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PS 2.4 - Changing Benefits

THE CONTRIBUTION OF PERI-URBAN FORESTS TO THE CIRCULAR BIOECONOMY: THE CASE STUDY OF MONTE MORELLO IN ITALY

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FORESMIT

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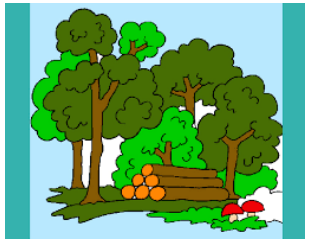
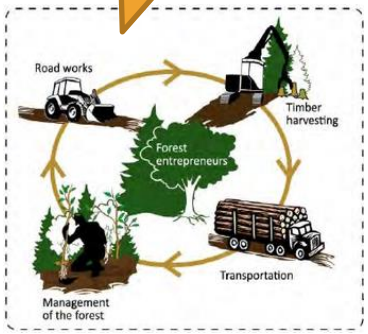
FRAMEWORK AND AIMS

The aim of the present study was to find a method to evaluate the potential value of the forest-wood chain in a peri-urban forest, following the circular bioeconomy point of view.

LIFE FoResMit project





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Steps of the work:

First step: We need data

- **First step:** materials flows (timber and woody biomass for energy use) generated by the forest management actions have been quantified;

Second step: We need a link

- **Second step:** a set of indicators to link the forest management actions to the 4R (*Reduce*, *Reuse*, *Recycle*, *Recover*) of the circular bioeconomy approach have been defined.

Third step: We need a way to compare

- **Third step:** the current forest management strategy applied in the study area has been compared with four different scenarios, to evaluate the optimum solution by means of Multi-Criteria Decision Analysis (MCDA)

MONTE MORELLO – PERI-URBAN FOREST

The Monte Morello peri-urban forest located North West of the Florence city (Tuscany Region) is the result of a reforestation (1909 -1980) action for hydrogeological protective purpose.

Currently, Monte Morello forest can be considered a **degraded forest** often characterized by poor regeneration, huge quantity of standing dead trees and lying deadwood, and a high degree of flammability.

- Growing stock: 560 m^3 ha^{-1}
- Annual increment: 9.6 m^3 ha^{-1} yr^{-1}
- Deadwood volume: 75 m^3 ha^{-1}

MONTE MORELLO – PERI-URBAN FOREST

In 2015 – LIFE FoResMit project –two different silvicultural treatments have been applied to Monte Morello forest (tested area of 10 ha).

Traditional thinning

Small and leaned trees and standing dead trees are harvested, while the lying deadwood is not removed.
Thinned 15-20% of basal area

Selective thinning

The choice of the trees to be cut is based on a positive selection all crown-volume competitors trees are harvested, standing dead trees and lying deadwood of 1st and 2nd decay class with dbh more than 20 cm are removed. **Thinned 30-40% of basal area**.

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	Traditional thinning	Selective thinning
Surface [ha]	5.35	4.73
Volume of growing stock [m^3 ha^{-1}]	134.7	202.0
Volume of deadwood (standing and lying) [m^3 ha^{-1}]	9.5	18.2
Volume harvested for surface unit [m^3 ha^{-1}]	144.2	220.2
Total volume collected [m^3]	**772**	**1042**

STEP 2- FOREST INDICATORS

- To try to link the 4R principles of the circular bio-economy with the forest sector 6 indicators have been defined.
- The six indicators take into account: the timber volume harvested, the potential and effective earnings due to the selling of the wood products, the saving of CO_2 emission due to the utilization of a renewable resource, the deadwood volume valorization, products life span.

4R	Definition	Indicator defined for the forest sector
Reduce	Improving of the process efficiency reducing the utilization of natural resource	I_1 - ratio (on annual basis) between the economic value of the wood harvested and the wood volume harvested [€ ha^{-1}] I_2 - CO_2 emissions of the steps of forest-wood chain (from the felling to the transport) for unit volume [tCO_2 m^{-3}]
Reuse	Life span of products/Products re-utilization before its disposal of .	I_3 - product life span before to be send to landfill or to be used for energy generation [years]
Recycle	Level of recyclability of the products for other purpose/objects (paper, animal bedding, chipboard panels)	I_4 - ratio between the potential economic value of the wood assortment and the real value earned. [€ $€^{-1}$]
Recover	Energy production from the "end-of-life products"	I_5 - ratio between CO_2 emissions saved by the timber sold for energy production (respect to the diesel oil) and the total cubic meter collected [$kgCO_2$ m^{-3}] I_6 - ratio between deadwood used for energy purpose and deadwood available in forest [m^3 m^{-3}]

STEP 2 BUSINESS-AS-USUAL : RESULT

Thanks to the data collected during the silvicultural actions a value has been calculated for each forest-wood chain indicators. In the current scenario all the wood harvested has been chipped and sold to the District Heating Plant (DHP) of Calenzano , Florence.

Indicator	Description	Value
I_1	Annual economic value of wood harvested (€) / surface (ha)	421,3 € ha^{-1}
I_2	CO_2 emissions during thinning and harvesting operations (kg_{CO2}/m^3)	7,8 $kgCO_2$ m^{-3}
I_3	Life span of the wood products (years)	0,5 years
I_4	Potential earning – effective earning /potential earningIncremento valore (%)	25,3 %
I_5	Avoided emissions using wood for energy purpose ($kgCO_2/MWh$)	626 $kgCO_2$ MWh^{-1}
I_6	Deadwood for energetic purpose (m^3) / deadwood in forest (m^3)	0,37

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- Wood products value: 421 € per hectare
- 25,3% of the Indicator 5, means that we can work on the wood destination to improve the valorization of the wood harvested.
- 37% of the deadwood of (1-2th class) has been collected for energy purpose. The deadwood valorization, is mainly applicable in degraded forest.

SCENARIOS

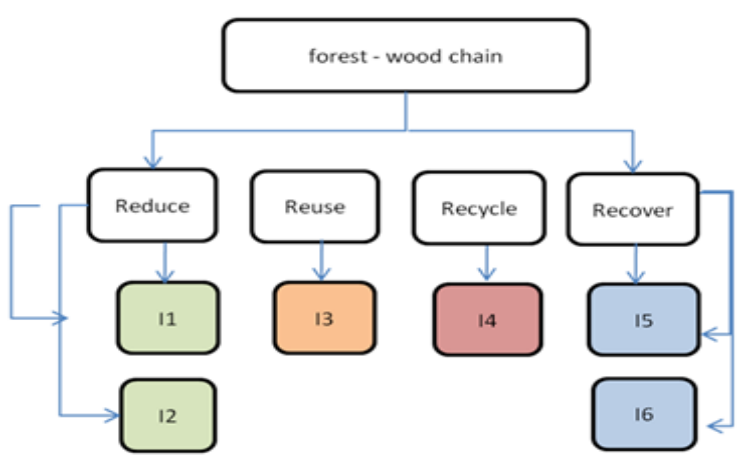
To look for a better management solution 5 different scenarios have been compared:

- A - Business as usual (traditional & selective thinning)
- B - Traditional thinning ad woodchips production
- C - Selective thinning and woodchips production
- D - Traditional thinning and wood products valorization (e.g., packaging or environmental engineering poles)
- E - Selective thinning and wood products valorization (e.g., packaging or environmental engineering poles)

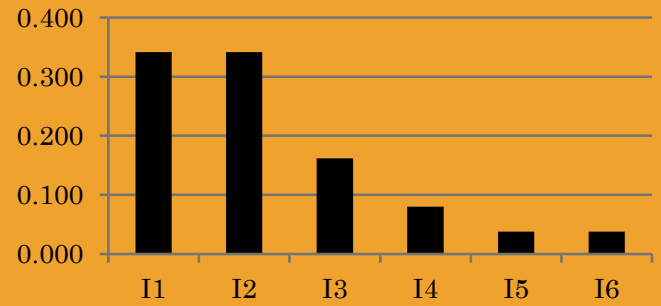
Scenario	Thinning method [T=traditional, S=selective]	Timber volume [m^3]	Wood volume allocation		
			Woodchips [m^3]	Packaging [m^3]	Large poles [m^3]
A	T+S	1,813	1,813	-	-
B	T	1,454	1,454	-	-
C	S	2,220	2,220	-	-
D	T	1,454	850	535	63
E	S	2,220	1,251	604	363

MCDA Analysis – Definite software

An MCDA analysis has been run among the 5 scenarios by means of the AHP approach. The weights of the indicators have been assigned by means of the pairwise comparison.



For the weights assignment, the hierarchy of the 4R principles has been followed.



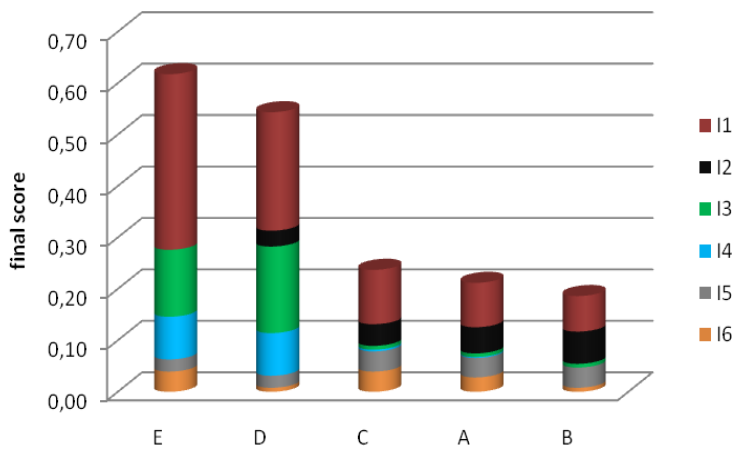
Input matrix

Scenario	I_1 [€ ha^{-1}]	I_2 [kg$_{CO2}$ m^{-3}]	I_3 [y]	I_4 [%]	I_5 [kg$_{CO2}$ m^{-3}]	I_6 [m^3 m^{-3}]
A	421.3	7.8	0.5	25	-626.6	0.37
B	337.8	7.5	0.5	26	-626.9	0.10
C	515.8	8.0	0.5	25	-626.4	0.50
D	1,124.8	8.3	11.6	0	-373.2	0.10
E	1,667.3	8.4	8.9	0	-378.7	0.50

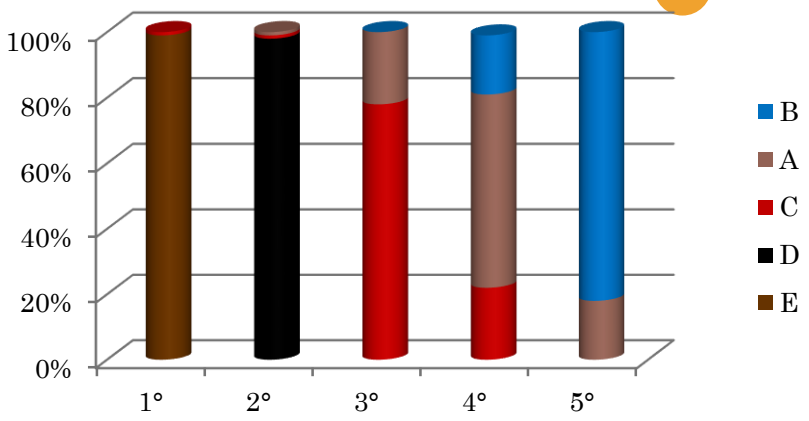
RESULTS

- The best management solution is the scenario E: selective thinning with wood products valorization. In these scenario increase the earning from the wood sold (I1), the span life of the wood products (I3);
- The scenario D follows the scenario E. The wood valorization has a key role in the forest wood chain.
- If the wood is devote only to woodchips production – scenarios A,B,C , the scenario C is the favored one: with selective thinning higher volume of wood harvested are collected

Results



Sensitivity Analysis



OUTLOOKS AND CONCLUSIONS

- Two thinning methods have been applied in a degraded forests – data on timber/deadwood volume, costs and time of felling and chipping, have been collected
- Six forest indicators have been defined according to the circular bioeconomy principles
- Five different forest management scenarios have been compared by means of MCDA approach

✓With the selective thinning higher timber volume have been collected, with higher timber quality; If the aim is the woodchips production the selective thinning must be preferred rather then traditional thinning;

✓By the MCDA the preferred scenario for the forest management is the selective method with wood valorization – increasing of 1200 €/ha;

✓The forest indicators could became useful tool to evaluate the forest status, to point out the aspect that can be improved and to compare different forest management options;

✓According to the circular bioeconomy principles, the "cascade" approach wins. The wood valorization is the key variable to increase the value of the peri-urban forest.

Thanks for your kind attention

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