Challenges and potentials of Agrophotovoltaic in Germany

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Introduction

Adaption to increasing extreme weather events as a result of climate change will be a challenge in particular for farmers. To face climate change, the expansion of renewable energies is being supported by German policymakers. In order to achieve the goal of Germanys emission neutrality until 2045, the expansion of Photovoltaic systems (PV) must be increased by a factor of 6 - 8 (Fig. 1). However, they require a huge amount of land. Agrophotovoltaic (APV) is the combined use of land for the generation of solar electricity and agricultural production on the same field. Nowadays, this new concept is expanding worldwide: Whereas in 2012 the obtained capacity was 0.005 Gigawatt peak (GWp), by 2021 it had already reached 14 GWp In Germany, the use of APV is still at an early stage. Since 2013, there have been several research studies investigating its use in Germany.

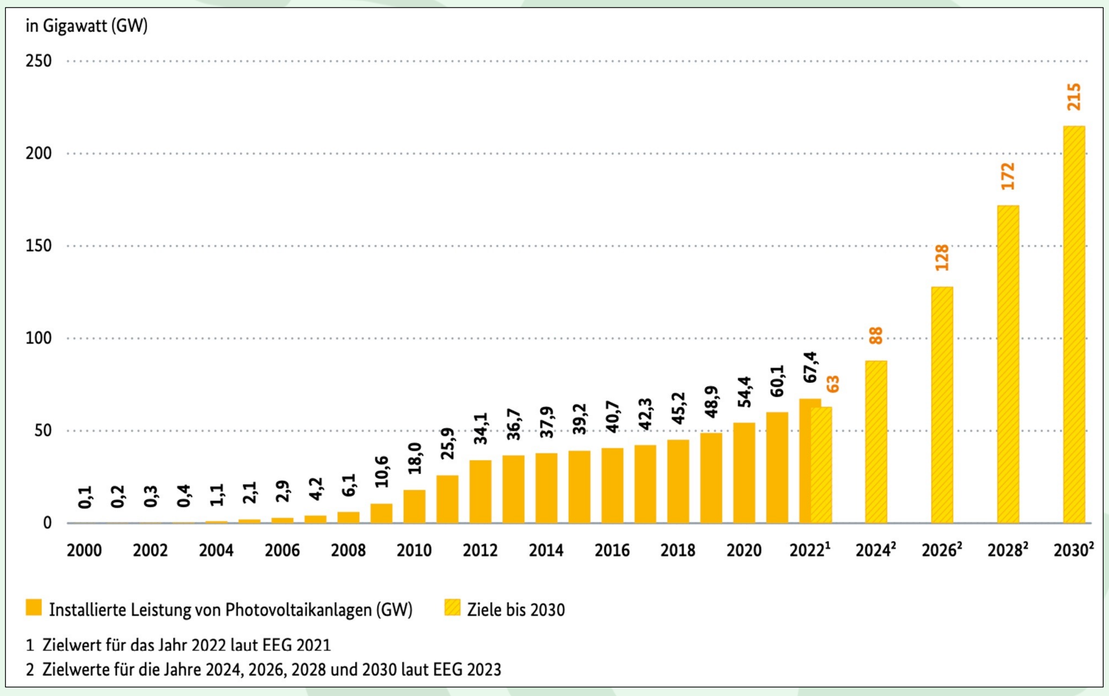

Fig 1: Capacity of installed photovoltaic systems in Germany until 2022 and the expansion targets of the Renewable Energy Sources Act (EEG) 2021 & 2023 up to the year 2030 (BMWK 2023).

Results

The current state of research indicates several advantages for APV regarding climate adaptation. For once, solar panels have a protective effect against extreme weather conditions such as heavy rain, hail and heat waves. Additionally, APV can prevent land-use conflicts and increase the soil productivity. The pilot project APV-RESOLA conducted by the Fraunhofer Institute in Germany shows that APV led to better crop yields up to 12 % during the drought year of 2018 compared to the reference field (Fig. 2). Especially, potatoes and celery grow better under APV in dry weather conditions. In contrast, the grass yields turned out negative in both investigated years. Moreover, losses were reported in 2017 for all crops investigated in the study. Another problem are toxic substances used in photovoltaic panels that are also concerning.

Discussion

The research results indicate that the years 2017 and 2018 led to different crop yields (Fig. 2). These findings highlight the protective function of APV on soils under dry weather conditions. However, due to the small number of studies, no general statements can be made on the impacts of APV on crop fields in Germany. The efficiency of APV depends on the particular APV system, geographical differences and crops. Furthermore, the impact on biodiversity cannot be predicted at the moment. Finally, it can be concluded that APV can be a potential method for adapting to climate change if it is used in appropriate regions with suitable crops. However, there is a need for more research on the impacts of APV on the growth of different crops in different climatic regions.

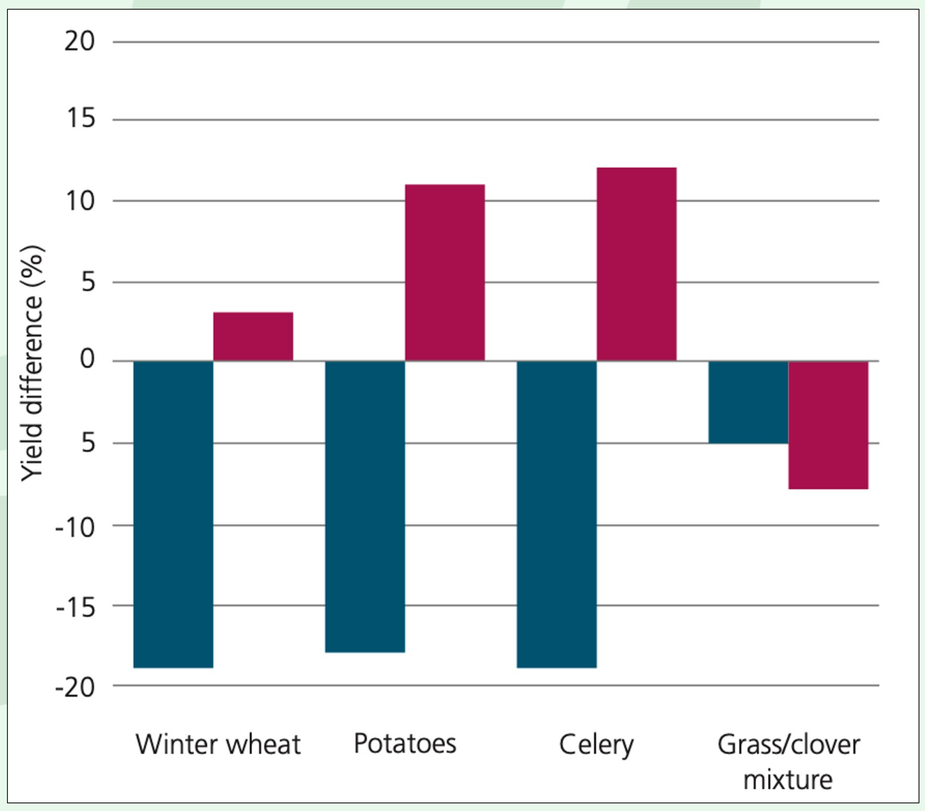

Fig 2: Results of the pilot project in Heggelbach: Crop yields under Agro-Photovoltaic (APV) compared to the reference field. 2017 blue, 2018 red. (Fraunhofer ISE 2022).

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Literature

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