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"Global food security and food safety:
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Analyzing Drought Impacts on Tomato Producers in Ghana and Morocco by Using System Dynamics Modelling

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Abstract

In a world characterised by globalisation of agricultural markets and climate change, farmers are increasingly exposed to various types of stresses and shocks. For example, drought is a shock which is increasingly challenging the availability of water in countries like Morocco and Ghana. In both countries, tomatoes are produced in large quantities and require a significant amount of water. While in Morocco tomatoes constitute one of the main agri-food export commodities, the Ghanaian farmers produce entirely for the domestic market. In a comparative study, we analyse whether an export-oriented production system (Morocco) is more resilient against drought versus an agricultural production system that is serving only the domestic market. We do this by analysing the direct cascading impacts (yield and income changes) of a drought shock which occurred in both countries in 2016. For this analysis, we use system dynamics to display the causal links that explain the effects of a drought across different tomato production systems. We compare the effects of this climatic shock on tomato production in greenhouses and open field as well as compare bigger producers versus smallholders. The results of this study show that producers in Morocco who are producing for export markets and have a more mechanised tomato production with a yield reaching 220 $^{t}/_{ha}$, generate greater income and are most resilient to extreme weather events. In contrast, smallholders who mostly rely on rain for irrigation of their open fields are less capable to absorb the impacts of drought and produce down to four times less (around 60 $^{t}/_{ha}$). However, export-oriented producers rely largely on the provision of groundwater which means that their production is less sustainable from an ecological perspective. We conclude that export-oriented tomato production is less sustainable, but more resilient against drought due to available technologies which ensure a continuous production of tomatoes regardless of the weather conditions. Finally, we debate whether tomato production systems need to be sustainable in order to be resilient or not.

Keywords: Food systems, Ghana, Morocco, resilience, system dynamics, tomato production

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