The Biomasses Deriving From the Public Parks Management: an Hypothesis of a City-Wood-Energy Chain in Potenza

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Abstract

The aim of this work was to hypothesize a city-wood-energy chain in Potenza, using the residuals deriving from the public parks maintenance.
In this study it emerged a maintenance conditioned from the scant municipal funds and the assimilation of the wood residuals to a common urban waste. From here was originated the hypothesis of a chain, to exploit the biomasses potentials and to follow the European tendency about energy politics for the incentive in the renewable sources, such as the biomasses. We considered the chips such as product derivable from the wood biomasses transformation and we analyzed its more important characteristics and the machines for its production. We hypothesized, analyzed and compared two hypothetic yards for the production and sale of the chips, using two different types of calculus programs.
In the first yard would support a chips cost equal to 59 €/t and would have a work capacity of 0,68 t/h; in the second yard, with a higher degree of mechanization, the work capacity would be 0,99 t/h, with a cost reduction of 23%. In the last case the convenience would have only whit a great quantity of chips, about 946 t/y, obtaining with an accurate management of the green heritage of the city.
From the results, obtained and compared with the currently public park maintenance in Potenza, it appears clearly the economical convenience of the chips chain, that must represent in future a valid instrument of investment, if supported by a correct and a regular public parks maintenance.

Keywords: public parks, biomasses, chips

Introduction

In the last twenty years the most important international organizations, such as ONU, OCSE and UE, promoted increasingly the initiatives in order to preserve the green patrimony quantity and quality of our cities and wildlife reserves, in behalf of the future generations. If on one hand more prominence to the sustainability has been given, concerning the quality life improvement, on the other hand the aspects relative to energetic recovery of the material deriving from the maintenance operations has been disregarded.
The public parks management by municipalities has been modified, joining to the direct management the outsourcing; ad hoc companies have been established as an alternative. Currently the public parks rules are lean and fragmented, devoid of an organic policy emphasizing its whole potentialities, as provider of recreational and environmental functions, moreover potential biomasses source. At present the Interdepartmental Decree n. 1444, April 2th, 1968 is the primary normative reference nationwide; the article 3 establishes the max relationships between the residential settlements spaces and the public spaces or assigned to

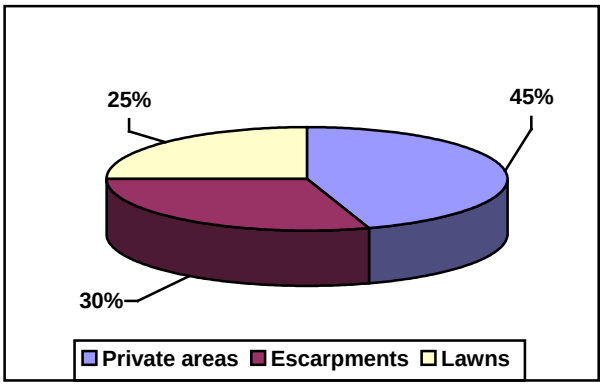
collective activities, to public parks or parking. Other normative instruments discipline specific aspects of the public parks, for example the phytosanitary struggle and the road masts. Each region can provide, with several planning instruments, more detailed such as the Plan and the Map of the public parks, as well as the Regulations that few municipalities has got, only the 23% (Sanesi G., 2001).
The aim of this work was to analyze the current public parks management in Potenza and to provide a starting point to improve this management, in order to increase the value of the waste biomasses.

Materials and methods

In the first phase of this work we characterized the public parks in the center and in the periphery of Potenza city, using maps and tables provided from the municipally. Specifically it's about these paper supports, dated back to 2002:

- *a map with the public parks topography*, that splits the city areas in numerated squares;
- *a map with the public parks numbering*, for each area has been highlighted the green belts and assigned an identification number;
- *a green table*, reporting for each area the surface, the typology (lawn or escarpment) and the property, with the possibility to trace back the exact placing of the area in the city.

For the road masts has been performed the same work, processing a *trees table* that, for each plant, reports the progressive number, an identification code, the exact collocation and the species. The total extension of the city green belts is equal to about 140 ha and according to the ISTAT dated 2008, the head surface is equal to 22,1 m^2, a quite low value if compared to the national mean. This surface presents the 45% of private areas, 30% of escarpments and the remaining 25% of lawns, as the following graph shows.



Graph 1. Green belts typologies in Potenza.

Currently the only planning instrument is the *Regulation of the public and private parks* edited in 2004, containing predominantly conservative prescriptions, as the pruning and felling modalities, with sanctions in case of non-commissioned interventions. Besides the struggle phytosanitary has disciplined on the strength of a preventive logic, promoting the adoption of not damaging means and products.
Subsequently a management analysis of the public parks carried out, in order to verify the figures which effect it and the implementation modalities. Since 2006 the city green patrimony management is of municipally competence and has been committed to the

cooperative society "Città Verde", composed by twelve member-workers and an employee; the remaining part has been managed by cooperatives engaging in the care green of the schools and the leisure centres, from the forest workers managing the peripheral city areas and from the useful socially workers. Specifically Città Verde society performs the grass and hedges cut, pruning and felling trees.
Although the municipally has a Regulation, it is lacking in a planned program of interventions relating to all city green belts in the same manner. The maintenance interventions are limited to the emergency, due to meager disposal funds.

Figure 1. Workers of the "Città Verde" cooperative at work.

With regard to the wastes deriving from the public parks maintenance the survey pointed out such as these has been accounted as a whichever urban waste, because after the picking they have been transported to apposite garbage bins posted in several city zones, where reach all typologies of urban solid wastes too. From here the material has been transported in the regional dumps placed from some tens kilometres to about an hundred, because the city dump is saturated and act as station where the material remains waiting for the transport in the regional dumps. Consequently the storage, disposal and transport costs are equal to 160 €/t, upon which weigh heavily on the transport cost.
From here rises the idea to create a city-wood-energy chain in order to recover the wood fraction to transform in chips, for a final energetic use, reducing considerably the costs that the municipally meets now, fusing the economic and environmental benefits.
The city-wood-energy chain expression indicates the organised altogether of the production, transformation, transport and utilization wood factors for the energetic purposes and in the urban environment specific case we must consider the operations beginning from the recover of the maintenance material (deriving from felling, pruning, lower branches lopping, etc.) until the wood transformation in a material suitable for the heat and electric energy production and the final use in appropriate boiler.
In order to evaluate the organization of the yard to obtain a low cost chipping, we used the ChipCost software, making possible the simulation of several chipping yards with different mechanization degree.
This program requires data entry as the weight of the middle piece for chipping, the power and cost of the chipper, the amortization period, the use of the chipper and the possible tractor connected, expressed as number of work hours per day and days number per year. These and other information have been used, from the software, to calculate the gross and net productivity (t/h), the yard cost (€/h), the chipping cost (€/t) and the chips quantity to work annually in order to remain in this cost.

Results

In this research we considered several chains: the compost, panel, chips and firewood chains, evaluating their advantages and disadvantages. The choice of a chain in respect to another has been effected considering firstly the starting material characteristics, the presence of a demand for the produced typology biomasses and the distance of the energy plant, that should not go over 40 Km in order to an economic convenience.
The first typology chain provides the compost, like final product, obtained by a transformation and stabilization process of organic waste. It has employed as organic fertilizer for its beneficial effects on the soil, because assures an adequate bringing in organic substance, improving the fertility and containing the erosion phenomenons.
The public parks maintenance wastes with the crop residuals represent the so-called green fertilizer compost, different to the mixed fertilizer compost including the organic fraction deriving from the diversified harvest, agro-industrial activities, wood and textile processing and the animal wastes.
In an hypothetical energetic chain the waste deriving from the maintenance operations would has carried from the yard site to the composting plant. This chain would allow a total disposal of the material, with a marginal recourse to further subordinate processing, but disposal costs would support without the possibility to obtain proceeds.
The panel and chips chains envisage both the woody waste chipping with appropriate machines, the chippers, cutting into small pieces the material by a cut perpendicular to the fiber. The product obtained consists by parallelogram-shaped scraps, called "chips".
In the first chain the material would has chipped after the harvesting and transported to the panel industries, avoiding to undergo seasoning treatments. In this manner the total wastes disposal and the chips sale would execute, without to support storage costs and the material transport would be more easy thanks to low volume and the fluidity of the chips. The proceeds obtaining depend to the yard mechanization degree, to the presence of a chips market for panels, to the existence and distance of the panel industries.
The chips chain foresees the use in small-sized heat plants, such as domestic boiler, netting district heating or cogeneration plants. The economic convenience depends primarily on the mechanization degree and the presence, in a limited range, of chips heat plants.
The heterogeneous raw material represents a critical point and prevents a precise chips characterization, as the normative foresees.
In the firewood chain is necessary to separate the wood fraction from the material deriving from the maintenance operations, in order to effect the sale as combustible. For the equipping wood the yard needs to a log-splitting machine for the wood pieces of greater size. Therefore this chain involves processing quite high cost, compensated by the combustible sale price, higher as regard to the chips price. During the processing a waste quantitative has produced.
Starting on the main energetic chains comparison we come to the conclusion whereby the chips chain is the most appropriate choice, considering the total recovery of the waste material thanks to the whole tree introduction in the chipper, avoiding the preliminary equipping operations with a gain come from the biocombustible sale.
In the two hypothesized yards we presuppose the employ of a drum chipper that represents the most adequate typology to work an heterogeneous material, like that deriving from the public parks maintenance.
The chipping yards hypothesized have composed by:

- ***yard n.1*** → a drum chipper with the operative capacity equal to 15-20 m^3/h, mounted tractor of 48 kW. The members of staff are three: the first worker placed in the tractor, the second responsible to introduce the wood material in the chipper and the third for the management operations of loading and unloading chips;
- ***yard n.2*** → a drum chipper with autonomous diesel motor of 94 kW and a productivity per hour equal to 20-25 m^3 , equipped by an hydraulic crane with a lift capacity of 300 kg and a length equal to 4,20 m. The workers number is two: the first for the timber loading by crane and the second for the chips unloading.

In order to guarantee the safety we avoid the chipping yard equipping in correspondence to the maintenance yard, instead in a square situated in an easy reachable and central zone, to reduce the transport costs.
The ChipCost software applied to two yards provides these results:

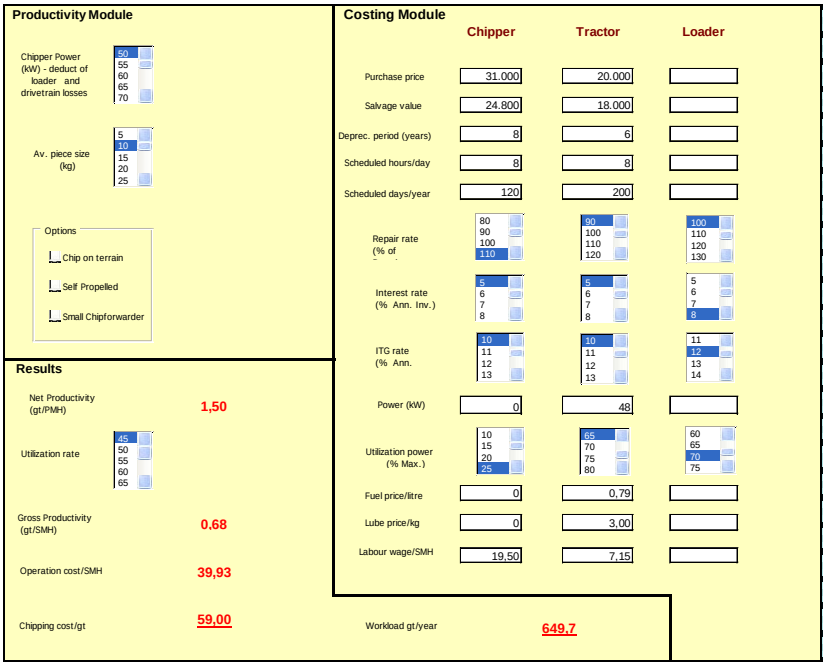


Figure 2. ChipCost applied to yard n.1.

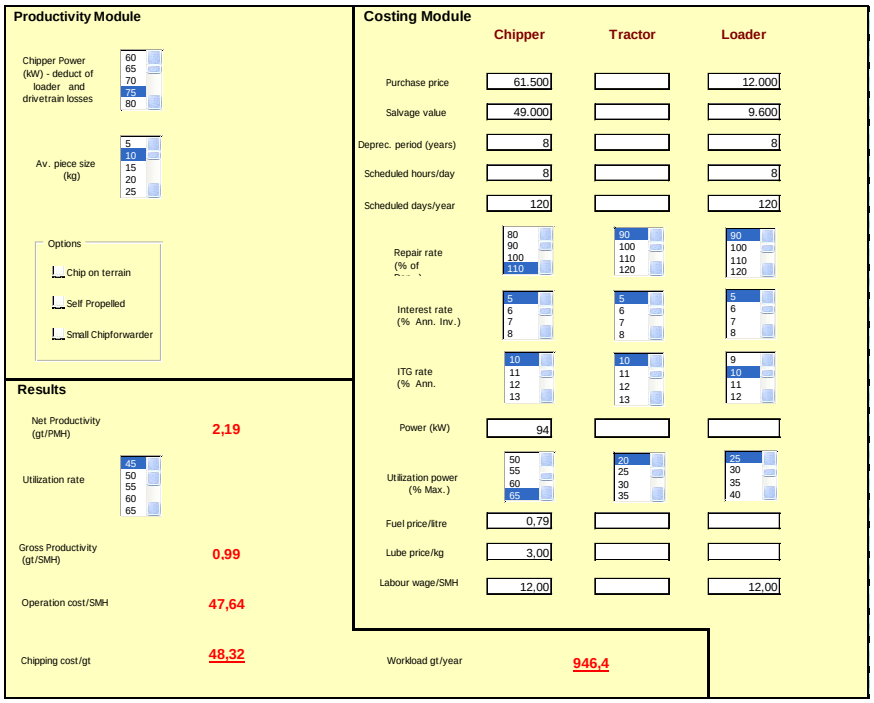


Figure 3. ChipCost applied to yard n.2.

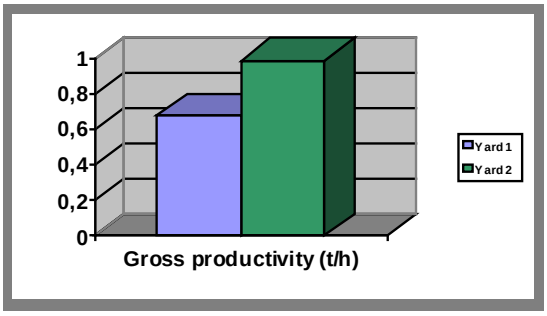
The following table resumes the main results deriving from the ChipCost applied to the chipping yards, characterized by a different mechanization degree.

Table 1. Comparison of the ChipCost results.

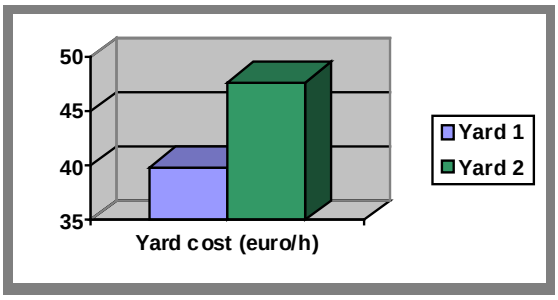
	YARD 1	YARD 2
Net productivity (t/h)	1,50	2,19
Gross productivity (t/h)	0,68	0,99
Yard cost (€/h)	39,93	47,64
Chipping cost (€/t)	59,00	48,32
Biomasses worked (t/y)	649,7	946,4

From the comparison between the yards hypothesized results as the yard n.2, with a high mechanization degree, guarantees a gross productivity, including the dead times, equal to 0,99 t/h , of 45% more high as regards to the productivity obtaining from the yard n.1, with a low mechanization degree (graph 2).

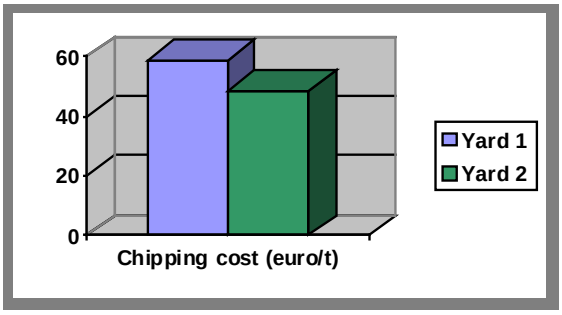
In the first yard the chipping cost is equal to 59 €/t against 48 € of the other yard (graph 4); 649,7 tons per year of chips needs to work in the first case and 946,4 tons in the second case, in order to avoid that the cost obtained exceeds the cost shown from the software (graph 5); quantitative obtainable by a regular management effected during all the year round and regarding all city green belts, included the most marginal areas.



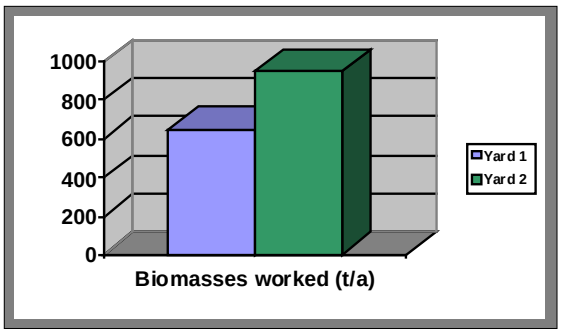
Graph 2.Gross productivity.



Graph 3. Yard cost.



Graph 4. Chipping cost.



Graph 5. Biomasses worked.

From the results obtained, the yard 1, with a low mechanization degree, represents a right compromise between productivity and costs of chips production. These costs would be very low in respect to expenses supported by municipally for the storage, transport and wastes disposal, including the public parks residuals too and the gain deriving from the sale of the chips produced needs to consider.

Conclusions

The public parks should have considered for its positive effects on the human health and as potential biomasses source. The wastes deriving from the maintenance operations have considerable energetic potentials to exploit and to constitute a source gain.
The public parks normative in force, for several aspects, is lean and has the aim to improve the environmental and recreational functions, preserving the green belt existing and planning new green areas, but there is not a national action plan concerning the energetic recovery of the wood wastes.
In Potenza city, at present, this material follow the same destination of the urban solid wastes because it has been transported to dump, meeting the transport and disposal costs, weighing on the municipal balance.
The chips chain results the most appropriate, from the analysis executed, because allows:

- to use totally the material deriving from the maintenance operations, without the further waste production, since the whole plant can be introduced in the chipper, avoiding the equipping operations;
- to obtain as product the chips, extremely manageable and, thank its fluidity, able to reduce the apparent volume of the starting material and the transport costs;
- to support the cost chipping principally, very low as compared with disposal costs.

In this way the waste biomasses retrieves its "identity" of resource, to improve and the chain hypothesized would represent a motivating force to manage the public parks efficiently, in virtue of the gain obtainable and would be an incentive to invest in this direction, considering the environmental positive outcomes.

Rerefences

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Each author contributed in this paper in same measure