1. Introduction

Sustainability is an ever-growing concern in our society as the negative impact of human action is becoming tangible on a global scale. Sustainable development of our world means a development that meets the needs of the present without compromising the ability of future generations to meet their own needs and encompasses the concurrent dimensions of the 3P approach: Society (People), Economy (Profit), and Environment (Planet). Also, the road towards sustainability in the agri-food sector poses many challenges in achieving sustainable use and production of our renewable resources to protect both the environment and human health.

The Dutch pig sector in particular is confronted with societal and market concerns regarding sustainability, such as concerns about environmental pollution, degradation of biodiversity, animal welfare and food safety. In particular, the segments focusing on animal production have become the object of significant pressure for change. Until around 1997, it was generally thought that the problems of manure and emissions as well as animal welfare could be solved through adaptation by technical innovation accompanied and induced by strict regulations (Bos and Grin, 2008). Policies and regulations set by the European Union put increasing pressure on farmers to adopt innovations related to sustainability issues. Among governments there is great interest in acquiring a better insight into the decision-making process of farmers to adopt such innovations – in the case of this study the decision by farmers to build or not build a stable with sustainability innovations.

Sustainability concerns, however, have provoked innovation in the Dutch pig sector in the last few decades. The innovation process in general involves recognition of needs, articulation of demands, and the design, implementation, replication and upscaling of innovative solutions. The latter stages in particular demand strong entrepreneurial capabilities on the part of the companies involved (Tidd, 2001). It is the purpose of the present study to explore the process of adoption of sustainability innovations in animal production, in particular pig husbandry systems. Such innovations should tackle problems in pig farming related to energy use, manure, emissions of ammonia and odorous gases, as well as animal welfare concerns (stable climate, slatted floors, lack of straw, etc.). The adoption of the innovation and the related investments will depend upon strict regulations, the convictions of the farmer related to the environment and whether the innovation translates into economic benefits to the farmer. Additionally, the decision is influenced by the adopter’s personal and farm household characteristics, and elements concerning the structure of the farmer’s business. The present study will analyse which of the above-mentioned factors has the greatest impact on the farmers’ decision to build or not build a new stable, and in case of building, which influences the choice for either a conventional stable or a (more) sustainable stable.
The structure of this paper is as follows: Section 2 elaborates on the theoretical and empirical considerations for this study and addresses innovation adoption in general and for sustainable pig husbandry systems in particular. Section 3 explains the research framework, the translation of this framework into a questionnaire, and the methods used for data collection. Section 4 first presents characteristics of the research sample. Then the factors that play a role in the decision to build a new stable will be discussed, as will the differences between the farmers who wish to build a conventional versus a sustainable stable and the factors that influence the choice to build a conventional versus a sustainable stable. Section 5 elaborates on the results and presents the main conclusions and implications of the present study, as well as suggestions for further research.

2. Study domain and theoretical background

Study domain: the Dutch pork sector

The present mass production of pork in the Netherlands originates from soon after World War II, and up until early '90s substantial growth was possible for Dutch pig farmers. Especially between 1970 and 1980 the total number of pigs almost doubled. Today, pork is the most widely sold meat in the Netherlands. More than half of the total meat consumption consists of pig meat products.

Due to intensive pig production, the Netherlands faced high groundwater pollution of nitrate and, due to public and societal concerns about pork production, higher welfare standards for pigs became an important issue. Issues such as the safety of pork meat, the living conditions of pigs in the stables, as well as environmental implications of the production methods, contributed to society's decreasing trust in the pork industry.

Research has shown that achieving sustainable development in general offers a number of economic advantages, such as cost savings, shorter lead times and better product quality associated with the implementation of standards (Hanson et al., 2004), as well as increased attractiveness to suppliers and customers, due to enhanced reputation (Ellen et al., 2006).

In the case of the pig sector, a number of drivers for innovation towards improved sustainable production (Nijhoff-Savvaki et al., 2008; Roep and Wiskerke, 2006) should be taken into account:

- Further reduction of risk in the area of food safety and animal health.
- Continuous improvements in efficiency and at the same time the development of structured market-driven innovations for fresh and convenience products.
- Design of a transition trajectory aimed at sustainability of energy use, manure and emissions.
- New means by which the knowledge infrastructure finds an effective match with the private sector.

When looking at the number of innovations that have taken place, the Dutch pork sector has reacted positively to these drivers (Nijhoff-Savvaki et al., 2008): in breeding, innovations can be found at the level of stress-free animal breeds and certification for special bred sows; in feeding, innovations took place to reduce piglet mortality; in finishing, innovations can be found in the adjustment of stables to meet legislative and/or private certification; and we saw innovations related to improved transportation of live animals. As discussed, this paper focuses on innovations at the farmer stage, in particular stable innovations.

Characteristics of innovation adoption

Adoption of environmental policies does not seem to be affected by the same variables as those that affect production and financial decisions (Lynne and Rola, 1988). They argue that income alone is not a significant predictor of, for example, conservation behaviour; a positive attitude to the environment is also required. A more complete understanding of how farmers make decisions is therefore of interest to policy makers in government and to social scientists interested in the determinants of human behaviours (Bergevoet et al., 2004; Edwards-Jones and McGregor, 1994).

According to Rogers (1995) the innovation adoption process is the process by which an individual or other decision-making unit passes from first knowledge of an innovation, to forming an attitude towards an innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision (Frambach and Schillewaert, 2001).

Characteristics of adopters (in this study the farmers) may differ. Those characteristics known to be important in adoption decision-making include age, education, gender, attitude to risk, and personality (Bergevoet et al., 2004; Nkonya et al., 1997; Willock et al., 1999). Characteristics of the farm household, including the presence of a successor and working with employees, are also known to be important in the decision-making process. Several key elements related to the structure of the farm business are also known to have an important influence on decision-
making, including farm type and the farm size (Bergevoet et al., 2004; Potter, 1985). Finally, the structure of the (social) environment has also more recently been identified as important in influencing adoption decisions (Bergevoet and Woerkum, 2006). In the case of farmers, they constantly have to cope with stakeholders from the community they are part of (such as distance to neighbour farms and distance to acid-sensitive areas). Therefore, social skills and knowing how to get access to sources of knowledge are becoming increasingly important for farmers (Gielen et al., 2003).

Finally, while technically the innovation may have superior characteristics, for adopters the increase in the economic viability of the farm is the key issue (Linder, 1987; Reid et al., 1993; Rogers, 1983).

3. Research framework, questionnaire construction, and data collection

Research framework

This study aims at gaining insight into the process of adoption of new innovations in Dutch pig husbandry systems. The factors which are expected to affect the innovation adoption of sustainable stable systems are visualised in the research framework in Figure 1.

We argue that the decision of a farmer to adopt an innovation is influenced by a number of variables. They relate to the adopter’s institutional setting, which highly influences the perceived characteristics of innovation, and thus the decision to build or not to build a new stable. These variables are related to social acceptance, the influence of neighbours, and the influence of external stakeholders (slaughter houses, consumers, environmental groups, sector organizations). In addition, other variables will influence a farmer’s decision to adopt an innovation. These are grouped in adopter (farmer) characteristics and operation (farm) characteristics. Adopter characteristics relate to personal variables (such as age, knowledge), while operation characteristics relate to farm operation variables (such as type, size, location). Jointly these two groups represent the variables that shape the perceived characteristics of the innovation, based on which a farmer decides to adopt an innovation or not; in this case to decide to build a new stable or not and if so, what type of new stable will be built.

Questionnaire construction

In order to answer the research questions, a questionnaire was developed which consisted of thirteen questions. Adopter characteristics were operationalized using questions on age, education, information sources, knowledge of stable systems, availability of a successor, type of farmer (see ‘Data collection and analysis’). Operation characteristics were operationalized using questions on farm size, expected profitability, employees, farm distance to neighbours, farm distance to acid-sensitive areas, meat farm versus non-meat farm (e.g. breeding), farm performance, farm cost efficiency.

Institutional setting was operationalized using questions on (perceived) influence of society on decisions, influence of government or the sector on decisions, social acceptance by community, farm acceptance by neighbours.

Data collection and analysis

Farms with a minimum of 500 fattening pigs were selected from the database of the agricultural service organisation AgriDirect. The questionnaire used for this survey was sent to 1000 farmers in four major provinces in the Netherlands; 329 usable questionnaires were returned, which is a response rate of nearly one in three. From the respondents’ group roughly 50% indicated having plans for building and/or renewing their stables – the other half of the respondents functioned as a control group having no plans to build a new stable in the near future. A non-response analysis was performed by looking at the location of the farmer (province), the number of pigs, as well as the age of the farmer. The results did not show any large differences within the respondents vs. non-respondents group on the variables tested.

A number of tests were performed to analyse the data. First, all variables were inspected: some were transformed (natural logarithm, dummy-variable, ordinal groups), and outliers were inspected and, if necessary, deleted. In all following analyses and models, missing values were excluded list-wise.

Figure 1. Research framework.
For a number of variable groups, a factor analysis was carried out to find the underlying constructs. Principal Component Analysis with Varimax rotation was used.

A cluster analysis was performed in order to find groups/types of farmers that are relatively equal to each other, and relatively different compared with other groups. Based on the standardized scores on the variables a hierarchical clustering has been carried out, and with the dendogram the four most distinctive clusters have been found:

1. The innovative community farmer (high on innovativeness, high on community influence).
2. The independent/self-assured farmer (high on innovativeness, low on community influence).
3. The conservative farmer (low on innovativeness, high on community influence).
4. The traditional farmer (low on innovativeness, low on community influence).

To find the factors that play a role in the decision whether or not to build a new stable, a multi-nominal logistic regression was carried out. A 3 group and a 4 group model was estimated with two different dependent variables. Both are highly significant in the amount of variance they explain (Chi²-values), and have a reasonably high McFadden R-square.

The 3 group model compares:
- farmers that will definitely build a new stable (definite builders);
- farmers that have doubts about building a new stable (doubters); and
- farmers that will not build a new stable (non-builders, reference group).

The 4 group model compares:
- farmers that will not build;
- farmers that are definitely going to build a conventional stable;
- farmers that doubt between a conventional and a modern/sustainable stable;
- farmers that are definitely going to build a sustainable stable.

In addition, in order to find differences between farmers that are definitely going to build a sustainable stable (definite sustainable builders) versus those that are definitely going to build a conventional stable (definite conventional builders), a Mann-Whitney-test has been carried out, as most variables were not normally distributed.

4. Results

The pig industry has been searching for alternative solutions to meet the increasing demands placed by society on pig husbandry systems, and on stables in particular. A representative example includes a stable with a special air-washing system. The air-washer is a machine that blows the air from the stable over a surface with water and sulphuric acid. The ammonia in the air reacts with the sulphuric acid, resulting in clean air that is blown out while the ammonia remains inside. The manure is removed from the stable by a vacuum sewer system.

General characteristics of farmers and farms

The age of the farmers varied between 30 and 60, with an average of 44 years. Most farmers have an intermediate applied education degree; nearly no one has a university degree. The majority of the farmers had turnovers close to the average Dutch farm turnover of € 869,000, with the smallest farmer having an annual turnover of € 100,000 and the largest € 10.9 million. Roughly two-thirds of the farmers had (at least) one employee. Most of the farmers (84%) concentrate on meat production (80% of total production), with a small number of farmers concentrating on breeding. Almost all of the farms (93%) are situated more than 75 meter away from the nearest ‘environmentally sensitive’ area (such as populated areas), with an average distance of 160 meters.

In terms of profitability, most farmers indicate that they make moderate to good profits compared to their colleagues, with only a minority indicating otherwise. Likewise, concerning living conditions of the animals, working circumstances, efficiency of work, technical results, low costs of production, security, and ease of work, farmers have a positive opinion about their own farm. Furthermore, in terms of cost efficiency, low costs of investments, low costs of production, high security, possibilities to sell manure, and possibilities to decrease the volume of manure, our results show that farmers are optimistic. Concerning knowledge about different types of stable systems the majority of the farmers score rather low. Most of the farmers use between 3 and 7 different sources to obtain information. On the possibility of building a new stable, most farmers doubt they will, with 14% being certain they will not do so in the next 5 years. Yet, 12% are certain they will build a conventional stable, while 11% indicate they are certain to build a sustainable stable.
To build or not to build: factors that play a role in the decision

To study the effects of the different factors on the decision to build a new stable or not, we performed a multi-nominal logistic regression. Table 2 shows the results of the three group model, to determine the factors that play a role in the decision to build a new stable for the non-builder, the doubter, and the definite-builder.

Doubters versus non-builders

In the second column, the results are presented for the doubters compared to the non-builders. A positive sign indicates that the factor positively influences the chance that the farmer is a doubter, a negative sign indicates that the chance that the farmer is a doubter is decreasing. The results show that if a farmer employs hired workers, the chance of being a doubter increases. This goes together with the size of the farm; the larger the farm, the more chance of the farmer having doubts about building. Higher age does increase the chance of farmers not building: the older the farmer, the more probable that he/she will not build a new stable. The availability of a successor increases the chance of building a new stable. Farms with a low number of meat pigs (≤20%) have a bigger chance of being doubters. And finally, if a farm is situated at a maximum distance of 75 meter or less from an acid-sensitive area, the chance of being a doubter is bigger when compared to further than 75 meters away, possibly as a result of legislation.

Definite builders versus non-builders

Having a larger farm, and a larger expected profitability is positively correlated to the chance of being a definite builder. The same applies to knowledge: increased knowledge is positively correlated to the chance of being a definite builder. The explanation for this finding may be that a farmer who decides to build is more eager to gather information about the latest stable systems. Yet being

Table 1. Descriptive statistics of the data.

<table>
<thead>
<tr>
<th>Variable</th>
<th>n=329</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chance of new stable</td>
<td>290</td>
<td>1.06</td>
<td>0.61</td>
<td>0=no chance (non-builders), 1=10-90% chance (doubters), 2=100% chance (definite-builders)</td>
</tr>
<tr>
<td>Chance conventional vs. sustainable stable</td>
<td>254</td>
<td>2.63</td>
<td>0.93</td>
<td>1=not building a new stable, 2=certain about building conventional stable, 3=doubting between conventional or sustainable stable, 4=certain about building a sustainable stable</td>
</tr>
<tr>
<td>Capacity farm employee</td>
<td>298</td>
<td>0.64</td>
<td>0.48</td>
<td>0=no hired workers, 1=hired workers</td>
</tr>
<tr>
<td>Availability successor</td>
<td>318</td>
<td>0.16</td>
<td>0.37</td>
<td>0=no successor or not known, 1=having a successor</td>
</tr>
<tr>
<td>Distance farm to acid-sensitive areas</td>
<td>319</td>
<td>0.93</td>
<td>0.25</td>
<td>1=distance is larger than 75 meters, 0=distance equal to or lower than 75 meters</td>
</tr>
<tr>
<td>% of meat vs. no-meat pigs</td>
<td>318</td>
<td>0.84</td>
<td>0.37</td>
<td>1=80% or more meat pigs, 0=20% or more non-meat pigs</td>
</tr>
<tr>
<td>Farm size ln(expected turnover)</td>
<td>288</td>
<td>&lt;0.01</td>
<td>0.68</td>
<td>Mean centered, below 0=smaller than average, higher than 0=above average</td>
</tr>
<tr>
<td>Expected profitability</td>
<td>311</td>
<td>1.22</td>
<td>0.86</td>
<td>Below 0=making loss, above 0=making profit</td>
</tr>
<tr>
<td>Farmer age</td>
<td>318</td>
<td>2.85</td>
<td>0.90</td>
<td>1-5: (1=21-30, 2=31-40, 3=41-50, 4=51-60, 5=61-70)</td>
</tr>
<tr>
<td>Farmer education</td>
<td>316</td>
<td>2.92</td>
<td>0.56</td>
<td>1-5: (1=primary, 2=basic professional, 3=professional, 4=higher professional, 5=university)</td>
</tr>
<tr>
<td>Distance farm to neighbours</td>
<td>311</td>
<td>159.45</td>
<td>121.94</td>
<td>Natural logarithm (m)</td>
</tr>
<tr>
<td>Farmer information sources</td>
<td>322</td>
<td>4.76</td>
<td>2.26</td>
<td>Total number of farmer information sources</td>
</tr>
<tr>
<td>Farmer knowledge sustainable stables</td>
<td>315</td>
<td>2.12</td>
<td>1.51</td>
<td>1-4: (1=no knowledge, 4=very good knowledge)</td>
</tr>
<tr>
<td>Farmer knowledge conventional stables</td>
<td>315</td>
<td>1.73</td>
<td>0.85</td>
<td>1-4: (1=no knowledge, 4=very good knowledge)</td>
</tr>
</tbody>
</table>
situated further away from neighbours and a higher age of the farmer lessens the chance of being a definite builder. At the same time, farms with hired employees have a greater chance of being a definite builder.

**Doubters versus definite builders**

The study shows that a larger farm, i.e. a higher turnover, a higher expected profitability and more knowledge are factors that are positively related to the chance of a farmer being a definite-builder rather than a doubter. Moreover, the results show that a relative higher level of education reduces the chance of being a definite-builder, although not significantly. The result of distance to neighbours indicates that the further away the farmer is from his neighbours, the lower the chance of him being a definite-builder.

In conclusion, the study shows that the factors that influence a farmer’s decision to build or not to build a new stable are significantly different per group. Farmers who are certain they will build (definite-builders) are more knowledgeable and operate larger-sized and more profitable farms. Farmers that **doubt** also operate larger-size farms compared to the non-builders, using hired workers, but are situated closer (less than 75 meters) to an acid-sensitive area and further away from their neighbours. Finally, farmers that will not build are older, have no successor nor hired workers, have a relative higher education, and operate a farm with at least 80% meat pork pigs, which is situated further away from neighbours.

**Build a conventional or sustainable stable: differences between farmers**

Table 3 shows the results of the four group model to determine differences between adopter groups: the non-builders, doubters, definite conventional stable builders, and definite sustainable stable builders. The table provides additional insights into the aspects related to knowledge, profitability and society (social influence, acceptance and expectations).

The results for non-builders versus doubters, and conventional and sustainable builders are largely a copy of
Table 3. Differences between farmers on building a conventional vs. sustainable stable.

<table>
<thead>
<tr>
<th>Adopters chance of new stable</th>
<th>Doubters vs. non-builders</th>
<th>Definite conventional builders vs. non-builders</th>
<th>Definite sustainable builders vs. non-builders</th>
<th>Doubters vs. definite conventional builders</th>
<th>Definite sustainable builders vs. definite conventional builders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>P-value</td>
<td>Parameter</td>
<td>P-value</td>
<td>Parameter</td>
<td>P-value</td>
</tr>
<tr>
<td>Intercept</td>
<td>11.42</td>
<td>0.14</td>
<td>15.46</td>
<td>0.02</td>
<td>19.66</td>
</tr>
<tr>
<td>Farm size</td>
<td>0.32</td>
<td>0.84</td>
<td>-1.49</td>
<td>0.29</td>
<td>-1.20</td>
</tr>
<tr>
<td>Expected profitability</td>
<td>1.94</td>
<td>0.05</td>
<td>1.37</td>
<td>0.08</td>
<td>2.05</td>
</tr>
<tr>
<td>Farmer age</td>
<td>-1.79</td>
<td>0.09</td>
<td>-2.35</td>
<td>0.01</td>
<td>-3.26</td>
</tr>
<tr>
<td>Farmer education</td>
<td>-0.76</td>
<td>0.52</td>
<td>-0.18</td>
<td>0.83</td>
<td>-1.58</td>
</tr>
<tr>
<td>Farmer information sources</td>
<td>-0.34</td>
<td>0.31</td>
<td>-0.07</td>
<td>0.79</td>
<td>-0.31</td>
</tr>
<tr>
<td>Farmer knowledge of conventional systems</td>
<td>1.98</td>
<td>0.05</td>
<td>-0.17</td>
<td>0.81</td>
<td>-1.12</td>
</tr>
<tr>
<td>Farmer knowledge of sustainable systems</td>
<td>-0.50</td>
<td>0.32</td>
<td>0.08</td>
<td>0.86</td>
<td>0.95</td>
</tr>
<tr>
<td>Farm distance to neighbours</td>
<td>-0.32</td>
<td>0.73</td>
<td>-0.15</td>
<td>0.82</td>
<td>-0.12</td>
</tr>
<tr>
<td>Farm employee capacity (hired employees)</td>
<td>0.42</td>
<td>0.82</td>
<td>4.06</td>
<td>0.01</td>
<td>4.53</td>
</tr>
<tr>
<td>Available successor</td>
<td>5.30</td>
<td>0.05</td>
<td>3.46</td>
<td>0.13</td>
<td>3.70</td>
</tr>
<tr>
<td>Innovative community farmer</td>
<td>-1.86</td>
<td>0.31</td>
<td>-3.78</td>
<td>0.02</td>
<td>-7.05</td>
</tr>
<tr>
<td>Independent/self-assured farmer</td>
<td>-1.03</td>
<td>0.60</td>
<td>-0.16</td>
<td>0.92</td>
<td>-0.43</td>
</tr>
<tr>
<td>Conservative farmer</td>
<td>-1.89</td>
<td>0.38</td>
<td>-0.32</td>
<td>0.84</td>
<td>0.47</td>
</tr>
<tr>
<td>Farm ≤20% meat pigs</td>
<td>20.80</td>
<td>&lt;0.01</td>
<td>21.19</td>
<td>&lt;0.01</td>
<td>22.07</td>
</tr>
<tr>
<td>Farm distance to acid-sensitive areas (&lt;75 meter)</td>
<td>24.29</td>
<td>&lt;0.01</td>
<td>23.30</td>
<td>&lt;0.01</td>
<td>25.33</td>
</tr>
<tr>
<td>Farm performance</td>
<td>2.28</td>
<td>0.03</td>
<td>0.97</td>
<td>0.27</td>
<td>1.42</td>
</tr>
<tr>
<td>Farm cost efficiency</td>
<td>1.81</td>
<td>0.02</td>
<td>0.89</td>
<td>0.16</td>
<td>0.63</td>
</tr>
<tr>
<td>Influence society on decisions</td>
<td>-0.11</td>
<td>0.89</td>
<td>0.77</td>
<td>0.27</td>
<td>0.84</td>
</tr>
<tr>
<td>Influence sector/government on decisions</td>
<td>-1.12</td>
<td>0.15</td>
<td>-0.04</td>
<td>0.95</td>
<td>-0.39</td>
</tr>
<tr>
<td>Farm social acceptance/sustainability</td>
<td>-0.09</td>
<td>0.90</td>
<td>-0.90</td>
<td>0.14</td>
<td>0.05</td>
</tr>
<tr>
<td>Farm acceptance by neighbours</td>
<td>0.16</td>
<td>0.84</td>
<td>-0.73</td>
<td>0.32</td>
<td>-1.22</td>
</tr>
<tr>
<td>Expectations of society about environment/animal welfare</td>
<td>-0.01</td>
<td>0.99</td>
<td>-0.23</td>
<td>0.60</td>
<td>-0.59</td>
</tr>
</tbody>
</table>

1 NE = not estimated due to small number. 
Chi² = 119.5; df=66 (P<0.01); McFadden R²=0.43.
the results of the 3 group model and are presented here for reasons of comparison. The comparison of conventional builders versus doubters and, more importantly, conventional versus sustainable builders are presented below.

**Doubters versus conventional builders**

The study finds that a larger farm reduces the chance of being a doubter (or, the larger the farm, the greater the likelihood of being a definite-conventional builder rather than a doubter). The more a farmer is open to social influence, and accepted by its neighbours, the lower the chance of this farmer being a doubter. Also, scoring higher on knowledge about conventional stables decreases the chance of being a doubter, while being knowledgeable about sustainable stables increases this chance. This might be explained in different ways: farmers seek more knowledge about the kind of farm they want to build; farmers wish to build the farm they know most about or they react to the knowledge about sustainable stables as a reason for having doubts about building a conventional stable. Also, the influence of government is positively related to being a doubter, probably because knowledge about (expected) sustainability-oriented governmental regulations (e.g., regarding manure) may cause farmer to be less interested in building a conventional stable. Having hired worker(s) increases the chance of being a doubter.

**Definite sustainable builders versus definite conventional builders**

The size of the farm or its profitability does not make a significant difference. What does, is the age of the farmer: the older the farmer, the smaller the chance of the farmer being a sustainable-builder. This may be explained by the fact that ‘sustainable’ is a relatively new development, and older farmers are less familiar with this concept or regard it as being of lesser importance. Knowledge about sustainable stables among farmers increases the likelihood of being a definite sustainable builder, while knowledge about conventional stables decreases this chance. The higher significance of the knowledge about conventional systems compared to knowledge about sustainable systems seems to indicate that farmers who want to build a sustainable stable start with the knowledge they have about the negative aspects of conventional farming systems, and then gather information about sustainable farming systems.

The greater the importance attributed to the neighbours’ acceptance, the less the chance of being a definite sustainable builder. Apparently, building a conventional stable is more acceptable in the farming community. This might have something to do with the lack of knowledge about those systems among the neighbours. Having a hired worker increases the chance of building a sustainable stable. It seems likely that hired workers may have a ‘greening influence’ on a farm, maybe because they are relatively young, bring in new knowledge and/or see practices at other farms. Being a self-assured or independent farmer (compared to the traditional farmer) increases the chance of being a definite sustainable builder, although this effect is not statistically significant. An innovative community farmer has a lower chance of building a sustainable stable, compared to the traditional farmer.

What is remarkable about the results is that having a successor only affects the decision about whether or not to build, but not which stable type (conventional or sustainable) to build. Distance to sensitive areas also seems to make no difference between sustainable or conventional stable builders, but does affect the overall decision whether or not to build. Moreover, distance to neighbours does not have any significant influence in this model at all, while it did in the three-groups model.

In conclusion, the study shows that there are significant differences between the four different adopter groups. Among definite-builders, farmers certain of building a conventional stable (definite conventional) do not differ from those who are certain of building a sustainable stable (definite sustainable) on a number of aspects: size and profit of the operation, percentage of non-meat pig production, and closeness to a sensitive area or to neighbours. However, differences between the two are found on age (definite conventional are older than definite sustainable), on hired workers (definite sustainable builders have more employees than definite conventional builders – who may bring ‘young, sustainable’ influence to the farm). Both have knowledge of stable systems, yet among the definite conventional farmers the conventional knowledge overrules the sustainable knowledge. Definite conventional farmers are traditional farmers: low on innovativeness, low on community influence. Definite sustainable farmers are independent/self-assured farmers: they are also low on community influence, but high on innovativeness.

As regards the doubters, the survey shows that their operations are profitable, involving 20% or less non-meat pigs, and farms that are situated less than 75 meters from acid-sensitive areas. They have or may have hired workers, and have high knowledge of sustainable systems. In their decision-making process, they are influenced by colleagues and/or law and legislation. Finally, the non-builders are of
higher age, have no successor and no hired workers, and can be categorized as traditional farmers: low on innovativeness, and low on community influence.

5. Discussion, conclusions and further research

There is little scientific literature that focuses on the factors that play a role in the decision of farmers whether or not to adopt sustainability-oriented innovations. This study explores the process of adoption of innovations in animal production, in this case new pig husbandry systems.

The results of the study show that age seems to be the most important factor in the overall choice to build a new stable or not, and that age also seems to influence the choice between building a conventional or a sustainable stable: among builders, younger farmers intend more to build a sustainable stable. This is in accordance with the argument that age is a very important factor in adoption decisions. (Nkonya et al., 1997; Willock et al., 1999b). The results also show that farmers that have no intention to build a new stable (non-builders) are generally of a higher age compared to the definite builders and doubters, and have no successor. They have no hired workers, but do have a higher education. The non-builder operates a farm with at least 80% meat pork pigs, which is situated further away from neighbours. He or she can be categorized as the traditional farmer: low on innovativeness, and low on community influence. In addition, the study shows that farmers that have doubts about building a new stable (conventional or sustainable) generally have a profitable, larger-sized farm (as do the definite builders), with a hired worker(s) and high knowledge about sustainable systems. Their operation has 20% or more non-meat production, and is situated less than 75 meters from sensitive areas. However, for scores on aspects of the stable system it seems that doubters are a different group than definite conventional and definite sustainable. Although they might be influenced by colleagues and/or law and legislation, they are still categorized as being independent/self-assured farmers: low on community influence, high on innovativeness.

Among governments there is great interest in acquiring more insight into the decision-making process of farmers with respect to the adoption of new stable systems. The results of the study show that among farmers that are certain of building a new stable, the farmers that are certain that they will build a conventional stable do not differ much from farmers that are certain that they will build a sustainable stable when it concerns: the size and profit of the farm, the share of non-meat pig production, or closeness to a acid-sensitive area or neighbours. Overall, both the definite conventional and definite sustainable builders are more knowledgeable and operate larger-size and more profitable farms than those that have doubts about building or say they will not build.

The extent to which farmers adopt available innovations in stable systems is not only determined by the (expected) impact of innovations in terms of productivity growth but also related to sustainability considerations. In the current policy context there is much interest in knowing how farmers respond to sustainability-oriented policies. Seen in this light it is reassuring that the present study shows that next to profit orientation, a positive attitude (based on knowledge about the environmental impact of farming) towards the environment is needed for the decision to build a more sustainable stable.

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