112 Wiśniew
	Agroforestry	silvoarable	fruit forest	silvoarable	silvopastoral	silvoarable	silvoarable
	Farm size [ha]	6	9	7	300	7	7
Equipment	Tractor	1	0	1	1	1	1
	Tractor trailer	1	0	2	1	2	2
	Car	1	2	1	1	1	1
	Car trailer	1	2	1	1	1	1
	Other:	water tank, buckets, shovels, forks, bags, gloves, saws, secateurs					
Materials	Feedstock	pine, spruce, oak, fir	pine, willow, poplar	pine	American black cherry	hemp	pine, birch
	Water used [m3]	0.5	0.8	0.6	0.55	0.1	0.64
Process	Collection of material [h]	2	2	2	1	0	2
	Burning [h]	2	4	3	4	2	2.5
	Extinguishing [h]	1	1	1	1.5	0.5	1.5
	Unloading [h]	1	1	1	1	0.25	1
	Breaks [h]	1	0	1	1	0	1
Staff	Workers	3	6	2	4	4	3
	Person-hours	21	48	16	34	11	24
Travel	Travel [km]	0	320	0	240	0	0
	Transport [km]	5	2	4	2	98	4
Outcome	Volume [m3]	0.7	0.95	0.8	0.95	0.2	0.95
	mass [kg]	175	240	200	285	40	250
	Use	manure, potato and cereal cultivation	workshops, compost, vegetable cultivation	barbecue, vegetable cultivation, research	workshops and research	research	compost, vegetable and legume cultivation

Conclusions

It has been demonstrated that biochar can be produced and used on small-scale agroforestry farms using low-tech methods. It was estimated that producing 1t of biochar requires 3-5 tones of wood, 2-3 m^3 of water, and 130 man-hours of work. At least two people are needed in the process, while the use of agricultural equipment such as a tractor, trailer and lift significantly accelerates the work, but is not necessary. Access to a water source in close proximity is essential. Depending on the scale of production, efforts can be made to register and certify the product, however, it is easier to apply it for own use and make a profit from the higher crop yield. Alternatively, biochar can be ground, pressed and dried for sale as charcoal briquettes, however, this would be a major loss of its environmental potential. Other sources of income can include services such as providing trainings and workshops on biomass carbonization, collaborating on scientific projects, selling biochar to universities and institutes and payments for carbon credits. The outcomes of the study could be applicable to Poland and UE countries with similar legislation and the same regulations on biomass burning.

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