Public summary Wrap or Waste

Case study ‘Sustainability of paddy straw pulp packaging’

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Many companies in the food sector are faced with dilemmas in their search for more sustainable packaging. They are faced with questions such as: Which package is more sustainable under which conditions? How do you compare various types of packaging regarding sustainability? The Greenery and Bio4Pack asked these questions regarding a new type of tray based on paddy straw pulp that can be used for strawberries. In particular, they asked whether this tray a more sustainable alternative than the usual PET tray or paper pulp tray. This case study was part of the PPP project Wrap or Waste involving researchers from Wageningen University & Research (WUR) with funding from TKI Agri Food and the companies involved.

Approach

The researchers developed a calculation tool to quantify the sustainability effects of various types of packaging. This makes it possible to clarify the differences in sustainability effects between packaging alternatives for a specific product. The CO_2 impact of the entire production chain for the packaged product was calculated, including possible effects of the packaging on the shelf life and quality of the product. The analysis also quantified factors such as recyclability and the risk of litter for each product-packaging combination. Scenarios were also used to determine the sensitivity of the calculation for various assumptions, such as the share of renewable energy used to produce the material and whether a specific type of packaging is actually recycled.

Figure 1 The three types of trays for strawberries that were compared regarding various sustainability aspects (from left to right PET, paddy straw, paper pulp).

Experimental steps

Material properties

The paddy straw tray is manufactured from rice crop residues (the leftover paddy straw). The current study focused on the technical validation of the recyclability of the material in paper recycling.

Process description paddy straw trays

Bio4Pack and the tray manufacturer (Ramaness/Free The Seed Sdn. Bhd., Malaysia) mapped out the production process of the packaging. Based on the available information, the researchers also determined the energy and water consumption per process step. The results of this analysis were subsequently used for the sustainability analysis and laid the foundation for the scenarios.

The effect of tray type on strawberry shelf life

To determine whether the type of tray influences the shelf life of the strawberries, an experiment was conducted with the paddy straw tray, a paper pulp tray and a PET tray as reference packaging. To simulate a retail situation, strawberries from three different growers were displayed at a controlled temperature (12°C) and the product losses on various days were determined. The losses after four days served as input for the sustainability analysis, as this period most closely corresponds with an actual retail situation.

Figure 2 The three types of trays during the shelf life experiment (left). The trays were filled with strawberries mixed in crates. 'Blind' assessment (without seeing the tray) of good quality strawberries and the percentage of strawberries in a tray that would no longer be eaten.

Analysis – calculation tool

CO_2 impact calculations were performed using data supplied by the companies involved, supplemented with estimates based on literature and expert knowledge, numerical data from the Ecoinvent database[1], and data from the shelf-life study.

1 Ecoinvent 3.6 database with the IPCC 2013 GWP 100a method

Case study results

The new paddy straw tray can be a sustainable alternative.

The calculated CO_2 emissions in the reference scenario showed that the net emissions (per kg of strawberries consumed) were comparable for the three types of trays. For the paddy straw tray, the reference scenario was based on the avoidance of emissions that normally occur when the rice straw is burned in the open field instead of being collected. Compared to the PET tray, this scenario resulted in fewer total CO_2 emissions (92%). However, the production of the paddy straw tray itself currently requires more energy than the other trays. See Figure 3.

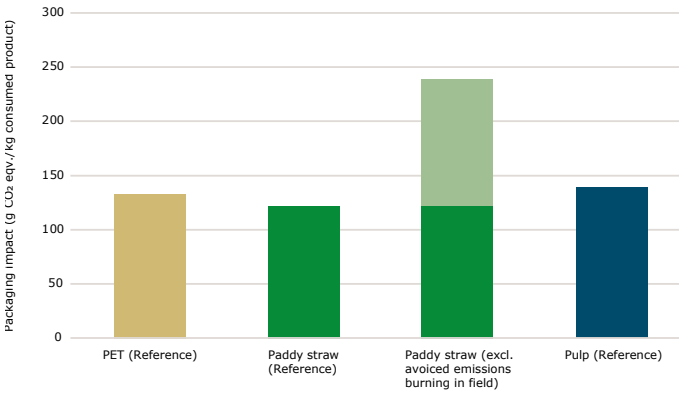

Figure 3 Result analysis of CO_2 impact calculated per kg of strawberries consumed related to the packaging (PET, Paddy straw, Pulp). For the reference scenario of the paddy straw tray, the CO_2 emissions avoided by not burning rice straw in the field have been included. The second scenario shows the result when these avoided emissions are not included in the calculation. The large difference shows that the analysis is sensitive to this factor.

Type of energy and recycling percentage are crucial to the CO_2 impact of packaging

The calculated CO_2 emissions for all three trays appear to be highly dependent on the energy source actually used in the packaging production process (renewable, gas, coal, etc.) and also on the recycling percentages actually achieved (Figure 4). Failure to recycle (orange scenario) resulted in a sharp increase in CO_2 emissions in each scenario. Using more renewable energy (expected in 2025 and 2035 for the country of origin of the paddy straw trays; scenario EM2025 and scenario EM2035) resulted in a reduction in greenhouse gas emissions of up to one-third. Due to the use of renewable and/or cleaner energy or the actions of individual companies, a similar effect is possible in the countries where the PET and paper trays and their raw materials are produced.

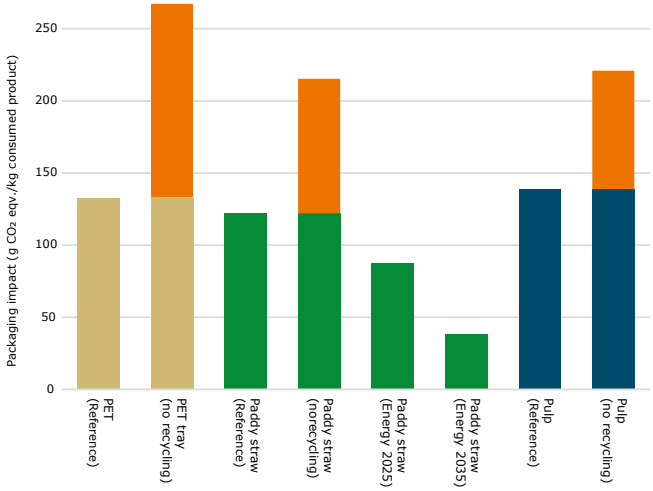

Figure 4 Result analysis of CO_2 impact calculated per kg of strawberries consumed related to the packaging. The reference scenarios are shown for each type of tray (PET, Paddy straw, Pulp). In addition, the sensitivity to actual recycling can be seen in the scenarios without recycling (orange). Two future energy scenarios have also been calculated for paddy straw (2025 and 2035) in which more renewable energy is used in the production process.

No effect of type of tray on shelf life, but product losses contribute to CO_2 impact

The results of the shelf life study confirm that strawberries have a limited shelf life and that the amount of loss after 4 days at 12°C varies greatly between growers and production methods. This aspect also contributes to the total calculated CO_2 impact of the product-packaging combination. See Figure 5. However, no meaningful relationship was found between the type of tray and the percentage of product loss. In this regard, the choice of packaging material is not a factor in relation to the sustainability impact.

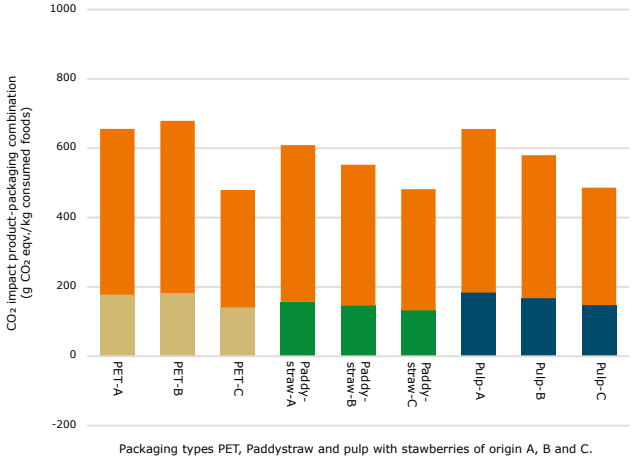

Figure 5 Calculated CO_2 impact of the product packaging combinations, PET, paddy straw and pulp, originated from growers A, B, C. The CO_2 impact is divided in a part related to the packaging and a part related to the product (Orange). Product losses, determined during the experiment after 4 days, are included in the calculation.

The paddy straw tray is technically suitable for paper recycling

The current study confirmed the results of two previous studies that the tray is suitable for paper recycling. These studies were conducted by the Kenniscentrum Papier en Karton (Paper and Cardboard Expertise Centre) and the Papier Technische Stiftung in Germany.

Circularity and prevention of litter

The paddy straw tray and the pulp tray scored similarly and better than PET scale on various other sustainability indicators such as recyclability, material circularity and the prevention of litter. The recycling of PET trays is still in under development in the Netherlands, while the used paper recycling system is fully developed. In the unlikely event that the trays end up as litter, the pulp trays will disappear after a few rain showers, while PET trays will remain intact for decades.

Table 1 Selection of sustainability indicators for the three types of trays. The most positive value per indicator is shown in green.

	PET tray	Paddy straw tray	Pulp tray
Recyclability indicator [%]	88%	**94%**	**94%**
Litter prevention indicator [%]	75%	**98%**	**98%**
Material circularity indicator [%]	45%	**93%**	**93%**

Conclusion

The paddy straw tray is a sustainable alternative if 1) the avoided emissions from not burning the rice straw in the open field are included in the sustainability analysis, 2) the energy for manufacturing the trays is renewable and/or clean and 3) the used trays are recycled. The tray is suitable for inclusion in the current recycling stream of the paper industry.

This case study has shown that it is possible to compare various packaging scenarios and analyse various sustainability aspects on the basis of the data that was collected and the calculation tool that was developed. The analysis showed a nuanced picture in which the actual sustainability of the alternatives depends on the context in which the packaging is produced, used and processed. The quantitative results from the project can be used by companies to make well-founded decisions about sustainable packaging choices. The PPP Wrap or Waste contributes to a more sustainable society.

More information

For more information about the approach and results of this study, please contact Wageningen University & Research or visit the PPS Wrap or Waste website.

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