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Assessing frost risk perception and adaptation in moroccan orchards: insights from a survey in the fes meknes region

HAJAR MOJAHID¹, THI THU GIANG LUU², OSSAMA KODAD³, EIKE LUEDELING⁴

¹University of Bonn, Inst. Crop Sci. and Res. Conserv. (INRES) - Horticultural Sci., Germany

²University of Bonn, Inst. Crop Sci. and Res. Conserv. (INRES) - Horticultural Sci., Germany

³National School of Agriculture of Meknes, Department of Arboriculture, Fruit Tree Cultivation and Viticulture,

⁴University of Bonn, Inst. Crop Sci. and Res. Conserv. (INRES) - Horticultural Sci., Germany

Abstract

In the Mediterranean region, discussions on climate change impacts on temperate fruit trees often focus on insufficient winter chill. However, farmers in the Fes Meknes region in Morocco report that spring frost events pose an immediate threat to orchard productivity. Understanding farmers' perceptions is crucial for supporting sustainable tree fruit production in the context of climate change. This study assessed how farmers in the Fes Meknes region perceive changes in frost occurrence, what adaptation measures they have implemented, and whether these adaptations are associated with reported income changes. We conducted a survey among 73 farmers to test the hypothesised impact pathway. Among all farmers, 76.7 % (95 % CI: 65.8 % - 84.9 %) reported perceiving changes in frost frequency or severity over the past decade. Of these, 26.8 % reported adapting their production processes. The 23.5 % (95 % CI: 9.6 % - 47.3 %) of farmers who did not perceive any change in frost still implemented adaptation measures. This behaviour may be explained by long-standing exposure to frost risk, recent improvements in access to technology or resources, or external influences such as extension services and peer networks. Understanding the relative importance of these factors will require further investigation. Among the 19 farmers who reported adapting, 78.9 % (95 % CI: 56.7 % - 91.5 %) experienced a positive impact on income, which indicates the potential benefits of adaptation and highlights the need for further investigation with more comprehensive data. Coupling survey results with frost risk projections will inform targeted, climate-resilient adaptation strategies. Participatory planning and enhanced extension services are recommended to support effective adaptation in practice.

Keywords: Agricultural resilience, climate change adaptation, farmer perceptions, frost risk, income impact, Morocco, orchard productivity, temperate fruit trees