

Factors Influencing Small-scale Dairy Farmers' Decision to Adopt and Continued use of A Successful Innovation in the Highlands of Central Mexico

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Abstract. In the small-scale dairy systems, animal feeding costs represent the highest expenditure of milk production. Pastures for grazing have shown to be an alternative of improvement to the economy efficiency of small-scale dairy farms. A study was conducted with 80 farmers who are already engaged with the use of improved grassland to identify cognitive (beliefs), and social psychological factors (social norms) associated with the use of this innovation. The sample was divided in established users (n=64) and resent users (n=16). The Theory of Reasoned Action (TRA) was used as theoretical framework and Spearman Rank Order correlation was conducted to analyse the data. To identify differences between groups, the analysis of Mann-Whitney U test was conducted. The TRA analysis identified that farmers' beliefs and salient referents (social pressure) played an important role in farmers' intention. It also identified specific drivers (i.e. the use of improved grassland decreases animal feeding expenses, increases fodder production, increases milk production, offers a cheap way to feed the herd, provides fodder of good nutritive quality and provides fodder availability throughout of the year) and salient referents (father, other experienced farmers, brother and uncle) that could be taken into account by government in the design of extension activities for improved grassland to small-scale dairy farmers. It is concluded that the TRA offers potential means of improving the design of more effective extension approaches both in Mexico and in other contexts and systems.

Keywords: Theory of Reasoned Action (TRA), small-scale dairy farmers, improved grassland, extension, adoption of innovations, Mexico.

1. Introduction

Animal feeding costs in small-scale dairy farms in Mexico represent the highest expenditure of milk production costs with an investment of 70% (Espinoza-Ortega et al., 2005). Studies have suggested that some alternative improvements to the productive and economic efficiency of small-scale dairy farms could be through the implementation of feeding strategies and the optimization of the use of high quality forage as pastures for grazing (Heredia-Nava et al., 2007). The Mexican government has been promoting the use of improved grassland among small-scale dairy farmers; however, farmers have shown low uptake of this technology. This has been attributed to different factors such as capital constraints, high cost of fertilizing and irrigation; farm characteristics (farm size, herd size, land tenure, land characteristics and level of infrastructure), farmers and household characteristics (education, age, farming work members and household incomes) and institutional characteristics (access to credit, and extension service) (Martínez-García et al., 2012). These studies have not taking into account cognitive and social psychological factors associated with farmers' intention to adopt improved grassland. Several researchers illustrate the importance of farmers' attitude, beliefs and social pressure from the salient referents in the adoption of technologies (Garforth et al.,

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2004; Rehman et al., 2007). Little research has addressed the role of farmers' attitudes and beliefs in either adoption or rejection decisions; particularly, for technologies with evident economic potential that have not been taken up by farmers (Rehman *et al.*, 2007). Regarding Mexico, there is a lack of information about understanding of attitudes, beliefs and social pressure underpinning farmers' intentions to adopt agricultural innovations. In contrast to many adoption studies, it focuses on an innovation that has been successfully adopted, in order to understand reasons for this and to provide insights that may improve design and implementation of future research and extension activities. Therefore the objective of this research was to identify farmers' beliefs and salient referents which underlie farmers' decisions to continue using improved grassland on their farms over the next 12 months.

2. Methodology

2.1. Theoretical Framework

The theoretical framework for this study was based on the social-psychology Theory of Reasoned Action (TRA), which is composed by intention, outcome beliefs, outcome evaluations, subjective beliefs and motivation to comply (Ajzen and Fishbein, 1980). The TRA has shown to be valid in circumstances where an individual has volitional control over the behaviour in question. In this study, the use of improved grassland behaviour is assumed to be under volitional control of the small-scale dairy farmers, because they have used the technology for several years.

2.2. Research Site

The research was carried out in the municipality of Aculco, which is located in the northwest of the State of Mexico, Mexico. It is 484.7 km², representing 2.0% of the surface of the State of Mexico. Acualco has a total population of 40,492. Altitude is 2000 and 3400 m.a.s.l., and annual rainfall is 700 to 1000 mm. Aculco has a daily milk production of 49000 litres, representing 8.7% of the total daily production of the state. It is relevant to emphasize that Aculco has developed a symbiotic relationship between dairy farmers and cheese manufactures. It is estimated that the 82% of the milk production is destined to produce traditional cheese varieties, which are sold mainly in the Mexico City (Espinoza-Ortega *et al.*, 2007).

2.3. Farmers Selection and Data Collection

The selection criteria were based on two characteristics; a) farmers who were already engaged in the use of improved grassland in their farms and b) with a herd size of 3 to 20 animals; these were defined by Espinoza-Ortega *et al.* (2007) as small-scale dairy farmers in central Mexico. Snowball sampling method was used to identify participants. Data were collected from 80 small dairy farmers, representing 5.3% of the total farmers in the study area. The data were gathered from August (2009) to January (2010). Data collection for the TRA was carried out in two distinct phases. In the first phase, semi structured individual interviews with 15 farmers, elicited statements of beliefs in relation to the advantages and disadvantages of using improved grassland on the farms and also elicited the people whose opinion influence farmers' behaviour in respect of using improved grassland. Statements that were recorded from multiple interviews were regarded as salient outcome beliefs and incorporated into a structured questionnaire for the second phase. The questionnaire included 11 salient outcome beliefs statements (decreases animal feeding expenses, increases fodder production, increases milk production, cheap way to feed the herd, provides fodder of good nutritive quality, provides fodder availability throughout the year, grassland is easy to manage) and 10 salient referents (self-initiative, self-observation, father, other experienced farmers, bother, uncle, university, government, veterinarian and grandfather). Farmers' responses were measured along semantic-differential interval on five point bi-polar scales e.g., very strong (+2) to very weak (-2) and very good (+2) to very bad (-2) as recommended by Rehman et al. (2007). The second phase comprised an interview survey with 80 farmers. The questionnaire also asked for information about socioeconomic and farm characteristics.

2.4. Data Analysis

In order to analyse the data, the sample was divided in established users (n=64) and recent users (n=16). To identify differences between established and recent users, a set of eleven quantitative variables (five socioeconomic variables: farmer's age, farmer's education, farmer's experience, family members, farming

work members and six farm variables: herd size, number of cows in production, total milk yield per herd per year, total number of hectares, area (ha) used for grassland, and years using improved grassland) were analysed through an independent sample *t*-test. The TRA components were analysed in disaggregated form. According to nature of TRA data, non-parametric tests were adopted; thus, Spearman Rank Order correlation was conducted. The Mann-Whitney *U* test was used to assess the significant differences between established and recent users of improved grassland. The data were analysed with SPSS 15.

3. Results and Discussion

3.1. General Features of Established and Recent Users

The general features of the established and recent users of improved grassland are shown in Table 1. For farmer's education, farmer's experience and years of using improved grassland in the farm, there were statistical differences ($P<0.05$) between the two groups.

Table 1: General features of established and recent users of improved grassland

Variable	Established users (n=64)		Recent users (n=16)		P value ²
	Mean	SD ¹	Mean	SD ¹	
Socioeconomic					
Farmer's age, years	49.0	13.2	49.3	12.8	.946
Farmer's education, years	5.9	3.1	8.9	4.7	<.002
Farmer's experience, years	30.91	12.9	22.7	15.4	<.031
Family members, number	5.3	2.0	5.3	2.0	.932
Farming work members, number	2.7	1.1	2.7	1.1	.932
Farm characteristics					
Herd size, heads	12.4	5.5	13.3	6.0	.569
Cows in production, heads	5.9	3.0	5.2	2.3	.408
Total milk yield per herd per year, litres	20,142	13,912	15,819	9,305	.257
Total number of hectares	4.6	4.5	2.8	1.9	.179
Area used for grassland, hectares	1.4	0.8	0.9	0.6	.090
Time using improved grassland, years	22.6	9.8	4.1	4.7	<.001

¹SD=Standard deviation; ²t-test ($P<0.05$)

3.2. Intention of Established and Recent Users Towards Using Improved Grassland

The established and recent users expressed a positive intention to use improved grassland in the farm over the next 12 months. However, the Mann-Whitney *U* test showed that the intention of established users (median=1.47) was significantly greater ($U=300.00$ $p<0.05$) than recent users (median=0.69). This could be attributed to established users relying more on milk production as a main source of family income. Moreover 12.4% of recent users were undecided and 25% had weak intention; possible explanations include: price of seeds, farmers are still experimenting and that non-farm activities were the main source of family income.

3.3. Beliefs Underpinning Attitude of Established and Recent Users

The direct attitude of the established users (median=1.69) were significant different than the recent users (median=0.81), ($U=280.00$ $p<0.01$), i.e. the use of improved grassland was considered of more importance by established users than recent users, who also were growing smaller areas. The use of improved grassland on farm was viewed by established and recent users as an economical and productive benefit, since most felt that using grassland on their farms increases fodder production, provides fodder of good nutritive quality, provides fodder availability throughout the year, decreases animal feeding expenses, provides a cheap way to feed the herd, increases milk production and its management is easy. However, some negative beliefs of using improved grassland were also recognised. These were high financial investment demands, investments not recovered from milk sales, the availability of land and land of good nutritive quality.

There were few significant differences between established and recent users regarding belief strength, outcome evaluation and their summated product (attitude). The two groups only differ in one out of 11 salient beliefs. Established users slightly believe that investments for using improved grassland are not recovered with the milk sales (median=0.16) this was significantly stronger than the recent users (median=-

0.50), ($U=356.00$ $p<0.05$). Indeed, more than half (54.7%) of established users agreed with this belief, whereas more than half of recent users (68.8%) disagreed; since they considered that investments for using improved grassland are recovered within milk sales. A possible explanation could be attributed to the difference of markets and milk price per litre between established and recent users. The former sells the milk to the intermediary who pays on average US\$ 0.34 per litre; whereas the latter directly sells to the consumer, allowing farmers to have a better price of US\$ 0.53 per litre.

In the evaluation of outcomes, there were significant differences in four out of eleven evaluative beliefs between the two groups. Established users showed higher score (median=1.50) than recent users (median=1.06) about the knowledge importance of grassland management ($U=279.50$ $p<0.001$). This could be attributed to the higher experience of the established users, i.e. the higher the farmer experience of using improved grassland, the easier the management. In contrast, three negative beliefs about using improved grassland on farm: high financial investment demands (established user median=0.83, recent user median=0.06, $U=332.50$ $p<0.001$), investments are not recovered with the milk sales (established user median=1.28, recent user median=0.56, $U=318.00$ $p<0.001$) and availability of land (established user median=1.39, recent user median=0.50, $U=303.00$ $p<0.001$) were significantly more negatively evaluated by recent users than established users; i.e. the latter considered that investing in grassland, recovering investments and requiring availability of land are of major importance than to recent users; this could be attributed to milk yield being the main source of their incomes.

3.4. Subjective Norms Toward Using Improved Grassland by Established and Recent Users

The overall median of the direct subjective norm for established users was slightly positive (median=0.56). This further indicated a significant correlation with intention ($r=0.284$, p (2-tailed) <0.05), indicating that social pressure would influence the established users' intention to use improved grassland on their farms over the next 12 months. Whereas in the recent users the overall median of direct subjective norm was neutral (0.00), moreover no significant correlation was found with intention; this implies that social pressure would have no influence on recent users to use improved grassland. Significant differences in the subjective norms were observed between the two groups in three out of 10 salient referents; however, there were no statistical differences between the two groups in terms of the overall median scores of the subjective beliefs, however established users are more strongly encouraged, than recent users, to use improved grassland in the farm by their fathers (established user median=0.88, recent user median=0.25, $U=218.00$ $p<0.001$) and their uncles (established user median=0.53, recent user median=-0.19, $U=262.50$ $p<0.001$).

Regarding motivation to comply, established users felt more motivated by their self-initiative, self-observation, fathers, other experienced farmers and brother; whereas recent users by their self-initiative, self-observation and other experienced farmers. The comparison of the overall median scores shows that established users are more motivated to comply than recent users by the salient referents (established user median=5.69, recent user median=2.25, $U=325.50$ $p<0.05$), mainly by their fathers (established user median=0.98, recent user median=-0.06, $U=302.00$ $p<0.01$) and their uncles (established user median=0.27, recent user median=-0.69, $U=253.50$ $p<0.01$). Extension programmes could be target these salient referents as channels and sources for the development of appropriated communication strategies for promoting the use of improved grassland, especially among farmers who have not already been engaging in the use of this technology. It is interesting to note that the government shows negative median scores in the motivation to comply in both established and recent users; this could be attributed to its lack of participation in the zone and demanding many requisites when farmers apply for support.

3.5. Cognitive Barriers and Drivers for the Established and Recent Users

One cognitive barrier for using improved grassland on farm is evident for the two groups: investments are not recovered from milk sales. This implies that farmers in both groups who feel that investments for using improved grassland on farm are not recovered from milk sales are less likely to express an intention to use the innovation in the farms. On the other hand, four cognitive drivers or promoters for using improved grassland are evident for the established users: to increase fodder production, to increase milk production, to provide a cheap way of herd feeding and to provide fodder of good nutritive quality. Among the recent users, six drivers for using improved grassland are evident: to decrease animal feeding expenses, to increase fodder

production, to increase milk production, to provide a cheap way of herd feeding, to provide fodder of good nutritive quality and to ensure fodder availability throughout of the year. This suggests that farmers' decisions were based on their general feelings about the pros and cons of the use of the technology on their farms. Garforth *et al.* (2004) mentioned that farmers' attitudes towards a technology have a strong influence on whether or not farmers intend to use it.

3.6. Factors Behind Established and Recent Users Intention to Use Improved Grassland

In general terms, the use of improved grassland by established users was mainly influenced by the social pressure and the opinion of salient referents, in which their fathers played an important role. Garforth *et al.* (2004) mentioned that when normative element is clearly dominant, the salient referents become the more important elements within the proposed audience. The recent users were more influenced by their attitude originated from the positive and negative beliefs of the use of improved grassland on farm. Garforth *et al.* (2004) pointed out that when intention is strongly influenced by attitudes, promotion of the technology should focus on reinforcing those beliefs that are identified as drivers and combating those, which are barriers. However the overall findings showed that both farmers' beliefs and social referents were important factors to use improved grassland for farmers.

4. Conclusion

The results of TRA showed that farmers' attitude and social pressure from salient referents clearly had strong influence on farmers' intention to use improved grassland. The drivers and social referents identified in the research should be considered as channels and sources of knowledge and communication by the extension services in order to promote improved grassland, especially among farmers who have not already engaged in the use of the innovation. Therefore, the TRA was a useful tool in identifying specific drivers and salient referents for established and recent users of the innovation, which underlie farmers' decisions to use improved grassland. This approach proves to be useful in understanding decision making and in using findings to develop more effective approaches for development and dissemination of technologies.

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6. References

- [1] C.G. Martínez-García, P. Dorward, and T. Rehman. Farm and socioeconomic characteristics of small-holder milk producers and their influence on the technology adoption in Central Mexico. *Tropical Animal Health and Production* 2012, 44: 1119-1211.
- [2] A. Espinoza-Ortega, E. Espinosa-Ayala, J. Bastida-López, T. Castañeda-Martínez, and C. M. Arriaga-Jordán. Small-scale dairy farming in the highlands of central Mexico: Technical, economic and social aspects and their impact on poverty. *Experimental Agriculture* 2007, 43: 241-256.
- [3] D. Heredia-Nava, A. Espinoza-Ortega, C. E. González-Esquível, and C. M. Arriaga-Jordán. Feeding strategies for small-scale dairy systems based on perennial (*Lolium perenne*) or annual (*Lolium multiflorum*) ryegrass in the central highlands of Mexico. *Tropical Animal Health and Production* 2007, 39: 179-188.
- [4] T. Rehman, K. McKemey, C. M. Yates, R. J. Cooke, C. J. Garforth, R. B. Tranter, J. R. Park, and P. Dorward. Identifying and understanding factors influencing the uptake of new technologies on dairy farms in SW England using the theory of reasoned action. *Agricultural Systems* 2007, 94: 281-293.
- [5] A. Espinoza-Ortega, A. Álvarez-Macías, M. C. Del Valle, and M. Chauvete. Small-holder (Campesino) milk production systems in the highlands of Mexico. *Técnica Pecuaria México* 2005, 43: 39-56.
- [6] C. Garforth, T. Rehman, K. McKemey, R. Tranter, R. Cooke, C. Yates, J. Park, and P. Dorward. Improving the design of knowledge transfer strategies by understanding farmer attitudes and behaviour. *Journal of Farm Management* 2004, 12: 17-32.
- [7] I. Ajzen, and M. Fishbein. *Understanding attitudes and predicting social behaviour*. Prentice-Hall, Upper Saddle River, NJ. 1980.