Extended Abstract
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Paper Title	The economic relevance of social learning in the context of agricultural climate change mitigation

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Abstract	***200 words max***
Agriculture has a key role in global climate change mitigation. Farmers' decision to adopt mitigation practices depends on their costs and benefits, but is partly also affected by individual characteristics and social networks. Here, we assess the influence of such behavioural factors on the adoption of greenhouse gas (GHG) mitigation measures using an agent based modelling framework including bio-economic optimization. More specifically, we assess how learning from knowledgeable peers influences adoption of four different mitigation measures. In our agent-based modelling approach, we combine farm census, survey and social network data of 50 Swiss dairy and beef farms. The simulation quantifies the effect of social networks on the amount of GHG emissions, farm level marginal abatement costs and total farm income. The results provide a basis to assess advisory services or information campaigns aiming at increasing the adoption of climate change mitigation measures in agriculture.	
Keywords	Greenhouse gas emissions; climate change mitigation; social networks; behavioural factors; agent-based modelling
JEL Code	Q54; Q12; Q15; C61; C63

Introduction	***100 – 250 words***
Agriculture is a considerable source of global greenhouse gas (GHG) emissions. Consequently, reducing these emissions has become a central policy goal in many countries (Horowitz, 2016). To achieve this goal, farmers should adopt mitigation measures. Whether a farmer adopts such measures is influenced by their costs and benefits, farm structural characteristics as well as policy and market environment. Furthermore, adoption decisions are also influenced by individual farmers' characteristics such as control beliefs (Kreft et al., 2021b) and social networks (Kreft et al., 2021a). Here, we integrate these behavioral aspects with economic decision-making in an agent-based modelling approach. More precisely, accounting for farmers' individual preferences, we investigate how social learning among connected farmers influences adoption and associated costs of agricultural mitigation on 50 Swiss dairy and beef farms. Social learning has been widely recognized as important factor for adoption and diffusion of e.g. innovations (Conley and Udry, 2010). Yet, little is known about the economic importance of knowledge exchange within farmers' social networks, particularly in the context of climate change mitigation. The main research questions guiding our analysis are thus: 1. To what extent do knowledgeable peers in social networks increase the uptake of on-farm climate change mitigation measures? 2. What is the effect of social networks on the amount	

of GHG emissions, marginal abatement costs and farm income? Quantifying the effect of behavioral factors on mitigation adoption allows to assess policies aiming at a reduction of agricultural GHG emissions e.g. trough advisory services or information campaigns.

Methodology	***100 – 250 words***

We use the agent-based modelling framework FARMIND (FARM Interaction and Decision-making) to simulate farmers' mitigation adoption on dairy and beef farms in Switzerland (Huber et al., 2021). The decision is simulated in three steps, which allows to align behavioural factors with standard bio-economic modelling. The three steps are: (1) the agent makes a strategic decision based on four heuristics considering behavioural factors and social networks; (2) the agent's decision space is reduced to preferred activities; and (3) the agent chooses a farming activity and the corresponding income in a sub-model. Here, we use the bio-economic farm model FarmDyn (Britz et al., 2014) as a sub-model to calculate incomes, GHG emissions and marginal abatement costs. FARMIND allows to disentangle the relative influence of social and personal versus structural and economic aspects of farmers' mitigation behaviour. The emerging phenomena of our simulations are the amount of greenhouse gas emissions and the changes in total farm incomes due to the adoption decision as well as the marginal abatement costs on farm level. We compare the difference of GHG emissions and income when behavioural factors and social network ties are present to a counterfactual scenario without these factors. Both models are calibrated based on farm census, detailed survey and network data of 50 dairy, beef and suckler farms in a Swiss region (Kreft et al., 2021c; Kreft et al., 2020). We incorporate information on farmers' adoption of four greenhouse gas mitigation measures, i.e. the replacement of imported concentrate feed with legumes, an increase in the number of lactations per dairy cow, the use of emission reducing technologies for manure application (trail hoses) and the introduction of feed additives to reduce enteric fermentation of cattle.

Results	***100 – 250 words***

Preliminary results show that i) The marginal abatement costs of the different farms and between mitigation measures are highly heterogeneous. More specifically, we find marginal abatement costs to range from - 500 to around 13 000 Swiss francs per ton of CO^2eq across measures and farms. The mean costs of the four measures amount to around 500 Swiss francs. The replacement of imported concentrate feed with legumes is the most expensive measure while increasing the number of lactations per dairy cow can even save costs (i.e. may result in negative marginal abatement costs). ii) Given high marginal costs on farm level, the existing policy and market environment alone cannot explain the observed uptake of climate change mitigation measures in our case study region. We suggest behavioural factors and social network effects as important aspect to link to observed uptake, which we will integrate in our model as next step.

Discussion and Conclusion	***100 – 250 words***

Our simulation analysis contributes to a deeper understanding of famers' decision-making in the context of climate change mitigation and allows to assess and compare costs and benefits of policy measures supporting knowledge exchange in farming communities with alternative instruments. We build on a coherent agent-based modelling framework and use empirical in-depth data to shed light on the interactions of social networks with farmers' individual preferences in a given market and policy

environment. Our results can inform policies aiming at a reduction of agricultural GHG emissions.

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