ENVIRONMENTAL ASSESSMENT: ENVIRONMENTAL ANALYSIS OF THE BELEAF PRODUCT

Introduction

The **Euro-Mediterranean Centre for Climate Change (CMCC)**, in collaboration with **WWF Italia**, has conducted a study analysing the environmental impact reduction that the **Beleaf** company (hereinafter Beleaf) has managed to achieve through an innovative production process for panels and veneers that replaces the use of wood material from offcuts or forest plantations with fibres extracted from banana cultivation waste.

To obtain the necessary data for analysing the reduction in greenhouse gas emissions, the CMCC used questionnaires, which provided qualitative and quantitative information on the process for supplying and transforming the raw material. The data was then processed using the 'Life Cycle Assessment' (LCA) technique.

In detail, the work quantifies and analyses the reduction in climate-changing gas emissions connected with the production process of the Beleaf product compared with the MDF (Medium Density Fibreboard) panel industry and that of wood veneers.

General framework

The Beleaf company selected about 240 ha of banana cultivation land for the supply of the biomass waste. The selected land belongs to family-based growers possessing limited cultivation units of 1 or 2 hectares. The planting layout used in the plantations varies from 1400 to 2200 per ha, according to the type of cultivar grown. An average planting density of 1800 plants/ha was considered for the assessment purposes of the study. The banana pseudostems cut during the year are taken from each of these plantations. The banana leaves and tap roots are not collected, but are left in the field for plantation maintenance as a natural fertiliser or for surface use as a mulching material. Unlike these, the pseudostems are not used but are discarded in marginal lands, buried or scattered.

This excess biomass is never burnt, due the high water content of the banana plant (90% or higher). The disposal of large volumes of biomass on the land gradually leads to a process of natural decomposition, which, on the one hand, causes a stable and lasting return of organic substance to the soil (humic soil substances). On the other, it leads to anaerobic decomposition processes (fermentation), with consequent emissions of methane (CH_4).

Acquisition of this local awareness of the rich potential of unused banana stems led to the development of the Beleaf project.

The Beleaf veneer production uses 35% of the biomass; with production of simil-MDF panels from banana fibre, the remaining material (65%) is used, once it has been suitably chipped.

Method

The environmental impacts considered in the analysis of the production processes for the panels and veneers were measured using the life cycle analysis (LCA), through the following indicators:

1- Global Warming Potential (GWP), or greenhouse gas emission factor (avoided or generated by the processes), expressed in $kgCO_2$ equivalent. The two production chains are compared in order to define the quantity of greenhouse gases emitted in each production phase.

2- Ecological footprint, expressed in terms of land occupation (in m^2/year)

The LCA analysis of the Beleaf products did not include the activities carried out upstream from gathering of the biomass in the impacts, i.e. the agricultural practices connected with the plantations, as these generate impacts which are totally attributable to the banana growing activities.

Results

The LCA analysis indicates that the greatest contribution to greenhouse gas emissions due to the Beleaf production process is from energy consumptions for operating the machinery (90%), whereas the emission contribution due to the use of adhesives and chemical substances is notably reduced (or eliminated for certain products) thanks to the presence of natural banana resins. The Beleaf production chain does not use water resources during the process. The high water content of the banana fibre makes use of this resource unnecessary, whereas it is indispensable in the case of wood products.

Panels

The greenhouse gas emissions connected with the production of a square metre of MDF panels amount to 499 kg CO_{2eq}. On the other hand, a cubic metre of BELEAF panels produces 340 kg CO_{2eq} in emissions, due to energy consumptions and the need to supplement the banana resins with a limited quantity of other adhesives.
The difference in emission between the two processes is 0.16 tCO_{2eq}/m^3 for each cubic metre of panel produced, corresponding to a 32% reduction in emissions for the Beleaf product in comparison with the production of a cubic metre of MDF panels made from wood.

Veneers

The largest emission contribution in the industrial process for the manufacture of veneers is from the energy consumption for the transport and production phases. With Beleaf veneers there are no emissions due to the use of adhesives and chemical substances, since the banana fibre veneers benefit from the presence of natural resins that completely replace the synthetic adhesives used in the industrial processes based on wood. The difference in emissions between the two processes is 0.15 tCO_{2eq}/m^3, a figure which therefore indicates the quantity of CO_2 avoided by the Beleaf production process in comparison with the conventional production process for wood veneers. This difference corresponds to a reduction in greenhouse gas emissions of 58% by Beleaf.

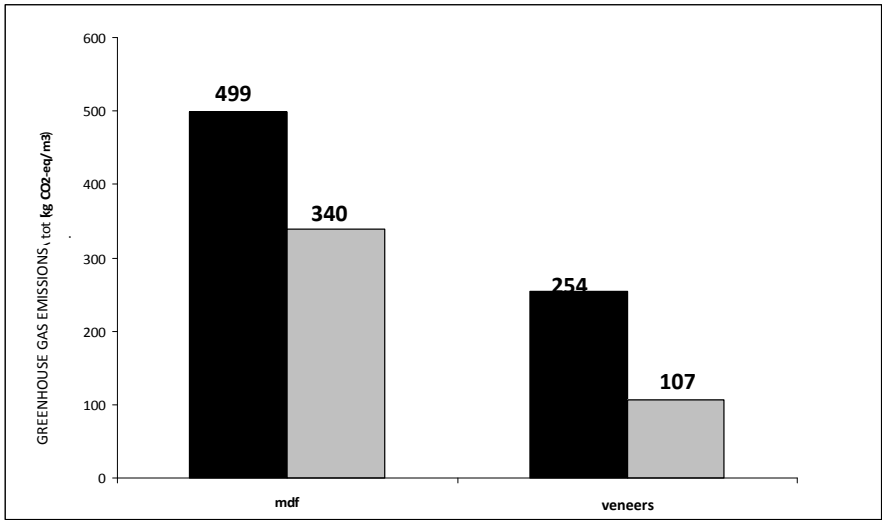


Figure 1: Comparison of emissions ($kgCO_{2eq}$ /m^3) between conventional MDF panels (in black) and banana fibre panels (in grey), and wood fibre veneers *vs* Beleaf veneers

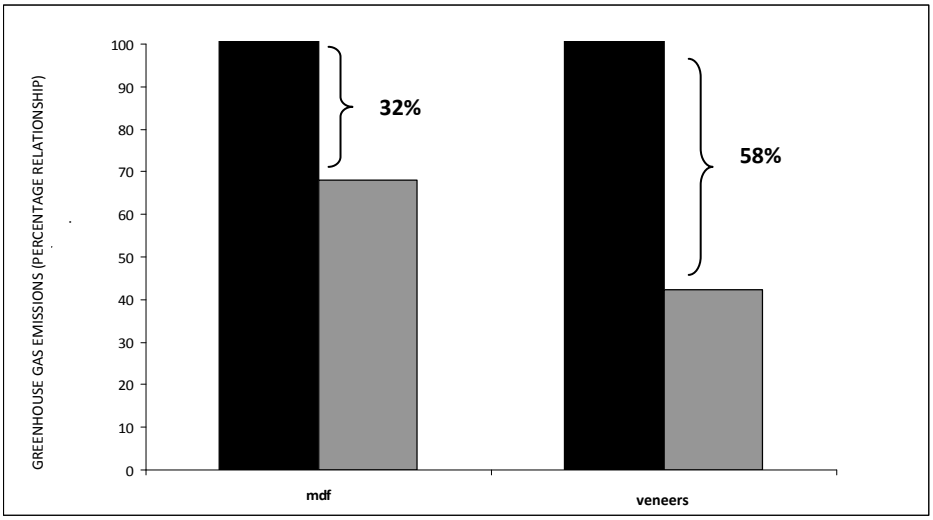
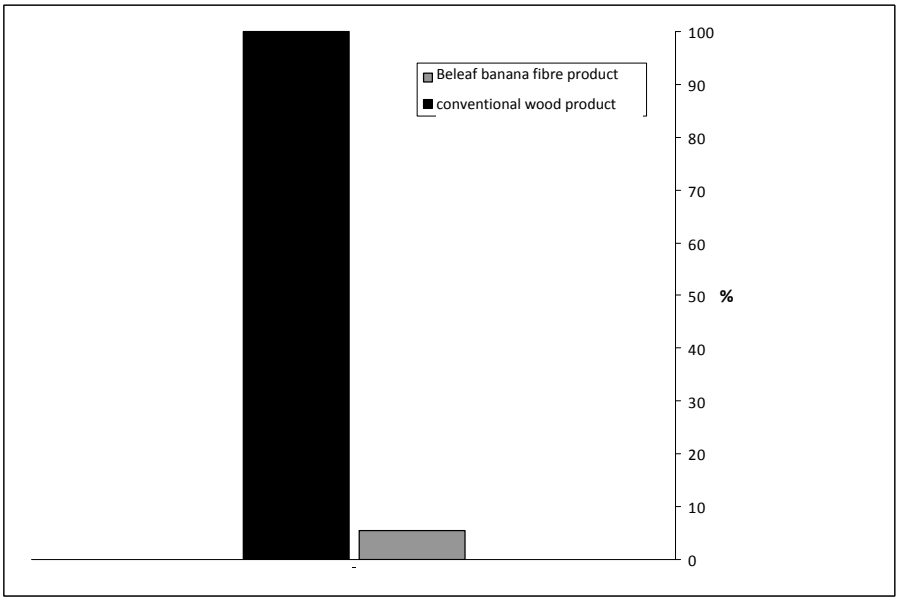


Figure 2: Comparison of emissions (%) between conventional MDF panels (in black) and banana fibre panels (in grey), and wood fibre veneers *vs* BELEAF veneers

The study was completed by the application of an ecological footprint indicator, expressed in the LCA analysis as "**land occupation**". This indicator represents the portion of planet Earth's surface required each year to absorb and eliminate the environmental impact generated by a production process. The ecological footprint of a cubic metre of Beleaf product is 6.5 m^2 $year^{-1}$, whereas an impact of 129 m^2 $year^{-1}$ is estimated for each cubic metre of wood veneer produced and 626 m^2 $year^{-1}$ for each cubic metre of wood MDF panel.

The difference in impact between the Beleaf production process and the conventional process based on wood raw material is **more than 90%**, with a minimum difference between the **types of product manufactured**. This is due to the use of waste plant biomass, which avoids: depletion of primary resources from forestry, deforestation phenomena and/or soil occupation, in the case of supply from forestry plantations for the production of marketable wood raw material for multiple uses.



Conclusions

To conclude, the advantages provided by the Beleaf production processes are both environmental and social.

Beleaf has introduced on the market a completely recycled alternative raw material for the production of products that were previously made with wood raw material. This has helped to develop new market niches for a waste product that produces a direct environmental benefit due to reduction in greenhouse gas emissions, thanks to non-use of adhesives and chemical pollutants in the case of veneers, and a much reduced use of these in the case of the panels.

In its choice of sites for gathering the raw material, Beleaf has excluded land managed by multinationals, giving preference to small land owners with family-based farming management. The industrial activity has also created new jobs in an area of the south of the world in which employment choices are limited and contributed to increasing public awareness of the topics of environmental sustainability and containment of global warming. Finally, this activity has many features that would allow it to be transferred and extended to other countries with a high level of banana production, as it is a production process that can easily be replicated due to the simplicity of the developed processing chain and the limited need for energy inputs.