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MODELLING FARMER INFORMATION TRANSFERS WITH NETWORK ANALYSIS: AN EXPLORATORY FARMLET STUDY

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SUMMARY

Traditional extension models place farmers at the receiving end of knowledge transfer. The agricultural sector would be better served by a learning model that emphasises networking rather than linearity. Farmers are not simply receivers but also routinely act as extension agents who circulate knowledge through their own interpersonal contacts. A Massey University case study demonstrates the power of these relationships to transfer scientific awareness between farmers. The case also suggests that knowledge flows are affected by the sociological traits of farmer networks. Densely connected and occupationally homogenous networks transfer knowledge at a faster rate than do networks that are loosely tied and heterogeneously composed.

INTRODUCTION

An experimental farmer learning project has been underway at Massey University since mid-2011. 25 sheep and beef farmers are working with an interdisciplinary group of 7 University experts (3 animal scientists, an agronomist, a farm management specialist, an educationalist and a sociologist). The project focuses on a farmlet trial that investigates lamb finishing with herb mix pastures (clover, chicory and plantain). The project has used this trial to explore knowledge transfer opportunities in the pastoral sector. These opportunities centre on farmer learning, in particular through improved interaction with the producers of scientific knowledge.

The Massey learning project has two major dimensions: (1) designing effective small group interactions between farmers and agricultural scientists, and (2) exploring the wider circulation of scientific knowledge through farmer networks. This paper concentrates on the latter. Every farmer maintains their own 'network of practice'. This network is a unique collection of agricultural practitioners (e.g. other farmers, consultants, researchers and merchants of various kinds) that the farmer contacts on a regular basis. Although these interactions are regular, they serve multiple purposes and hence the networks they construct tend to be informally, rather than single-mindedly, coordinated (Eastwood *et al*. 2012). A growing body of research emphasises the significance of such networks for the development of agricultural innovation systems (Darnhofer *et al*. 2012).

The Massey learning project brings together a number of agricultural scientists and farmers to test a specific pastoral innovation, the use of herb pastures. The project design has included an exploratory analysis of how the participating farmers circulate knowledge of the Massey trial through their own networking activities. This analysis lends support to the idea that farmers are significant scientific agents rather than simply end-of-the-line recipients.

METHOD

The participating farmers have been interviewed twice, once prior to the start of the Massey trial in mid-2011 and again 18 months later in December 2012. Complete network data has been collected for 17 of the farmers and this is the dataset analysed here. The first round of interviews recorded each of the farmer's existing contacts for herb knowledge. The follow-up interviews recorded the people with whom the farmer had discussed the Massey trial over the preceding 18 months. These people are divided into: (1) those already identified as existing contacts in the first interview, and (2) new people not previously identified as significant herb knowledge contacts. In essence then, the interviews reveal the extent to which the farmers activated and added to their existing networks. To use a learning terminology, the results show the retention and recruitment dynamics of farmer-sponsored enrolments in the herb trial.

Social network analysis uses various quantitative metrics to map the social structures in which individuals are embedded (Prell, 2012). The following variables are analysed here:

1. size: the number of herb pasture contacts nominated by the farmer, in terms of pre-existing relationships as well as with regard to retention, recruitment and growth from 2011 to 2012.
2. role: herb contacts are classified according to 11 occupational roles.
3. density: the number of actual ties divided by possible ties. For example, a network of 5 actors has (5*4)/2 = 10 possible ties (i.e. herb contact relationships). If there are 5 actual ties then network density is 0.5.
4. heterogeneity: calculated as 1 minus the sum of the squares of the proportions of each value of the categorical role variable in each of the 17 farmer networks. In network analysis this is known as Blau's heterogeneity index, but it is an often re-invented and diversely named measure (Gibbs-Martin, Gini-Simpson, Herfindahl-Hirschman). Varying between 0 and 1, the index measures the mix of occupations held by the farmer's herb contacts. Statistically, it is the chance that two randomly selected individuals from the farmer's network will have different occupations (Harrison and Klein, 2007).

THE HOMOPHILY HYPOTHESIS

We hypothesise (1) that the 17 farmers will retain and recruit other farmers into the herb trial more frequently than any other occupational grouping, (2) that densely interconnected farmer networks will grow at a higher rate than those that are more loosely tied together, and (3) that occupationally homogenous farmer networks will grow at a higher rate than networks which are occupationally heterogeneous.

The rationale for these hypotheses is furnished by the homophily principle, which holds that contact between similar people occurs more frequently than contact between dissimilar people (McPherson *et al*. 2001). Relatedly, the theoretical literature suggests that high density networks create the trust and shared values that enhance knowledge transfer (Nooteboom and Stam 2008). In short, birds of a feather flock together. A wide range of causal factors have been invoked to explain the homophily principle, but such explanatory analysis is not our objective here. Suffice to say that the principle has been so frequently observed empirically that it approximates a sociological law. Accordingly we hypothesise that social similarity has empowered the circulation of knowledge about the Massey herb trial, just as homophily routinely empowers the sharing of many other social resources.

RESULTS

Table 1 cross-tabulates the 17 farmers' network enrolments by occupational role over the period from June 2011 to December 2012. Prior to the trial's launch, the farmers were sharing herb knowledge across a wide range of occupations. However, half (50.4%) of their networkers were fellow farmers, well ahead of any other occupational group. By 18 months after its launch, the farmers had discussed the Massey trial with 63.2% (79) of their existing contacts and with 113 new people not previously identified. There had thus been a significant growth in network reach. By the end of 2012 the 17 farmers had constructed a new network with 192 members, 53.6% larger than when the trial began. As might be expected, seed merchants were consistently highly placed. Consultants, bankers, contractors, industry-good representatives, scientists and veterinarians all exhibited much the same network presence. Fellow farmers, however, had been both retained and recruited at a much higher rate than any of these other groups. While the pre-existing network was half farmers, the new network was two thirds farmers (65.6%).

Table 1. The 17 farmers' herb knowledge network enrolments by occupational role, June 2011 to December 2012

Role	June 2011 network	Retention	Recruitment	Dec 2012 network
Accountant	0	0	1	1
Banker	0	0	5	5
Consultant	8	5	1	6
Contractors	12	4	3	7
Farmer	63	46	80	126
Industry good	4	2	5	7
Merchant (fertiliser)	5	2	1	3
Merchant (seed)	20	12	4	16
Other	2	1	4	5
Scientist	8	5	2	7
Veterinarian	3	2	7	9
TOTAL	125	79	113	192

Table 2. Structural traits of the 17 farmer networks

Farmer	Initial size	Density	Heterogeneity	Growth%
A	7	0.333	0.776	57.14
B	7	0.476	0.694	14.29
C	17	0.544	0.616	58.82
D	11	0.400	0.744	0.00
E	6	0.733	0.500	233.33
F	6	0.733	0.500	233.33
G	17	0.191	0.740	-23.53
H	16	0.617	0.570	0.00
I	9	0.444	0.815	33.33
J	3	0.333	0.444	133.33
K	6	0.667	0.611	33.33
L	7	0.571	0.694	200.00
M	11	0.600	0.545	81.82
N	5	0.700	0.640	100.00
O	8	0.536	0.656	100.00
P	14	0.231	0.714	-21.43
Q	10	0.311	0.680	60.00

Analysis of the network findings presented in Table 2 lends further support to the homophily hypotheses. For example, the linear regression of network growth on density is significant (r^2 = 0.357, p = 0.011, slope = +284.00). So too is the regression of growth on heterogeneity (r^2 = 0.280, p = 0.029, slope = -0.320).

DISCUSSION

A social network analysis of Massey University's herb pasture trial suggests that farmers are well placed to disseminate agricultural science. As yet we know little about the actual content of these interpersonal communications (though some qualitative data have been collected to inform such an analysis). What is evident, however, is both the scale and the farmer-focus of networking by the 17 farmers participating in the Massey trial. This network reach runs along the lines of social homophily. Dense and occupationally homogenous networks seem to spread agricultural knowledge further than do networks that are loosely and heterogeneously composed. This suggests that farmer information transfers are the expressions of social solidarity; they disseminate science in relations bound by interpersonal trust and shared norms.

CONCLUSION

The scientific inflection of New Zealand farming has long been a significant source of competitive advantage in global markets. It is widely recognised, however, that the circulation of agricultural knowledge is at a critical turning point. New Zealand farming is challenged to make rapid and profound transformations, and yet its current knowledge transfer system is, as a major industry organisation candidly concludes, marred by 'too much noise and mistrust' (Beef+Lamb 2013). This paper has suggested that, in the midst of such official and commercial noise and mistrust, pastoral farmers maintain their own informal and practical networks. Those bent on improving the significance of agricultural science among New Zealand farmers would do well to enhance such farmer-to-farmer communication channels. The social embedding of agricultural science in spontaneous, farmer-driven, conversations is a key not only to the past successes but also to the future prosperity of New Zealand pastoralism.

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