DIFFERENCES IN ATTITUDE OF HORTICULTURAL ENTREPRENEURS TOWARDS THE INTRODUCTION OF REDUCTION TECHNIQUES FOR PESTICIDES AND NUTRIENTS

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Abstract

In order to meet the growing concerns of society horticultural growers have to adopt reduction techniques for pesticides and nutrients. Based on a theoretical framework the adoption of these techniques is influenced by personal and business characteristics and communication behaviour. Data were collected at 248 professional horticultural holdings, resulting in fifteen explanatory variables and one dependent variable representing the environmental score, calculated on the basis of the number of the applied reduction techniques. By means of a categorical principal component analysis the 15 explanatory variables were reduced to 5 independent dimensions. Regression analysis resulted in a significant influence of the dimension 'attitude towards openness and large business size' on the environmental score. The same result was obtained for a regression analysis for the sub sector vegetables. For the sub sector ornamental plants the dimension 'attitude towards risk and environmental sound production' was significant. For fruit production no relations were found.

Introduction

In horticulture pesticides and nutrients are used for the production of vegetables, fruits and ornamental plants. The use of these pesticides and nutrients can have a negative impact on the environment. During recent years horticultural growers are faced with growing environmental concerns of consumers and society in general. In order to meet these expectations many efforts are made to reduce the use of these products. The adoption of reduction techniques can reduce this negative impact. However a great variation in the adoption rate of these reduction techniques can be observed at firm level. Not all holdings use reduction techniques to the same extent, and some of them do not use them at all. In order to stimulate environmental sound production in horticulture, insight into the factors influencing the decision of the manager to use reduction techniques is needed.

Theoretical framework

The introduction of reduction techniques with respect to the use of pesticides and nutrients in horticulture can be considered as the introduction of an innovation. According to the innovation diffusion theory of Rogers (1995) external variables, personal characteristics of the manager and firm characteristics influence the adoption of innovations. In the case of horticulture the competitive environment in which holdings operate, stimulates the firm towards the adoption of environmental sound production methods, as environmental concerns are becoming more important for consumers and society in general. The manager characteristics can be divided into biographical characteristics such as age, education level and

so on, social characteristics such as personal values, attitudes, objectives and communication behaviour. According to Rogers (1995) earlier adopters of innovations are not different from later adopters in age.

According to Gasson and Errington (1993) the presence or absence of a successor may have more influence upon decision making than the farmer's age. One can expect that firm managers with a successor do have a higher probability to adopt innovations. According to Rogers (2005) earlier adopters have more years of formal education than later adopters. In addition, participation in seminars will have a positive influence on the adoption of innovative or 'pro-active' strategies (Rogers E., 1995, Taragola et al., 2000; 2001a). Participation in study clubs and projects was positively related to the plant protection policy of Dutch' farmers, since they were the first to be informed about new reduction technologies. However the influence was not equally important in all sectors (Theuws et al., 2002). Investments in environmental sound production techniques by Belgian glasshouse growers were positively influenced by participation in seminars (Taragola et al., 2001 a).

The influence of attitudes on behaviour is described in the Theory of Planned Behaviour developed by Fishbein and Azjen (1975) and further extended by Azjen and Madden (1986). It is based on the assumption that human beings are usually quite rational (Ajzen and Fishbein, 1980). An attitude is a disposition to respond favourably or unfavourably to an object, person, institution or event (Kim & Hunter, 1993). According to Rogers (1995) earlier adopters of innovations have a more favourable attitude towards change than later adopters. Also they are better able to cope with uncertainty and risk than later adopters. Research on decision making of Scottish farmers (Willock et al., 1998) revealed that environmentally oriented behaviour was significantly correlated with a negative attitude towards chemical use and environmental objectives and the psychological variables extraversion, intelligence, information gathering and an open and innovative personality. In the research cited it is the environmentally friendly farmer who is most innovative, while retaining the openness, information seeking and conscientiousness traits of the business farmer. With respect to the communication behaviour Rogers (1995) states that earlier adopters seek information about innovations more actively than later adopters. They have more change agent contact than later adopters, have more social participation and are more highly interconnected through interpersonal networks in their social system.

Among the firm characteristics business size, objectives and sector can be important to explain adoption of new technologies. According to Rogers (1995) earlier adopters have larger units than later adopters. S.M.E. research (Bamberger et al., 1990) reveals that the business objectives 'creativity and innovation' and 'growth' will have a positive influence on the adoption of innovations whereas 'stabilisation' will have a negative influence. This was confirmed in the research of Taragola et al. (2001 a) where investments in environmental sound production techniques of glasshouse holdings were influenced by economic dimension and the business objectives 'creativity and innovation' and 'growth'. As different sectors are acting in a different competitive environment and have a different social value system sector differences are likely to appear.

One can expect that differences in the use of external information will exist among the growers of vegetables and fruit and the growers of ornamental plants. According to Vijverberg (1996) the structure of commercialisation has a great influence on the exchange of knowledge among the producers. The vegetable and fruit sector is characterized by a co-operative commercialization structure (auctions), with a great number of producers per product (homogeneous production), stimulating an open structure of knowledge exchange. The sector of ornamental plants on the other hand is characterized by individual commercialisation and a small number of producers per product (heterogeneous production), resulting in a closed structure of knowledge exchange. However, one must remark that recently important changes are taking place in the commercialisation structure of glasshouse vegetables. Previous research in the horticultural sector revealed that vegetable producers make more use of external information than

producers of ornamental plants, which can be related tot their co-operational organization (Taragola et al., 2001b).

Methodology

Inventory and top 10 of possible reduction techniques

The current research on adoption of reduction techniques for pesticides and nutrients in horticulture was carried out under the authority of the Flemish government, who wants to stimulate environmental sound production methods. Flanders is the Dutch speaking part of Belgium and is located in the northern part of Belgium. 95% of the Belgian horticulture is located in Flanders. Horticultural production is very diverse, so according to the sub sector different reduction techniques can be applied. For that reason, the horticultural sector was subdivided into four sub sectors: production of vegetables in greenhouses, production of vegetables in open air, fruit production (especially apples and pears) and production of ornamental plants (mostly in greenhouses). The use of pesticides and nutrients is very different in each of these sub sectors. Therefore, in collaboration with four experimental stations, an inventory of possible reduction techniques was made for each of the four sub sectors. Afterwards four groups of experts, one for each sub sector, gave a score to each of the studied reduction techniques. This score was based on the degree to which each technique was able to provide a further reduction of the environmental impact in the future, taking into account the practical and economical feasibility at firm level. For every sub sector, the ten best scoring reduction techniques were selected and investigated (e.g. water recirculation, drift reducing sprayer nozzles, disinfection of drain water,…).

Adoption of reduction techniques

In the next part of the research, an inquiry was set up on the holdings of the Flemish accountancy data network. In this inquiry, several questions were asked about the ten selected techniques. In this way, information was gathered about the adoption rate and the possible bottlenecks for the application of the techniques. In total 248 professional horticultural holdings were selected for the inquiry, this is about 5 pct. of the total population of horticultural holdings in Flanders. There were 74 holdings specialised in production of vegetables in greenhouses, 44 in vegetables in open air, 50 in fruit production and 80 in ornamental production.

One of the objectives of the research was to investigate the factors influencing the adoption of reduction techniques in horticultural holdings. In the inquiry, a number of questions were asked on the biographical and social characteristics of the firm manager, the communication behaviour and the structural characteristics of the holdings. Biographical characteristics of the firm manager include the age and education level of the firm manager and the presence of a successor. Also additional courses of the firm manager were taken into account. Social characteristics that were expected to be important in explaining the adoption behaviour are the attitudes towards risk, environmental production and openness of the firm manager. These attitudes were measured by proposing for each of the three attitudes a certain number of theses to the managers. For each of these theses the manager could give a score on a Likert scale from 1 (not important) to 5 (very important). Based on the scores for each of the theses three attitude variables were created (see section 3.3.). The communication behaviour is measured by a group of 7 variables which give an indication for the searching for information of the managers; the variables are mentioned in table 1. For the structural characteristics of the firm the business size, measured in terms of economic dimension, was selected as variable. The economic dimension was measured as the total standard gross margin (S.G.M.) of the holding. The total S.G.M. of the holding is calculated by multiplying the cultivated area of each crop to the corresponding S.G.M.. The S.G.M. of each crop is a standard for the production value minus the direct costs.

In total, there were 15 explanatory variables. In the research the explanatory power of the variables on the adoption of environmental friendly reduction techniques was investigated. The dependent variable, which had to be explained, was obtained by calculation of the environmental score for each horticultural holding. The environmental score was calculated as the percentage of the possible reduction techniques under study which were used on the holding. It was taken into account that not all proposed techniques in a sub sector, could be introduced on all the holdings in the sub sector (e.g. water recirculation is only an option when there is hydroponic cultivation).

Construction of attitude variables

In order to determine the attitudes of the managers a number of theses were proposed for each of the three attitudes that were studied in the research: attitude towards risk, openness of management and environmental friendly production. For each of these theses the manager could give a score on a Likert scale going from 1 (not important) to 5 (very important). The score for each of the three attitudes was obtained by summation of the scores of the individual theses. In order to test the reliability of the summated scale the internal consistency reliability was checked by means of the Cronbach's alpha. This measure of reliability focuses on the internal consistency of the set of items forming the scale. The Cronbach's alpha is the average of all possible split-half coefficients resulting from different ways of splitting the scale items. The coefficient varies from 0 to 1, and a value of 0,6 or less generally indicates unsatisfactory internal consistency reliability (Malhotra, 1999). The results reveal that the Cronbach's alpha values for each of the three attitudes were greater than 0,6. The Cronbach's alpha value was 0,65 for the attitude of openness of management, 0,80 for the attitude towards risk and 0,77 for the attitude towards environmental friendly production.

Reduction of variables

In total 15 variables were used to explain the environmental score of the horticultural holdings. Many of these variables are correlated and are therefore difficult to use in a regression analyses. That is why a reduction of the variables was performed. As most of the variables are categorical variables all the variables were transformed to categorical variables, allowing to use the procedure of Categorical Principal Component Analysis (CATPCA) on the data of the 248 holdings in the survey. The CATPCA analysis resulted in a reduction of the variables to 5 dimensions. The loadings of these components are mentioned in table 1.
The five resulting dimensions can be described as follows:

Dimension 1 can be described as a dimension that represents a socially open manager with an active search for information. In addition, the economic dimension of the holdings is important. In table 1 the figures of the characteristics that belong to dimension one are in bold in the column 'dimension 1'.

Dimension 2 can be described as a dimension in relation with the future of the holding (see also table 1).

Dimension 3 can be described as the property of being open for risks and an environmental friendly attitude of the manager (see also table 1)

Dimension 4 can be described as the search for specific advice for the horticultural holding (see also table 1)

Dimension 5 has a high factor loading on agricultural or horticultural education (see also table 1)

Table 1. Loadings of the components of the Categorical Principal Component Analysis

Variables	Dimension				
	1	2	3	4	5
Biographical Characteristics					
Age manager	-,296	**,866**	-,026	,064	-,134
Education level of manager	,277	**-,645**	-,263	,106	,023
Education in agricultural or horticultural school	-,181	,060	,007	,294	**,883**
Number of additional courses of the manager	**,456**	-,403	-,124	,130	-,077
Presence successor	,151	**-,589**	,000	-,057	,108
Social characteristics					
Openness (attitude)	**,632**	-,035	,524	-,209	-,049
Risk (attitude)	,408	-,258	**,628**	,036	-,125
Environmental production (attitude)	,331	,193	**,645**	-,215	,197
Communication behaviour					
Seminars, demonstrations, excursions, meetings extension services	**,696**	-,019	-,092	,213	-,108
Consulting agricultural magazines	**-,675**	-,141	,279	,126	,222
Consulting sources of information	**,710**	,228	,078	,453	,051
Consulting persons, authorities	,576	,116	,015	**,618**	-,050
Paid extension services	,410	,017	-,190	**-,477**	,341
Membership of a horticultural society	**-,576**	-,178	,221	,439	,014
Membership of a study club or a work group	**-,664**	-,253	,157	-,149	-,053
Structural characteristics					
Economic dimension	**,924**	,213	-,196	-,229	,214

Results

To investigate the influence of the 5 dimensions on the environmental score a linear regression was used. This regression indicated that for the whole of the horticultural holdings in the survey only dimension 1 was significant (sign. = 0,000). One can conclude that the introduction of reduction techniques for horticultural holdings is significantly influenced by the search for information, a great openness of the manager, and a larger economic dimension (dimension 1).

This is the conclusion that can be drawn for the average horticultural sector. As the horticultural sector comprises a lot of different crops, production systems and market systems the question arises if the results are influenced by the sub sector. The same exercise was performed for each of the four sub sectors, a disadvantage however is that the number of holdings in the four sub sectors is rather limited in the survey. For every sub sector, the reduction of variables was performed using the CATPCA analysis, which resulted in the same 5 dimensions as the ones obtained in the analysis of the whole horticultural sector. However, when the relation between the environmental score and the five dimensions was investigated for each sub sector the results were not the same for every sub sector. The following results were obtained:

For the sub sector production of vegetables in greenhouses and the sub sector production of vegetables in open air it was found that dimension 1 has a significant influence on the environmental score for the production in greenhouses (sign. = 0,001) and for the production in open air (sign. = 0,027). The results were the same as for the whole survey.

In the sector of vegetable production there are very strict requirements on the use and residues of pesticides since they are used for human consumption. Consequently all vegetable producers are obliged to pay attention to the environment and it is a challenge for innovating managers to apply new reduction techniques. As most of these producers deliver their products to the auctions they are no competitors, which can explain the openness and the exchange of ideas between producers.

For the sub sector production of ornamental plants the analysis resulted in a significant influence of dimension 3 on the environmental score (sign. = 0,000). This result is different than for the vegetable sector. Most producers of ornamental plants are selling their products to wholesalers or retailers, which means that they are in competition on the market and consequently more reluctant to exchange ideas and experience with their colleagues. Moreover ornamental plants are not edible and there are less environmental restrictions on their production. So it is not surprising that early adopters of environmentally friendly production techniques in the sector of ornamental plants are managers with a positive attitude towards environmental friendly production. They will take acceptable risks to introduce these new techniques although this is not strictly required for the production process

For the sub sector fruit one could not find any dimension that had a significant influence on the environmental score of the holdings. This can be explained by the fact that the experts of this sector may have chosen reduction techniques that were already used by many fruit holdings, resulting in a low variance of the environmental score.

Conclusion

The results of the research reveal that the general theoretical framework used in literature for explaining the adoption of innovations is also useful for our research question. The introduction of reduction techniques in horticulture is significantly influenced by the search for information, a great openness of the manager, and a larger economic dimension. In the sector of ornamental plants a positive attitude towards risk and environmentally friendly production is important. No significant influence of the factors under study was found for the sub sector fruit. The sectoral differences can be explained by the fact that different sectors are acting in different competitive environments, have different commercialisation structures and consequently different systems of knowledge exchange.

Acknowledgements

The authors gratefully acknowledge the financial support received from the Flemish Government and the co-operation of the Research Centre for Ornamental Plants, Destelbergen, the Vegetable Research Centre in Kruishoutem, the Research Centre Hoogstraten and the Research Station for Fruit Growing in Sint-Truiden. Thanks also to the expert groups and the horticultural growers for their contributions to the research.

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