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Agricultural information systems and communication networks: the case of dairy farmers in the Samsun province of Turkey

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Abstract

Introduction. *Analysis of the agricultural information systems and communication network used by members and non-members of the Dairy Cattle Breeders' Association provided a framework to identify the strength and weaknesses of the current systems and led to recommendations to improve their performance.*

Method. *Structured interviews were used to collect data from a randomly selected forty-three members and sixty-five non-members of the Association.*

Analysis. *Tests of association (e.g., Correlation Coefficient and Kendall's tau) and tests of difference (Student's t test) were performed using SPSS.*

Results. *The main function of the information systems was the dissemination of dairy-faming-related information. Association membership functions as a means to keep more European pure-bred cows and provide financial incentives, rather than developing a modern dairy sector. The non-members of the Association mainly used their current knowledge and traditional practices.*

Conclusions. *The lack of information support from the institutional sources resulted in the development of personal information sources to exchange information and diffuse technology among the farmers themselves.*

We recommend that more functional cooperation between public and private information sources in the system is needed to motivate conventional dairy farmers to convert into modern dairy farming system.

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Introduction

Agricultural information interacts with and influences agricultural productivity in a variety of ways. It can help inform decisions regarding land, labour, livestock, capital and management. Agricultural productivity can arguably be improved by relevant, reliable and useful information and knowledge. Hence, the creation of agricultural information (by extension services, research, education programmes and others) is now often managed by agricultural organisations that create information systems to disseminate information to farmers so that farmers can make better decisions in order to take advantage of market opportunities and manage continuous changes in their production systems. Therefore, there is a need to understand the functions and use of particular agricultural information systems in order to manage and improve them.

This study analyses and compares the current information systems used by members and non-members of the Dairy Cattle Breeders' Association (hereafter, "the Association") in the Samsun province (Black Sea region) of Turkey. It analyses the components of the systems, how they interact, and what linkages exist between the organisations and the farmers. Thus, the aims of this paper are: (i) to compare socio-economic characteristics of members and non-members of the Association and their farms (such as age, educational level, income, experience, size of area and number of animals); (ii) to analyse the relationships between these characteristics and the information scores (i.e., information contacts and their usefulness) of members and non-members of the Association; (iii) to compare the information sources used by members and non-members of the Association; and, (iv) to present the nature of the information systems and their communication networks for members and non-members of the Association.

The study employed agricultural information system theory and research approach in order to address the main research question, “How do the current information systems and communication networks of members and non-members of the Association function in the study area?”

Individual cognitive processes and how the use of information influence dairy farmers' decision-making are beyond the research objectives of this study, but could be the subject for further research.

In this paper agricultural information system theory (Röling 1988) and related concepts are discussed in the Literature review section. The empirical survey method used in the study is explained in the Research methods section. The survey method identified dependent (membership of the Association or information score) and independent variables (some characteristics of the farmers and their farms). It allowed the perspectives of the various actors involved in the information system to emerge and be analysed. The results of the analysis are presented in the Results and discussion section.

Literature review

In this section, terms used in this research, such as system, system approach, information system, information behaviour, agricultural information system and communication networks, are first presented and discussed. Second, the rationale of the system approach and the agricultural information system are presented. Third, the findings of previous studies are reviewed and their relevance to the current research is considered.

A *system* is a group of interacting components, operating together for a common purpose (Spedding 1988). According to Checkland (1981) a system is a model of an entity. It is characterised in terms of its hierarchical structure, emergent properties, communication and control. The term *subsystem* is equivalent to system, contained within a larger system.

The *system approach* is a way of looking at an entity and dealing with problems in order to identify and improve the particular system. It can be applied to any

subject (Spedding 1988). The system approach has also shown a high potential for offering a conceptual framework to analyse, manage and improve a current system and to design a better one (Cavallo 1982). Models of *social system* can be used as a tool for analysing the information requirements of actors involved in a system (Checkland & Holwell 1998).

In general system theory, an *information system* is accepted as a system, automated or manual, that comprises people, machines, and/or methods organized to collect, process, transmit, and disseminate data which represent information. Ciborra (2002: 5) proposes that information systems "deal with the deployment of information technology in organizations, institutions, and society at large". Thus information systems are also social systems whose behaviour is heavily influenced by the goals, values and beliefs of individuals and groups, as well as the performance of the technology (Angel & Smithson 1991).

Processed information becomes knowledge when an individual knows (understands) and evaluates it. Thus, a *knowlege system* is more individualized and emphasises personal cognition (Demiryurek 2000). However, groups of people may share a common knowledge system such as an indigenous knowledge system (Brokensha *et al.* 1980). Wilson (2000) clearly defines *information behaviour* as "the totality of human behaviour in relation to sources and channels of information, including both active and passive information seeking, and information use. Thus, it includes face-to-face communication with others, as well as the passive reception of information as in, for example, watching TV advertisements, without any intention to act on the information given".

Röling defends the usefulness of the system approach to analyse agricultural information and defines an *agricultural information system* as

> *...a system in which agricultural information is generated, transformed, consolidated, received and fed back... to underpin knowledge utilisation by agricultural producers. (1988: 33)*

Accordingly, an agricultural information system consists of components

(subsystems), information related processes (generation, transformation, storage, retrieval, integration, diffusion and utilisation), system mechanisms (interfaces and networks) and system operations (control and management). In addition, the analysis of the agricultural information system in a specific farming system may provide the identification of basic components and structure of the system, the different sources of information used by different components in the system, the understanding of how successfully the system works and how to improve system performance (system management) (Demiryurek 2000). This approach is also useful to identify possible defaults and improve the coordination between components (i.e., information management).

In addition, the information exchange (communication) through networks among system components is critically important for successful technology generation and information transfers (Rogers 1995; Ramirez 1997; Garforth 2001; Leeuwis 2004). A *communication network* consists of interconnected individuals who are linked by patterned flows of information, and its analysis identifies the communication structure in a system (Rogers & Kincaid 1981). Rogers (1995) emphasises that the exchange of information (communication) and its diffusion take place within a social system. Actors such as individuals, informal groups, organizations and subsystems are the members of the system and the structure of the social system and their actors or members' roles affect the diffusion process.

Checkland developed a *soft system methodology*, which allows a group of actors who are faced with a common problem to solve it in a collective learning process. This is in order to design a *human activity system* for collective action (Checkland 1981; Checkland & Holwell 1998). The soft system is a social construct and hence actors such as researchers, extension workers and farmers cannot normally be considered as a system. They can be formed as a system if they link together and contribute to the performance of the system.

Some authors criticise the system approach to agricultural information system and especially knowledge dissemination and its ultimate utilisation. They defend

a different approach, namely an *actor-oriented* view (Long 1984; Leeuwis *et al.* 1991; Leeuwis 2004). They emphasise that knowledge and information are the elements of a single process in which information is internalised to become a part of knowledge. Thus, it is difficult to distinguish between knowledge and information. The actor-oriented approach views knowledge processes as *social processes* which may lead to conflict among social groups or common perceptions and interests. Ramkumar (1995) developed an *actor-oriented information system approach* which considers the farmers' social, economic and cultural characteristics. This approach helps to understand the complexity of farmers' information systems and their relations with other systems.

In turn, the actor-oriented approach was also criticised because of its more individual base and main focus on specific social interaction. Thus, the agricultural information system is a holistic approach and can be used to identify the components of a system, to analyse its performance, and to design a better one.

Although research regarding information systems and their probable impact on agricultural holdings is vital for sound policy recommendation, few studies have addressed the relationship between farms (especially dairy) and information sources. Some of the important research related to and providing support for the current study is summarised here.

One of the early studies conducted by Rolls *et al.* (1994) analysed the information system for smallholder farmers in Malaysia. They put farmers central to the information system and found their roles as producer, inventor and communicator. There was a considerable information exchange among the actors in the system and the farmers in particular were active in disseminating innovative information and technology.

Similarly, Ramkumar (1995) analysed the information systems of dairy farmers in two villages of India and found that each farmer's information system was unique. There was little linkage between farmers and non-farmers in and outside the villages. The printed media and the dairy extension workers were rarely used as information sources, but the private veterinarian and the secretary of the

milk cooperative were widely used. The farmers functioned as both disseminators and users of information. Decision-making by the farmers was made more complex by inappropriate and inefficient information transfer from research and extension services. This compelled the farmers to capitalise on their working knowledge to find suitable solutions.

On the other hand, Garforth & Usher (1996) reviewed various models of information system processes such as development and transfer. They stressed that these processes showed that information does not simply flow, but is continually being transformed and adapted through communication. Systems models allowed the researchers to move away from unilinear conceptions of information and technology development and dealt more effectively with the diversity of information sources available to potential users.

One of the major problems for animal status monitoring and farm-level information system users and developers is to determine farmers' critical success factors and information needs which are generally based on their goals and management strategies. Thus, Huirne *et al.* (1997) analysed the critical success factors and information needs on dairy farms in the Netherlands and USA (Michigan) and found that they varied widely across regions, but were consistent over time if the farmers were analysed as a group. However, significant differences were found when the farmers were analysed individually, and this low level of consistency was mainly due to information supply from farm level. The most important critical factor was finance (i.e., net farm result, margin, costs and net profit) and followed by the production of milk and feed and marketing.

Ortiz (1997) analysed an *agricultural knowledge and information system* and researched the dissemination of integrated pest management related information among research, extension and potato producers in Peru. It was found that potato-related pest management is a kind of technology which demanded from farmers the management of more complex types of information and knowledge. This created for farmers the need to understand the technological principles of integrated pest management. The researcher concluded that

information dissemination required to be included within a learning system so that farmers could acquire appropriate knowledge and used it to make decisions in a more flexible way. In addition, the system formation was facilitated by personal and organizational sources with internal and external pressures and between demand for, and supply of, integrated pest management information.

Demiryurek (2000) also used agricultural information system theory to analyse the current information systems used by organic and non-organic hazelnut producers and found that the information systems for the two groups of farmers were largely separate. The conversion to organic production clearly demanded changes in the information system to allow producers to acquire the appropriate new knowledge and skills. The organic producers had used more information sources more frequently and more actively than non-organic producers.

Rolls *et al.* (1999) analysed the information systems in Czech agriculture. The information systems appeared to be the construct of the personal characteristics of the farmers. The farmers appeared to regard information as a social good to be exchanged and discussed within social networks. Printed materials, agricultural shows, and demonstrations were strong sources of agricultural information, and consultants also gained recognition as valued components of the information system. Rolls & Slavik (2003) also investigated changes in information systems in Czech agriculture over time. The actual sources of information were changed although about half remained the same. Printed media remained most important, social sources decreased in importance, and professional sources, such as consultants, research and university sources, increased. The horizontal transfer of information between similar farms remained very important. The researchers suggest that new information sources were needed relate to agricultural information and predicted that computerised databases will be increasingly used in the future.

Naidoo & Rolls (2000) also investigated agricultural information use by small-scale cattle farmers in Mauritius and found that the farmers managed information as a production resource. The personal characteristics and cattle husbandry practices of

the farmers were major influences on their management of information. The practices were mainly learnt from family elders. Extension advice was only partly remembered, or rejected as the information from this source was sometimes not useful.

This literature review shows that there have been no farm-level studies on information systems, and especially communication networks, for dairy production in Turkey. Thus, this specific case can be considered as a contribution to understanding the management of information systems for dairy farmers and their associations. The research methods and process employed, if found useful, will be available for analysing and developing similar production systems in other parts of Turkey, and in other countries with similar conditions. They can also be used to develop suggestions to solve common problems faced by developing countries, to improve policy programmes, extension and research activities, and to manage information on livestock production.

Research methods

Study area

The study area is a special location which is the biggest agricultural production area of the Black Sea region, Turkey. The study area was deliberately chosen due to practical limitations (i.e., time, finance and transportation). The area covers the two districts of Samsun province (Bafra and Vezirköpü) where there was a high membership rate of the Association. The main aim of the Association is to stimulate members to keep European breeds through providing them with financial incentives. In the study area, a dairy farmer who has more than five European pure breeds (Holstein Frasier, Brown Swiss and/or Simmental) can be a member of the Association and benefit from the financial incentives and information support from the association.

Interviews and sampling

This study used structured interviews as the primary source of data. The interview technique is a good way to access people's perceptions, meanings, definition of situations and constructions of reality. The purpose of the interviews was to

confirm the existence of information systems and record the details of them. The research objectives made it necessary to understand the sources of information used by the farmers when they are engaged in their production activities and managing their farms.

Following identification of the study population, the sample frame was defined and the sample size was determined by the simple random sampling method. The interviews aimed to be 95% accurate with a 10% margin of error. Random numbers were used to select farms from the populations.

Structured interviews were conducted in 2006 with forty-three members and sixty-five non-members of the Association (total of 108 respondents). To ensure reliability and validity of the interview instrument, we first conducted a pilot study with a small group of producers (ten organic and conventional). In the pilot study we tested and refined the interviews questions before conducting the main fieldwork. Cronbach alpha was used as an index of internal reliability or consistency for a set of questions (Cronbach 1951), and an alpha of 0.80 or higher was considered to indicate an acceptable level of internal reliability (Cramer 1998).

The major content of the interviews (the concept and variables of the research) are the socio-economic characteristics of farmers and their farm characteristics, information systems, and networks of farmers. The main questions related to the information system of the farmers, and focused on the sources of dairy farming-related information (whether personal, institutional or mass media sources), the extent of contact farmers had with the information, and the degree of usefulness. In order to define the last two concepts, the respondents were asked to specify each source of information with their frequency of contact (both receiving and giving information) for the previous year. In addition, they were asked to score the degree of usefulness of these sources. The respondents had no difficulty in remembering the extent of contact with information sources due to their limited use of many information sources (especially the institutional information sources).

Multiple data collection techniques were also used to increase the validity and

reliability of the research through triangulation. Observation and group discussion techniques were also used to expand the interview data collected.

Calculation of information scores

Information scores for each component of the farmers' agricultural information system were calculated by multiplying the weights of information contact with degree of information usefulness. Total Information Score is formulated as:

$$TIS_{ij} = FC_{ij} \; x \; IU_{ij}$$

where FC is the number of contact with information sources for the i-th dairy farm and IU is the usefulness of information for the i-th dairy farm.

The weights were given to each component according to the extent of information contact. The weight of 0 was given to no contact, 1 for once a year, 2 for two or three times a year, 4 for four or five times a year, 12 for once a month, 30 for two or three times a month, 52 for once a week, 130 for two or three times a week and 365 for information contacts once a day. Similarly, the degree of usefulness of information sources was also weighted. The weight of 0 was given to not useful at all, 0.25 for little useful, 0.50 for somewhat useful, 0.75 for useful and 1.00 for very useful. The scores were calculated on the basis of percentages of farmers' reporting each level of use of the sources.

Statistical tests

Three statistical tests were used in this research. First, the *Student t test* was used to compare the differences of scores of information sources between the two kinds of farmers. Second, the *Partial Correlation Coefficients (r)* test was used to statistically explore the association between the Total Information Score and some selected socio-economic variables. We considered the effects of the Association membership (being a member or not) as a controlling variable to measure these correlations more accurately. Third, the rankings of the information sources were compared by use of *Kendall's Rank Correlation Coefficient (tau-c)*. The value of the coefficient differs between -1 and +1 (the

one-to-one correspondence) and an unrelated order is 0.

Results and discussion

The socio-economic characteristics of members and non-members of the Association

Comparing the socio-economic characteristics of the dairy farmers is essential to develop appropriate methods to transfer information and to analyse the information system used by both members and non-members of the Association.

Member and non-member farmers participating in this study were similar in terms of age and educational level. Because of the demographic structure of the study area, older people generally stay in the villages and relatively younger people go to cities to find a work. The reason for educational similarities can be explained by lack of schools (i.e., mainly primary schools are available) at the village level. In conclusion, age and formal educational level did not function as discrimination factors for Association membership (Table 1).

Variables	Members of the Association		Non-members of the Association		Student t test
	Means	Std.Dev	Means	Std.Dev	p
Age of the farmer (in years)	44.53	8.42	47.75	11.86	
Formal education of farmers (in years)	6.12	2.17	5.46	2.30	
General agricultural experience (in years)	26.42	9.18	33.18	13.33	**
Dairy farm experience (in years)	12.05	9.70	21.23	14.76	**
Agricultural income (% in the total income)	90.81	21.21	79.23	35.46	*
Time allowance for agriculture (% in the total)	90.00	28.70	76.31	39.98	*
Total cultivated area (in hectare)	24.007	84.202	4.968	5.999	*
Land used for feed crops (in hectare)	12.105	32.436	2.121	2.1.71	**
Number of European breeds	17.14	29.33	2.48	3.72	**
Daily milk yield (in L/cow)	13.79	4.31	8.23	4.37	**
Total Information Score	1408,87	610,12	1037,08	617,57	**
Note: *p<0,05; **p<0,01					

Table 1: Comparison of socio-economic characteristics

Interestingly, the members of Association had less experience in terms of general agriculture and dairy farming compared to those non-member farmers, indicating that the members of Association were new entrants to

agriculture and especially to dairy farming. However, the majority of their income came from agriculture and, of course, dairying. This is supported with the finding regarding time allocation for agriculture. The members of Association spent more time on agriculture compared to the non-members. They had also more cultivated land and nearly half of the area was planted with feed crops. This is because the members owned larger farms, and also rented land and made extensive use of sharecropping. The members of Association also had more European breeds and naturally obtained more milk per cow. In addition, the Total Information Score of the Association members was higher than that of the non-members, implying that the former had benefited more from information sources (Table 1). The components of the agricultural information systems for and their comparison between member and non-members of the Association were further analysed.

These findings implied that the members of Association had higher socio-economic status in terms of farmers' personal characteristics and farm structure. These factors may influence the nature of the information system which shows the information sources contacted and benefited from dairy farmers (i.e., their total information scores).

The relation between Total Information Score and socio-economic variables for all respondents

The relations between Total Information Score and some selected socio-economic variables were also explored. Partial correlation coefficient between these variables (controlled by Association membership) was conducted to test the hypothesis for the data. The hypothesis was that the farmers with relatively higher socio-economic status sought and benefited from more information (i.e., higher score).

Table 2: Correlation between socio-economic variables and Total Information Score

Variables	Total Information Score correlation value (r)
Age of farmer (in years)	-0.163*
Formal education level of farmer (in years)	0.262**

General agricultural experience (in years)	-0.266**
Dairy farm experience (in years)	-0.279**
Agricultural income (% in the total income)	0.219*
Time allowance for agriculture (% of total)	0.161*
Total cultivated area (in hectare)	0.0142
Land used for feed crops (in hectare)	0.0156*
Number of European breeds	0.275**
Daily milk yield (in L/cow)	0.285**
*p<0.05; **p<0.01	

The age and experience (both in general and dairy farming) of dairy farmers is negatively correlated with the Total Information Score (Table 2), implying that relatively younger and less experienced farmers sought more information and benefited from it.

Positive and relatively higher correlations were found between Total Information Score and those selected variables such as milk yield, number of European breeds, share of agricultural income in total and years of formal education. These findings imply that the farmers with higher educational levels sought and benefited from information related to dairy farming and animal husbandry more intensively than those with lower education levels and vice versa (even considering Association membership). In addition, the farmers with higher Total Information Score had been relatively more involved in (especially dairy) farming, allocated more land for feed crops, had more numbers of European breeds, obtained more yield (milk per cow) and therefore had a higher income from agriculture (Table 2). These findings also emphasise the importance of Association membership in seeking information, and positive association between Total Information Score and higher socio-economic status.

The information systems for members and non-members of the Association

This part of the study presents the analysis of the information system used by both members and non-members of the Association and how frequently the respondents and information sources interacted. This analysis will then construct the main features of the communication networks, which are analysed in the next section.

Both members and non-members of Association shared a variety of information sources on dairy farming and related subjects. They also had sources of different origins and nature. The questions about the sources of information, how frequently they interacted and how useful they found were asked both to groups of farmers.

Table 3: Scores and rank orders of information sources

Sources of information	Members of Association		Non-members of Association		't' test
	Information score	Rank order	Information score	Rank order	p
1. Family members	259.23	1	249.50	1	
2. Other Association members	139.66	2	87.42	4	
3. Other conventional breeders	111.09	5	133.39	2	
Personal Information Sources (1+2+3)	509.98	1	470.31	1	
4. District Agricultural Engineers	78.42	10	55.37	8	
5. District Veterinarians	75.30	11	79.38	6	
6. District Technicians	51.71	12	47.41	9	
7. Public Research Institute staff	0.02	20	0.03	17	
8. University researchers	1.09	16	0.04	18	*
Public Information Sources (4+5+6+7+8)	206.54	4	182.23	3	
9. Association experts	135.85	3	41.41	11	**
10. Private veterinarians	127.53	4	101.91	3	
11. Feed suppliers	99.08	7	69.69	7	
12. Medicine suppliers	81.45	9	45.50	10	*
Private information sources (9+10+11+12)	443.91	2	258.51	2	**
13. Television programmes	110.47	6	86.44	5	
14. Video programmes	0.57	18	0.17	15	
15. Radio programmes	13.15	15	2.85	13	
16. Agricultural manuals	82.49	8	36.21	12	*
17. Agricultural courses	1.05	17	0.30	14	
18. Demonstrations	0.39	19	0.05	16	
19. Personal computers	23.34	13	-	-	*
20. The Internet	16.98	14	-	-	*
Mass media (13+14+15+16+17+18+19+20)	248.44	3	126.02	4	**
Total Information Score	1408.87	-	1037.07	-	**

*p<0,05; **p<0,01
Kendall's tau for all components = 0.653 (High agreement)
Kendall's tau for Personal information sources = 0.333 (Weak disagreement)
Kendall's tau for the Public information sources = 0.600 (High agreement)
Kendall's tau for the Private information sources = 0.000 (Perfect disagreement)
Kendall's tau for the Mass media = 0.400 (Moderate agreement)

As can be seen from Table 3, both groups of farmers obviously used a wide range

of information sources. Although most sources were common to both groups, four of the sources were nearly exclusive to the Association members. Two of these were implicitly exclusive, namely the personal computers and the Internet. Although the Association experts and other Association members were also available for the non-members, these sources were little used by them. In addition the research institutes, university staff, video programmes, demonstrations and agricultural courses were almost unused. The reasons for the differences in using information sources between the members and non-members of Association are discussed in detail below.

The components of the system were also categorised according to their similarities (Table 3). Four categories emerged: Personal information sources, Public information sources, Private information sources and Mass media. There was an association between the rank orders of both groups of farmers when considering these categories. The value of the coefficient was 0.653, showing quite a high positive agreement.

Overall, the Total Information Score of Association members was higher than that of the non-member respondents, because the former had more extensively benefited from seven of the twenty sources of information. There was no difference between the two groups of dairy farmers with regards to the use of most of the personal or public information sources. (Table 3).

The rankings of the Personal information sources components were compared for members and non-members of Association and measured 0.333, indicating weak disagreement. The most valued information source was the 'Other similar group of farmers'. In other words, the members of Association mainly exchanged information within each other. There was limited information exchange across groups (i.e., between members and non-members of Association). This implies that information exchanges generally occurred within similar groups of farmers. However, there was more and beneficial contact between the respondent members of Association and other non-members of Association (score 111.09) than between the non-member respondents and other Association members (score 87.42).

This suggests that the members of Association more frequently evaluate their situation and compared it with non-member farmers (Table 3).

The Private information sources subsystem consisted of Association experts, private veterinarian and input (both feed and medicine) suppliers. The private veterinarians and the input suppliers were widely used by both groups of dairy farmers, which may indicate that they were perceived as credible sources of information on dairy farming. There was of course a significant difference between the respondents' uses of Association experts. More Association members had more contacted with and benefited from these sources. Evidently, the Private information sources and specifically the Association experts did not function much as information sources for the non-members of Association (Table 3).

The Association experts are the key people in the system and have two main responsibilities, namely the management of organizational activities (office work) and the services of technical and information supports (fieldwork). However, the interviews with the experts revealed that they could not balance those two responsibilities due to intensive office works and thus, farmer training and extension activities were mainly neglected (Table 3).

Although the Association experts were one of the main sources of information for their members, they were not more important than family members and other member of Association. This situation stimulated the members of Association to employ more Personal information sources and to generate and exchange their own information sources (Table 3).

The Public information sources were information sources from outside the villages and operated by professional staff of various institutions. Although they were supposed to be the main scientific and technical support services for the farmers, they were rarely used. The information exchanges between the dairy farmers and the Public information sources were generally weak, limited and led, or initiated, by the dairy farmers. The main reasons for the lack of extension services provided by the public agricultural directorates and their staff at the village levels were the lack of finance, personnel and mobility. Moreover, the staff were too busy with

the paperwork. On the other hand, the majority of the dairy farmers were unaware of the existence of these institutes and their research activities. Unfortunately, there was neither a specific extension branch of these institutions to transfer their research results to the farmers nor had they collaborated on farm trials with the farmers (Table 3) .

Agricultural information can be transferred to large numbers of farmers through mass media simultaneously and at a lower cost per farmer than other extension methods (group or individual). However, the availability of these sources limits the farmers' access, and hence their usefulness. In addition, the mass media has weaker feedback potential than other conventional extension methods and the capacity of these sources at the stage of adoption of agricultural innovations is limited (Demiryurek 2006).

The varioius Mass media were least beneficial for non-members of Association. The members of Association benefited more from some media (i.e., the agricultural manuals, personal computers and the Internet) than non-members (Table 3). The main reason for the lack of contact with Mass media sources was the limited number of programmes on dairy farming. Moreover, both public and private institutes and their staff seldom used printed and audio-visual materials in their training and extension activities.

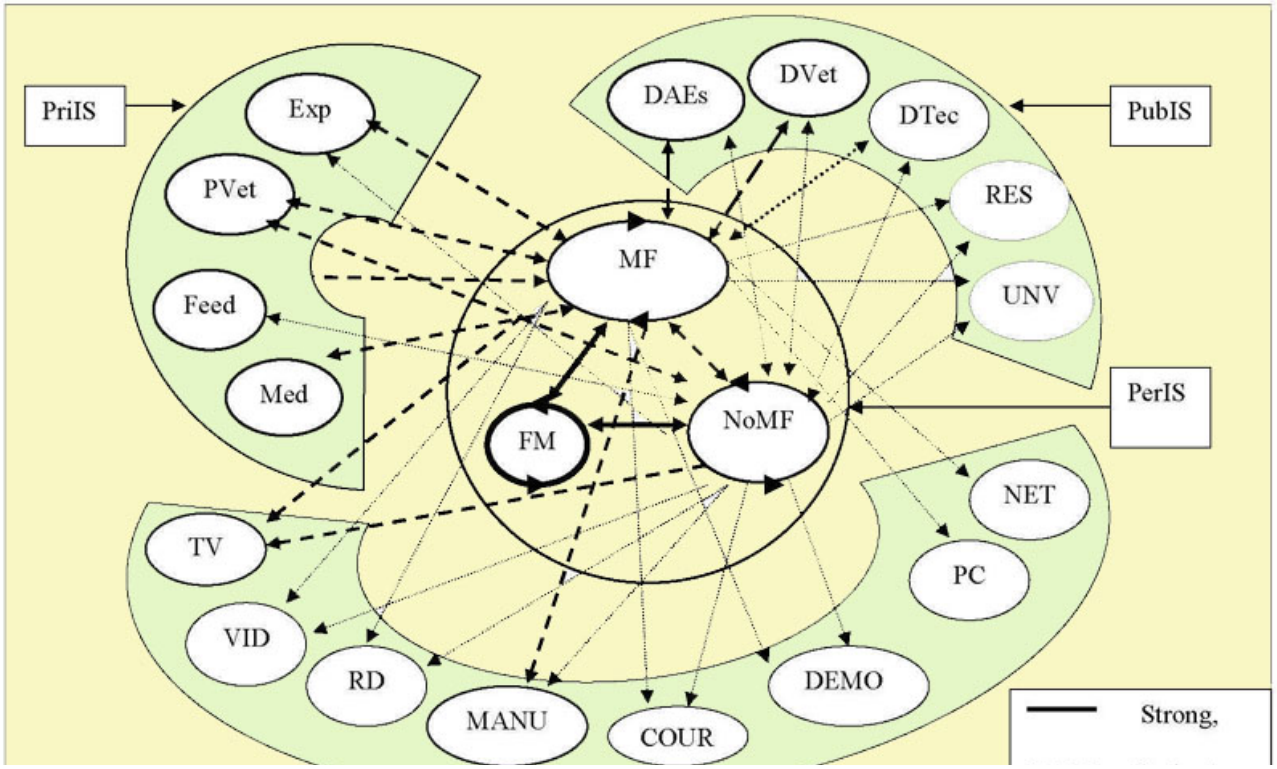
The communication networks for all respondents

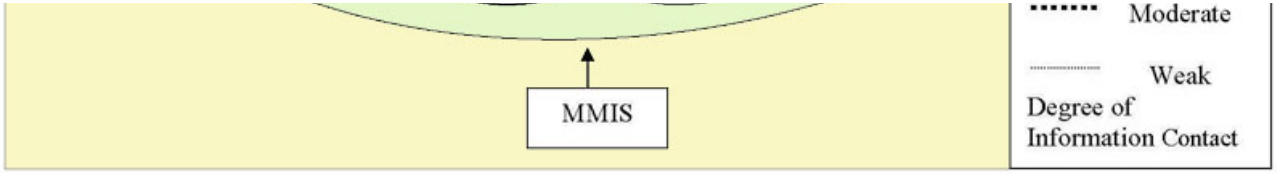
The data collected from the members and non-members of Association were combined and used to model the communication networks (Figure 1). The complexity of the network and its interactions became evident from the data, and conclusions about the nature of the information exchanges between the actors and organizations can now be drawn.

The degree of information contact was categorised into three main groups (Figure 1) according to the information scores (IS) of each information source (Table 3). There were weak (IS<74), moderate (75<IS<149) and strong (IS>150) degrees of information contact.

There was a strong system for information exchange among the components of the Personal information sources subsystem (especially among Association members). These interactions within the subsystem constituted a good level of dissemination of information within and between the farmers (Figure 1).

The Private information sources were one of the main sources of information for both groups of dairy farmer. The Association experts were, understandably, more widely beneficial to members of Association than to non-members. Along with the Association experts, private veterinarians were perceived as beneficial information sources for both groups of dairy farmers. This analysis also shows that these sources were more functional than Public information sources sources because of their availability and credibility. Mass media were the least beneficial for the non-members of Association, while the members of Association were more active in searching for and using information from their manuals, personal computers and the Internet (Figure 1).





Legend

COUR - Agricultural courses; DAEs - District agricultural engineers; DEMO - Demonstrations; DTec - District technicians; DVet - District veterinarians; Exp - Association experts; Feed - Feed suppliers; FM - Family members; MANU - Agricultural manuals; Med - Medicine suppliers; MF - Other Association members; MMIS - Mass media information sources;	NET - Internet; NoMF - Other conventional breeders; PC - Personal computer; PVet - Private veterinarians; PerIS - Personal information sources; PriIS - Private information sources; PubIS - Public information sources; RD - Radio programmes; RES - Public research institute staff; TV - Television; UNV - University researchers; VID - Video programmes

Figure 1: The communication networks for the dairy farmers in the study area

As mentioned in the literature review section, the previous studies confirm that personal information sources were the main sources of information for dairy farmers in India (Ramkumar 1995), for potato producers in Peru (Ortiz 1997), for hazelnut producers in Turkey (Demiryurek 2000; 2005) and for cattle farmers in Mauritius (Naidoo & Rolls 2000). Those studies also support the other findings of the current study and explain this situation as a consequence of limited information support from public, private and mass media information sources.

Conclusions and recommendations

The main function of the information system was assumed to be the generation and dissemination of dairy farming information. Although individual sources existed to exchange information in various forms and frequency, the analysis shows that primarily Association sources helped farmers to select European breeds, organize them under an association, keep the records of their breeds, stimulate them to keep more European breeds and obtain more milk yield per cow through financial incentives and other support services.

However, the agricultural information system did not function in such a way to enable agricultural research to be used to develop a modern dairy sector that could then, in turn, be supported by a functional information support (research and

extension) subsystem. This could have been a serious alternative to conventional (low yield with native breeds) dairy production system.

The accessibility, relevance and credibility of the information from other dairy farmers can explain its importance. This enhances the diffusion of information and technology within a cohesive, similar group and supports interaction between different groups. However, this information is mainly based on farmers' current knowledge and traditional practices which are not generally based on scientific application. Whether this independence and self-reliance for information may result in synergy or entropy for the whole system can only be a matter for speculation.

At this stage, the remarkable features of the system are its fragmentation and the existence of strong boundaries that appear to isolate the subsystems and both groups of farmers. The information system analysis indicates that more interactive information sources are needed. This may stimulate conventional dairy farmers to convert to the modern approaches of dairy farming. These changes could have been stimulated by more active experts working with selected local leaders if they had developed and improved relationships with public (especially extension and research) and private information sources, organized common activities with them, used more mass media information sources, obtained information from all these sources and transferred information to the producers.

Agricultural information system theory used in this study helps us to understand the situation as a whole (i.e., to provide an holistic approach) and to identify the strengths and weaknesses of the system studied. The interview research method used seemed to allow the perspectives of the farmers involved in the system to emerge. Data collected from different components of the system (triangulation of sources) and multiple data collection techniques (interview schedules and fieldwork observation) were useful to enhance the validity of the results. However, the data collected from the various actors may have emphasised their perceptions rather than the reality that might have emerged from a longer period of

participant observation than was possible.

This research concerned the nature and working of the current information systems used by both members and non-members of the Association. The focus of the study was directed to the interactions and information exchanges between these farmers and within their information sources. It would possibly have been useful to expand this focus to include (interview with) some selected professional staff and their information sources.

In contrast to the usual holistic approaches to the analysis of agricultural information system, the more individual and cognitive processes of producers i.e., the acquisition of knowledge about dairy farming, and its structure and management, could be an interesting subject for further research. In addition, the analysis of complex social structures in rural settings can be made with more dynamic communication (social) network analysis.

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