Agrivoltaics Solutions in the Context of Circular Agriculture and Landscape Experience. A Systematic Review

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1. Abstract

The world is facing considerable challenges while aiming to reduce greenhouse gas emissions by means of transitioning to renewable energy and circular agriculture (CA). There are concerns applicable to both transitions, for example scarcity of land, decrease of landscape experience, conflict between food and power production and consequently public opposition to those transitions. Solar energy presents a key energy source, giving rise to innovative Agrivoltaics (APV) technologies that combine agricultural with solar power production. APV projects are being developed and studied worldwide, propelling yield performances and various technological innovations. However there is a clear lack of knowledge on the (potential) environmental impacts caused by APV and, in particular, on CA and landscape experience.

The first aim of this study is to summarize the current scientific literature and to provide an overview of APV cases in terms of CA and their incorporation into the landscape. The second aim is to define CA aspects of Dutch APV cases and characterize landscape users' experiences of them. The focus of the study is the Netherlands due to increased number of APV cases and their high potential in accelerating energy transition. Our study proposes guidelines for future APV projects, aiming to contribute towards CA and enhancing the landscape experience to support both the social acceptance and progress of the energy transition.

In this systematic review, we examined peer-reviewed papers listed in literature databases Scopus and Web of Science, published up to January 2022. Due to scarcity of peer-reviewed literature on APV in the Netherlands, we additionally included grey literature. We complemented the systematic literature review with field work and interviews with researchers from Dutch organizations for applied scientific research and designers of frontrunners' APV systems. Firstly we identified the aspects of CA and experiences of landscape users in APV cases worldwide based on the critical performance indicators of CA and spatial properties of landscape experience [1], [2]**.** Secondly, we conducted a systematic analysis of 15 frontrunner APV projects in the Netherlands by studying spatial properties such as, among others, visibility and public accessibility.

The results show that three critical performance indicators of CA, (1) production of renewable energy, (2) reduction of greenhouse gases and (3) nature conservation, are found in 68% of APV cases in the world. The remaining seven critical performance indicators of CA are distributed across 30% of the studied APV cases. Visibility is reduced in all Dutch APV, with an average reduction of visibility by 48% along the perimeter of the site. Only one Dutch APV case is accessible for public, whilst nine are open upon request and four are not accessible.

This study provides valuable guidelines for advancing both transitions towards renewable energy and circular agriculture based on the knowledge gained from built APV projects worldwide. The guidelines present necessary guidance for policy makers and designers that opt to develop APV project while contributing to both CA and landscape experience.

2. References

[1] H. Dagevos and C. de Lauwere, “Circular business models and circular agriculture: Perceptions and practices of dutch farmers,” Sustain., vol. 13, no. 3 (2021) 1–15.

[2] D. Oudes and S. Stremke, “Next generation solar power plants? A comparative analysis of frontrunner solar landscapes in Europe,” Renew. Sustain. Energy Rev., vol. 145, (2021) 111101.