Paper Title	**Effect of biodiversity feedbacks, farmer collectives and social pressure on farmer participation in Agri-Environmental Schemes**

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Abstract	***200 words max***
Sufficient participation in AES schemes is important to ensure a high level of biodiversity. In 2016 a new way of AES implementation has been introduced in the Netherlands. Previously farmers had to apply individually for AES payments. In the new AES system only farmer collectives are able to apply for AES payments and farmers have to apply with the collective. However, the government has set biodiversity thresholds that have to be reached. If farmer participation is too low, this threshold will not be reached and a collective will not be able to apply for payments. We use a multi-objective mathematical programming farm model to analyse if the collective application (2016 AES system) is more effective than the individual application (pre-2016 AES system) in terms of biodiversity delivered and participation in the AES. The interlinked effect of farmers' decisions on biodiversity and the effect of social pressure are taken into account. Results show no effect on farmer participation of the introduction of the 2016 AES system in case we ignore social pressure. If we assume social pressure is stronger in the 2016 AES system due to the collective action element, the 2016 AES system could result in higher farmer participation.	

Keywords	AES, farmer collective, social pressure, feedback, interaction
JEL Code	Q570 Ecological Economics

Introduction	***100 – 250 words***
Due to agricultural intensification shifts have occurred from complex natural ecosystems to simplified managed ecosystems resulting in biodiversity loss. A high level of biodiversity is crucial for ecological services such as pollination, natural pest control and soil nutrient renewal. To prevent biodiversity loss, Agri-Environmental Schemes (AES) have been implemented on European and more specifically Dutch farmland. Unfortunately, low farmer participation and threshold effects for different types of biodiversity are common, resulting in poor biodiversity results of AES. To improve the Dutch AES system a new way of implementation has been introduced in 2016 (2016 AES system) in which only farmer collectives apply for AES payments, whereas previously individual farmers would apply (pre-2016 AES system). In the 2016 AES system payments could drop to zero when farmer participation is too low	

as the collective is obliged to deliver a minimum amount of biodiversity.

The Northern Frisian Woodlands (NFW) contains a landscape of hedgerows consisting of alder belts/wooded banks that separate different parcels of agricultural land. AES payments are provided to maintain these alder belts/wooded banks. We analyse if the 2016 AES system (collective application) is more effective than the pre-2016 AES system (individual application) in terms of biodiversity delivered and participation in the AES. We take the interlinked effects of farmers' decisions on biodiversity, the threshold that requires a sufficient number of participants in the 2016 AES system, and social pressure that might persuade farmers to join the AES scheme into account.

Methodology	***100 – 250 words***

We develop a multi-objective mathematical programming farm model. Utility is the result of the sum of the weights a farmer attaches to each of his objectives (profit maximization, labour minimization, risk minimization and biodiversity maximization) times the normalized value of each objective. The maximization of utility is subject to constraints with respect to livestock, land, feed, manure, labour, risk and biodiversity. Although we apply a mathematical programming model for individual farmers, farmers interact and are linked through feedbacks. One feedback is provided by the biodiversity in the region, which depends on the decisions of multiple farmers. Another feedback takes place through the AES payment. Only if sufficient farmers participate AES payments are provided. Furthermore, our model contains farmer interaction in the form of social pressure to participate in the AES scheme. Not every farmer will be susceptible to social pressure; therefore we divide the farmers into independent and conforming types. Data come from farmer interviews which are supplemented with data from research institutes (i.e. KWIN 2016-2017 and the handbook on the dairy farm sector 2016-2017). The model is applied to nine farmers which are assumed to construct a sub-region within NFW. We study four scenarios. First, a pre-2016 AES scenario in which payment is always provided. Second, a 2016 AES scenario in which payment depends on total farmer participation. Third, a pre-2016 AES social pressure scenario where farmers experience social pressure to participate in the pre-2016 AES scheme. Finally, a 2016 AES social pressure scenario which combines social pressure with the 2016 AES system.

Results	***100 – 250 words***

Labour needed to maintain alder belts/ wooded banks and the farm labour available are decisive whether or not to participate in the AES scheme. Model simulations show that if the AES payment is sufficient to cover the costs of maintaining alder belts and wooded banks, and only a relatively small amount of labour would be needed to maintain these elements, all farmers participate in every scenario. If the amount of labour needed to maintain alder belts increases the number of farmers that are willing to participate in the AES goes down in all scenarios. Interestingly, even in case the AES payments are cancelled due to insufficient participants, the number of participants does not drop further in the 2016 AES compared to the pre-2016 AES scenario. Thus, some farmers keep maintaining their alder belts/ wooded banks even when they are not paid to do so. In the 2016 AES social pressure scenario in case payments are cancelled the number of participants is lower than in the pre-2016 social pressure scenario because there still payments are provided. However, in both social pressure scenarios participation is higher than in in the case of no social pressure. Social pressure might be stronger in the 2016 AES social pressure scenario because farmers fear a cancellation of their AES payments when there are insufficient participants in the scheme. If we simulate an increase in social pressure in this scenario, farmer participation could be higher than in the other scenarios.

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

High farmer participation in AES schemes is important to ensure a high level of biodiversity. If individual farmers apply, AES payments to the farmer are guaranteed. In a collective system AES payments are only available if farmer participation and thus the biodiversity level is above a certain threshold. Once the participation is below this threshold, payments are no longer available. Our results do not show a drop in farmer participation if we compare the pre-2016 AES and the 2016 AES system. Even if payments are no longer available some farmers keep maintaining their alder belts/ woodland. However, if we take social pressure into account farmer participation drops when we compare the 2016 situation with the pre-2016 situation. From this one might conclude that the new AES system does not result in higher maintenance of alder belts and wooded banks. However, it might well be that social pressure increases in the 2016 AES system compared to the pre-2016 AES system, because farmer fear a cancellation of their AES payments when other farmers in the region do not participate in the scheme. If this is indeed the case the new AES system could result in higher farmer participation.