

**A PARTICIPATORY KNOWLEDGE INFORMATION SYSTEM FOR BEEF  
FARMERS – A CASE APPLIED TO THE STATE OF MATO GROSSO DO  
SUL, BRAZIL**

By

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## **Declaration**

I hereby declare that this thesis has been composed by me and that all work presented in the thesis is my own unless specifically otherwise stated

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## Abstract

This research is concerned with how farmers' knowledge networks are socially developed, in order to facilitate the development of a conceptual model focusing on the generation and transfer of technology. The conceptual background is that farmers' knowledge, goals and objectives should be integrated into a participatory model for the development of an agricultural knowledge information system (AKIS). In order to develop this research focus, two communities of Brazilian beef farmers belonging to different eco-regions were selected as the target social groups. Further, the National Centre for Beef Cattle Research (CNPGC-EMBRAPA) is the linked regional agency for the development of applied technology for beef. The objectives of this research are: (a) to investigate how farmers' information flows are socially developed, in relation to farm decision-making; (b) to identify and describe the structure of beef farmers' information systems; (c) to analyse relationships between "farmer" knowledge and CNPGC-EMBRAPA's technologies; (d) to develop a methodological learning approach in order to assess farmers' information demands and to improve the process of generating and transferring technology.

In order to examine the above research issues, a combination of survey (questionnaire) and case studies (in-depth interview) was applied to elicit data from a stratified random sample of the farmer population. Six groups of farmers were identified through application of multivariate analysis (factor and cluster) on selected set of *information* and *social* variables. In-depth interviews (qualitative data) were carried out with one representative farmer from each group and four nominated "trusted persons", in order to obtain deeper insights into the social construction of the farmers' information network, and to access additional data to permit a more comprehensive testing of the research hypotheses.

This research has indicated that each group of farmers develops its own information system. The social construction of the farmers' information networks presents some common characteristics, but each farmer builds the network on the basis of his/her values, beliefs, education, time preferences, and intensity of using the available sources of information; however, this is always marked by the presence of a "trusted person". Informal communication is preferred among farmers rather than reading to obtain information. The participation of CNPGC-EMBRAPA in the farmers' information networks has been peripheral. Although the farmers are using some of the developed technologies, the more advanced and wealthy farmers are taking advantage of the overall technologies. A participatory conceptual framework, both to link the technological innovation to the majority of farmers' needs and, at same the time, to increase the institutional efficiency, is proposed.

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## List of Abbreviations

ACRISUL	Breeder Association of Mato Grosso do Sul
AET	Agricultural Education Training
AKIS	Agricultural Knowledge Information System
AKS	Agricultural Knowledge Systems
ANUALPEC	Annual Livestock Statistical Report
C1, C2 and C3	Farmer Case 1, 2 and 3 of Campo Grande
CC	Centroid Co-ordinate
CIMMYT	Maize and Wheat Improvement Centre
CIP	International Potato Centre
CNPC	National Council for Livestock
CNPGC	National Centre for Beef Cattle Research
CPs	Productive Chains
cv	Cultivar
D	Distance
DPD	Department of Research and Diffusion
DSS	Decision Support Systems
DSSAT	Decision Support System for Agrotechnology Transfer
EMBRAPA	Brazilian Agricultural Research Corporation
EMPAER	Enterprise of Rural Extension
FAO	Food and Agricultural Organization
FD-MU	Farm Family Decision-Making Unit
FPR	Farming Participatory Research
FSR/E	Farming System Research/Extension
GATT	General Agreement on Tariffs and Trade
GOs	Government Organisations
IBAMA	Brazilian Institute of Environment and Renewable Natural Resources
IBGE	Brazilian Institute of Geography
ICRAF	International Centre for Research in Agroforestry
IDS	Institute of Development Studies

IGP	General Indices of Price
IICA	Institute Inter- American for Agricultural Cooperation
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
MERCOSUL	Southern Cone Common Market
MR	Micro Region
NGOs	Non Government Organisations
P1, P2 and P3	Farmer Case 1, 2 and 3 of Pantanal
PCBAP	Upper Paraguay River Basin Conservation Plan
PRA	Participatory Rural Appraisal
R&D	Research and Development
RRA	Rapid Rural Appraisal
S.U.	Livestock Unit (bovine of 450 kg)
SAS	Statistical Analysis Software
SEP	Planning Research System
SIP	Planning Information System
SP	Production Systems
SPSS	Statistical Package for Social Sciences
Std Dev	Standard Deviation
TOT	Transfer of Technology
TP1, TP2, TP3 and TP4	Trusted Persons
USA	United States of America
WARDA	West Africa Rice Development Association
WCED	World Commission on Environment and Development
WOFOST	World Food Studies
WWF	World Wildlife Foundation



# Chapter 1

## Introduction

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### 1.1 Introductory background

Agricultural development is becoming increasingly dependent on knowledge and technology transfer as a consequence of the greater focus upon environmental issues and demands to improve social welfare (WCED, 1990; Conway, 1990; Conway and Babier, 1990; Flores *et al.*, 1991; FAO, 1992; Chambers *et al.*, 1993; Crosson and Anderson, 1993; ISNAR, 1995; Dent *et al.*, 1995, 1996; Garforth, 1998). Currently, the forces driving R&D in agriculture claims to incorporate non-market components contrasting with the traditional influence from supply factors which encouraged the “green revolution” in the past (de Wit, 1990; WCED, 1990; FAO, 1992; Okali *et al.*, 1994; Anderson *et al.*, 1994; Alston *et al.*, 1995; Dent *et al.*, 1995).

According to Röling (1994a) it is no longer sufficient to consider farmers solely as primary producers, since the effects of farm decision-making are reflected in their eco-systems. Local farmer’s knowledge, goals and objectives are key components in the process of technology innovation in order to meet sustainable development objectives (Kloppenburg, 1991; Bunting, 1992; Word Bank, 1992, Chambers *et al.*, 1993; Röling 1994a; Dent *et al.*, 1995; Skerratt, 1995).

The introduction of the concepts and theory of systems brought marked advances in better understanding the functioning of farm complexities (Dent and Anderson, 1971; Dillon, 1971; Spedding, 1988). However, the traditional linear “top-down” model of technology development from research to farmers has continued as the way to meet the farm family needs, sustainable development, and limited the expansion of knowledge (Richards, 1985; Röling, 1988; Hildebrand, 1990; Kaimowitz, 1991; Chambers, 1993).

Farming Systems Research and Extension (FSR/E) emerged as a movement to overcome the limitations of such a model to develop and transfer technology (Jones and Wallace, 1986; Collinson, 1988; Hildebrand, 1990; Gartner, 1990; Tripp, 1991a; Sumberg and Okali, 1993; Amanor *et al.*, 1993; Cornwall *et al.*, 1994; Gibbon, 1994). Although FSR/E has advanced in this direction, limitations still remain, because such technological innovation continues to be totally developed within the research domain, where the flow of knowledge is generally in the direction of research results to farmers, and therefore remains insensitive to farmer's knowledge (Cornwall, *et al.*, 1994).

Participatory approaches have evolved from a large number of initiatives recognising participation as central issue for changes (Cornwall *et al.*, 1994). Participatory Rural Appraisal (PRA) has been presented as an evolutionary approach to integrate farmer's knowledge into the process of technology development (Theis and Grady, 1991; Chambers, 1992; Scoones and Thompson, 1994a; Freudenberger, 1994). This approach is in agreement with the philosophical pedagogy of "*humanisation*" of Paulo Freire (Freire, 1972; 1974), which "*every human being, no matter how "ignorant" he may be, is able of looking critically at his world in a dialogical encounter with others*" (Shaul, 1972). In fact, this is a new vision where peasants and farmers, no matter social status, are seen as thinking beings capable of creative actions according to their perceptions of the reality, contrasting with the traditional approach which considers them as passive receivers of technological packages. PRA demands that the researcher is oriented to learning attitudes in order to understand farmers' multiple knowledge, objectives and perspectives (Freudenberger, 1994).

Röling and Engel (1991) have incorporated participatory appraisal into an extended conceptual model to pursue a learning process which integrates local knowledge networks of farmers, researchers and extension officers, into an Agricultural Knowledge Information System (AKIS). However, a crucial and key aspect of these models' functioning is to take into account the *diversity* of the farmers' information knowledge networks and the social interactions, which have not been properly studied and incorporated into the models (see also Bennett, 1986 and Skerratt, 1998).

Further, at a higher level of decision, the complexity of an AKIS can be expanded to include issues related with Agricultural Education Training (AET) to support agricultural production and rural development of a nation as whole (Wallace *et al.*, 1996). The complexity stems from learning needs of: rural producers and their household members; people “outside” farming who provide agricultural inputs and services; professionals involved with research, extension, agricultural teaching, banking and associated activities; children in primary and secondary schools receiving “basic” information and skills upon agriculture; and young people being prepared for a career in farming or rural sector (Wallace *et al.*, 1996).

## **1.2 Thesis development and associated environment**

It has been recognised that most of the agricultural production units are characterised as farm family business (Errington and Gasson, 1994; Dent *et al.*, 1994; Ferreira 1997). Therefore the decisions at farm level are strongly affected by the socio-cultural context as well as the adoption of any policy or technology (Gasson, 1971; Dent *et al.*, 1994, Skerratt, 1995). In such a context, the process of decision-making is supported on a farmer’s information system in which “external” (out side farm) and “internal” (farmer knowledge and experience) information are brought into the process in order to find the best choice (Errington, 1985a; Ban and Hawkins, 1996). In general, the farmers are left to assimilate external information (e.g. new technologies) without an adequate assistance. The gap between the research process and how it is being presented to the farmers have not been adequately bridged.

Therefore, a better understanding of the decision process and the interrelation of the information mechanisms with agricultural policy/research and extension is crucial in order to provide guidance on the development of rural policies, research and extension priorities, and “delivery mechanisms” (policies and technologies) (Dent, 1994; Ferreira, 1997). As a result, it is expected that such an understanding should be possible to improve both the access of the farmers to “external” information and the efficiency of rural development agencies.

It is the underlying perspective of this thesis that the concepts and functioning underpinning an AKIS should be applied to increase the effectiveness of regional development and farm decision making. However, it appears relevant to begin by understanding how farmers' knowledge networks are socially developed. Communication networks are important components of farming systems, but according to Ramirez (1997) "*they are seldom perceived as a researchable dimension, or as a field of development which can be worked on and improved*". Further, an eco-regional approach should be applied as a methodological way to aggregate the components of a specific system (Röling, 1994a; Rabbinge, 1995). It is suggested that in so doing, better biophysical and socio-economic insights are facilitated and problem solutions can be more objectively found. Furthermore, it may be possible to understand better how farming operates within a region and how farmer's knowledge is locally and socially developed.

This thesis, therefore, is concerned with the overall process of farm decision-making and its implications for the development and technology transfer. Specifically the aim is to identify and understand how beef farmers' knowledge networks are socially developed within the process of farm decision-making. This is to facilitate a conceptual participatory model for development and transfer of technology which better approaches to beef farmers' needs and sustainable regional development. Two communities of Brazilian beef cattle farmers, belonging to different eco-regions in the State of Mato Grosso do Sul, Brazil, are the target social groups in this research.

This regional beef production has experienced a marked increase as a result of a rapid agricultural development which incorporated new areas of cultivated pastures into the production systems following incentives from government policies in the 1960's and 70's (see Chapter 2). However, recent increase in production is perceived as being from the aggregation of scientific knowledge and technology transfer associated with improvements of agricultural inputs and services, since incorporation of marginal areas into the productive process is no longer supported by policies or even economically and environmentally attractive (see Chapter 2).

Therefore, the regional agency for development of applied technology on beef, the National Centre for Beef Cattle Research (CNPGC) - EMBRAPA (Brazilian Agricultural Research Corporation), created in 1975, located in Campo Grande, State of Mato Grosso do Sul, with a multidisciplinary research team of forty-four researchers and an associated staff of two hundred people, comprises the institutional focus of this thesis. In the light of the thesis background, which is associated with an urgent need of reviewing the institutional approaches in order to adequate the institutions to new scenarios and paradigms, the development of the research problem in this thesis is represented by following hypotheses:

### **Hypothesis 1:**

The existing knowledge information systems of beef cattle farmers are complex networks of diverse sources and communication channels in which the participation of CNPGC-EMBRAPA has been peripheral.

#### ***Sub-hypothesis 1.1:***

A priori understanding of the format of farmers' knowledge information systems can facilitate the process of knowledge acquisition from the farmers.

### **Hypothesis 2:**

Technology development by CNPGC-EMBRAPA has not fully met the needs of the majority of beef farmers in the selected regions. This is because farmers have not participated effectively in the decisions of EMBRAPA due to inadequacy of adopted institutional participatory approaches, and top-down decisions.

#### ***Sub-hypothesis 2.1:***

Farmers adjust technologies and research findings to their specific situations and conveniences better than formal researchers.

### **Hypothesis 3:**

Farmers running beef cattle systems dependent on native pasture are more concerned about environmental conservation than farmers running systems on cultivated pastures.

### *Sub-hypothesis 3.1:*

The ecosystem has a strong effect on farmers' attitudes, goals, objectives, and decisions, as well as in the structure of their knowledge information systems.

### **Hypothesis 4:**

A dynamic, participatory and learning knowledge information system, taking into account the characteristics of information and knowledge flows of beef cattle farmers, can be proposed to create and disseminate information and technologies which better meet farmer's need in the region.

## **1.3 Structure of the thesis**

This thesis begins broadly by developing a holistic overview of the research background followed by Chapters focusing on the research methodology, research results, discussion of the hypotheses, implications and recommendations. These Chapters can be summarised as follows:

- Chapter 2 highlights the importance, evolution, limitations, future scenarios and main issues of the beef industry at National and Regional level.
- Chapter 3 is concerned with issues of agricultural research in a new context in which farmer's knowledge, goals and objectives are no longer neglected, and where participatory approaches are claimed as an adequate way to develop the technological innovations for sustainable development. In this new context, the strong and weak points of the approach of EMBRAPA are also highlighted.
- Chapter 4 comprises a literature review of the process of on-farm decision-making, and the ways in which farmers' knowledge information systems are socially developed. This review also includes a discussion of participatory approaches aimed at integrating researcher and farmer in the process of technology development. Details of the research hypotheses are then outlined.
- Chapter 5 is concerned with the methodological approaches applied in this research. The combination of survey (questionnaire) and case study (in-depth interview) is presented as the best approach to elicit data and information relating to the research problem. The survey is applied as a method to provide data in

order to identify the characteristics of the study population, to discuss the hypotheses and to identify possible groups of farms. Case study methodology is used to obtain deep insights into the social construction of the farmers' information network, and to access further data, which facilitates a more comprehensive testing of the hypotheses. A review and conceptual background of the survey and case study is presented. The background to multivariate techniques (factor and cluster analysis) is also outlined, including a description of how these methods, firstly, allow for the identification of possible groups of farmers, and secondly, facilitate the selection of representative cases.

- Chapter 6 is concerned with a description of the sample population based on the data obtained from the survey, and highlighting differences between the regions.
- The application of multivariate techniques (factor and cluster analysis) to identify groups of farmers, and to facilitate the selection of representative farmers for case studies, are described in Chapter 7.
- In Chapter 8, the data from the six case studies (in-depth interviews) within the groups of farmers and from four “trusted” people who were nominated by the case studies, are presented and discussed.
- The synthesis of this research is presented in Chapter 9. Specifically, the frameworks and discussion of the information networks, as well as a synthesis of the social links between the cases and their respective “trusted persons”, are presented.
- The hypotheses are discussed in Chapter 10. Further, as a result of the synthesis of the preceding issues related to the development of technological innovations, a conceptual framework of a dynamic participatory knowledge information system is presented.
- Finally, a summary of the key implications, and recommendation for government, research and extension policies, are presented in Chapter 11.

# Chapter 2

## Beef Industry: Midwest Region – State of Mato Grosso do Sul

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### 2.1 The Brazilian beef industry

The Brazilian beef industry, with an estimated herd of 159.2 million head, has played a marked role in the national economy and occupied an important place in the world beef production, only inferior in size to India's herd. The Brazilian chain of the beef industry, including services, transport, and by-product manufactures, has a gross income of US \$13,1 billion (CNPQ, 1993). The herd growth follows the increase of cultivated pastures in all Brazilian Regions, (see Table 2.1 and Table 2.2). Although over the last decade the herd has experienced a small growth rate, beef meat production has jumped from 4.97 million to 6.19 million ton (ANUALPEC, 1998) through production system improvements.

The internal market of 160 million people has consumed almost all of the production. However, the annual consumption of 34 kg per capita is considered low in comparison to the border countries of Argentina and Uruguay, each consuming 68 and 78 kg respectively, (ANUALPEC, 1995). The main limiting factor in this low consumption is the unbalanced distribution of income, even though the price of a prime cut is still low (US \$ 4.66/kg, price of 1998).

Historically, this imbalance is related to an inequitable social welfare system, where in 1995, according to GOVERNO DO BRAZIL (1998) 50 per cent of the poorest had only 11.6 per cent of total income while 20 per cent of the richest obtained 63.3 per cent. An average GNP of US \$ 4,400 per capita per year (World Bank, 1996) has limited the purchasing power of Brazilian people. However, a marked increase in the internal demand of beef meat is anticipated in future.



Despite the size of the herd, Table 2.3 shows that the performance of the Brazilian beef meat industry is below the other traditional producers such as Argentina, Australia and USA, contributing only 11 per cent of the world production (Zimmer and Euclides Filho, 1997). The advanced age of males at slaughter, and of females at first calving, associated with a low calving rate and a high calf mortality, are the main factors for the low performance. Although Brazil still has plenty of land to develop, there is also much of opportunity to increase the land productivity through the use of technology. The high cost and environmental issues related to incorporating new lands into the productive process have not encouraged the farmers to expand the agricultural frontier.

**Table 2.1: Annual growth rate of cattle herd (1970 - 1995)**

Regions	Annual Growth Rate (%)			Heads	
	70/80	80/90	90/95	Heads ('000)	% of total
North	13.3	12.5	9.3	19,529	12.3
Northeast	5.6	2.2	-3.1	22,142	13.9
Southeast	3.0	4.3	0.0	36,289	22.8
South	2.9	0.3	1.1	26,692	16.7
Midwest	9.3	5.1	4.2	54,609	34.3
<b>Mean (Brazil)</b>	<b>5.0</b>	<b>2.5</b>	<b>1.6</b>	<b>159,261</b>	<b>100</b>

Source: IBGE (1995) adapted from Zimmer and Euclides Filho (1997)

**Table 2.2: Distribution of pasture areas according to Brazilian Regions ('000) hectares**

Regions	1970		1985		1995*
	Cultivated	Total (native+cult.)	Cultivated	Total (native+cult.)	Cultivated
North	638	4,428	9,122	20,877	20,000
Northeast	5,751	27,875	11,866	35,149	14,000
Southeast	10,663	44,739	16,723	42,487	20,000
South	3,637	21,613	6,142	21,433	8,000
Midwest	9,073	55,483	30,252	59,244	43,000
<b>Total (Brazil)</b>	<b>29,782</b>	<b>154,138</b>	<b>74,105</b>	<b>179,190</b>	<b>105,000</b>

\* Estimated

Source: IBGE (1995) cited by Zimmer and Euclides Filho (1997)

**Table 2.3: Cattle herd, slaughter rates and carcass production of main producer Countries and Regions in the world, 1995**

Country/ Region	Herd (‘000 heads)	Slaughter (‘000 heads)	Slaughter rate %	Production (‘000 t)
Brazil	159,261	27,000	17	5,400
Argentina	54,207	12,300	23	2,600
Uruguay	10,512	1,506	16	370
South America	257,150	48,495	20	9,972
USA	102,755	37,249	36	11,585
North America	145,795	48,992	34	14,363
Australia	25,736	7,917	31	1,717
Oceania	34,448	11,482	31	2,347
France	20,524	5,992	29	1,640
European Union	83,409	28,316	34	7,846
India	274,155	9,470	3	1,230
China	123,317	34,900	28	4,154
Asia	410,067	47,459	12	6,344
Russian Fed.	70,949	27,942	39	4,405
World	1,057,609	226,520		48,374

Source: DBO Rural (1997) and ANUALPEC 97 (1997) adapted from Zimmer and Euclides Filho (1997)

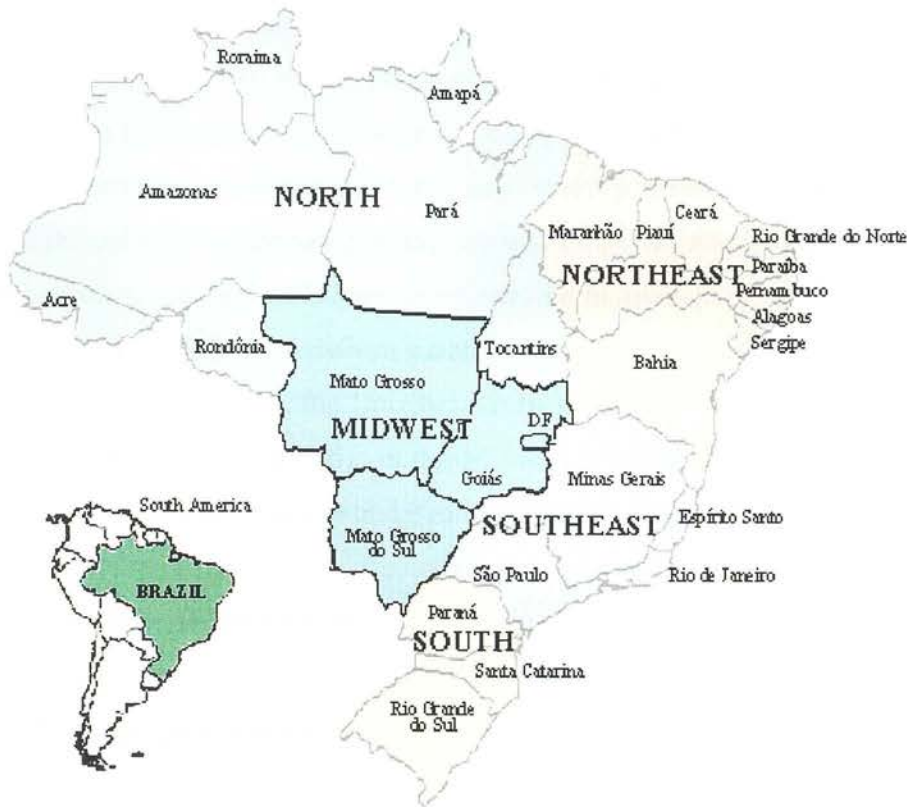
## 2.2 The Midwest Region and the State of Mato Grosso do Sul

The State of Mato Grosso do Sul is located in the Midwest Region (see Figure 2.1). Even though the Midwest Region occupies only 18.9 per cent of Brazilian territory, 34.3 per cent of the national cattle herd is in its 1,613,000 km<sup>2</sup>. The area of the State of Mato Grosso do Sul occupies 22.2 per cent of the Midwest, but the cattle herd, with 19,7 million head (IBGE, 1998a), represents 12.3 per cent of the national herd. Thus, the State of Mato Grosso do Sul has had an important place in the Brazilian beef industry.

### 2.2.1 Agricultural development in the Brazilian Midwest

Historically, the beef industry has become a much more important component of the region than is the case at the national level since primary production has been the main socio-economic component of regional development. Other segments associated with beef farming such as the slaughter industry, commerce and services are also integrated locally as part of the economic complex.

**Figure 2.1: States and Brazilian Regions**



During the 1970's and 80's, the highest growth rates of the beef cattle industry were registered in the Region. As shown in Table 2.1 the area of cultivated pasture increased 335 per cent and the cattle herd grew at annual rates of 9.3 per cent (70/80) and 5.1 per cent (80/90). The growth was encouraged through subsidised interest rates and long term payment schedules. These policies were created to promote agricultural development to support Brazilian industry, to provide new social opportunities in undeveloped areas and to minimise the “rural exodus”. They also ensured an internal food supply with excess being exported.

As a result of those policies, the landscape scenery of native vegetation (savannah and forest) was transformed into extensive areas of cultivated pastures and annual cropping. The main actors in this process were the traditional farmers, entrepreneurs, cropping farmers from the South and successful professionals. Each group was strongly motivated by the attractive policies, but they also had their own goals.

Traditional beef cattle farmers wanted to increase stocking capacity by replacing the rangeland with improved pastures. Entrepreneurs, from different sectors of the economy, were seeking diversified investments within the agricultural sector. Farmers from the South were motivated by transferring and extending their cropping activities to Midwest, due the low price of the land. Finally, successful professionals became farmers because they were also seeking alternative opportunities. The development process happened so rapidly that there was insufficient time to develop the best techniques and assistance. However, the motivation of economic growth was sufficiently powerful to transform natural resources into more intensive agricultural activities. In other words, the Brazilian green revolution was part of the “economic miracle of the 70’s”. Currently, in the Midwest, more than 40 million ha of land is occupied by cultivated pasture and 8 million by cash cropping (IBGE, 1995).

## **2.2.2 The State of Mato Grosso do Sul**

### **2.2.2.1 Geographic location**

The State is located between the parallels 17° S and 24° S and the meridians 51° and 58. Geographically the State is well located in relation to trading and supplying businesses.

### **2.2.2.2 Topography**

The topography is characterised by four main landscapes (Mato Grosso do Sul, 1990). Plateau, patamars and plains dominate the eastern part. A vast lowered surface is found from the eastern border to the west. Some land elevation appears in the middle of the lowered area providing exceptional scenery in the region.

### **2.2.2.3 Soils**

According to Mato Grosso do Sul (1990) twenty-four classes of soils have been identified - each with a variation of natural fertility having developed under different

conditions of topography and use. However, as shown in the Table 2.4, 75 per cent of the State is represented by seven soil classes. The first three classes cover the plateau region where the main crops and cultivated pastures are located (Zimmer and Euclides, 1997).

The Latossolo Vermelho-Escuros (LVEs) are acidic and poor in phosphorous and other nutrients. Different textures occur, being clay soils used for cash cropping in rotation with pasture, while in the sandy soils there is a dominance of cultivated pastures. Areias Quartzosas (AQ) have low water retention, lexiviation, low base saturation, high saturation of aluminium, and strongly acidic. These soils are not suitable for cropping, and thus utilisation is restricted to native and cultivated pastures.

The Latossolos Roxos (LRs) are similar to the former, but in general, present a high clay content, thus being adequate for cropping and pastures. In the Pantanal region three dominant soils are found. The Podzol Hidromórfico and Planossolo are poor and very sandy only suitable for native pasture. The Solonetz-Solodizado, which is easily flooded, thus similarly, only suitable for native pasture grazing after the water flows out. Therefore, the natural fertility of the soils in the State is low, thus restricting cropping to limited parts of the area.

**Table 2.4: Main classes of soils in the State of Mato Grosso do Sul**

Brazilian Classes	Soil Taxonomy	Area (km <sup>2</sup> )	%
Latossolo Vermelho-Escuro (LVE)	Oxisols	81.81	23.3
Areias Quartzosas (AQ)	Entisols	57.88	16.5
Latossolo Roxo (LR)	Oxisols	37.57	10.8
Podzol Hidromórfico (PH)	Ultisols	28.75	8.2
Planossolo (PLA))	Entisols	27.13	7.7
Podzólico Vermelho-Escuro (PVE)	Ultisols	17.25	4.9
Solonetz-Solodizado	Alfisols	14.60	4.2

Source: Zimmer and Euclides Filho (1997)

#### 2.2.2.4 Climate

The average annual rainfall is between 1,200 to 1,500 ml. However, a marked dry period occurs in the winter (May-September). The average temperature varies from 20° to 22°C, but in the spring-summer the average increases to 30° to 36°C and the maximum can go beyond 40°C. On the other hand, the winter is mild, although low temperatures can occur. In the coldest month the average is between 15° to 18°C.

#### 2.2.2.5 Establishments and land distribution

Table 2.5 shows that the structure of agricultural establishments has changed in the last twenty years; land concentration has increased in the classes of between 100 to less than 10,000 ha. A significant reduction occurred in the area of small units (IBGE, 1998a). It may be understood from Table 2.5 that 78.4 per cent of the area is distributed in establishments between 1,000 and over 10,000 ha.

**Table 2.5: Proportion of the number and area of establishments, by groups of area**

Groups of area (ha)	Number of establishments (%)		Area of establishments (%)	
	1975	1995	1975	1995
Less than 10	38.5	18.6	0.4	0.1
10 to less than 100	36.0	36.1	2.2	2.1
100 to less than 1,000	16.8	31.3	12.3	19.4
1,000 to less than 10,000	7.8	13.2	45.1	53.9
10,000 and over	0.9	0.8	40.0	24.5
Total	100.0	100.0	100.0	100.0

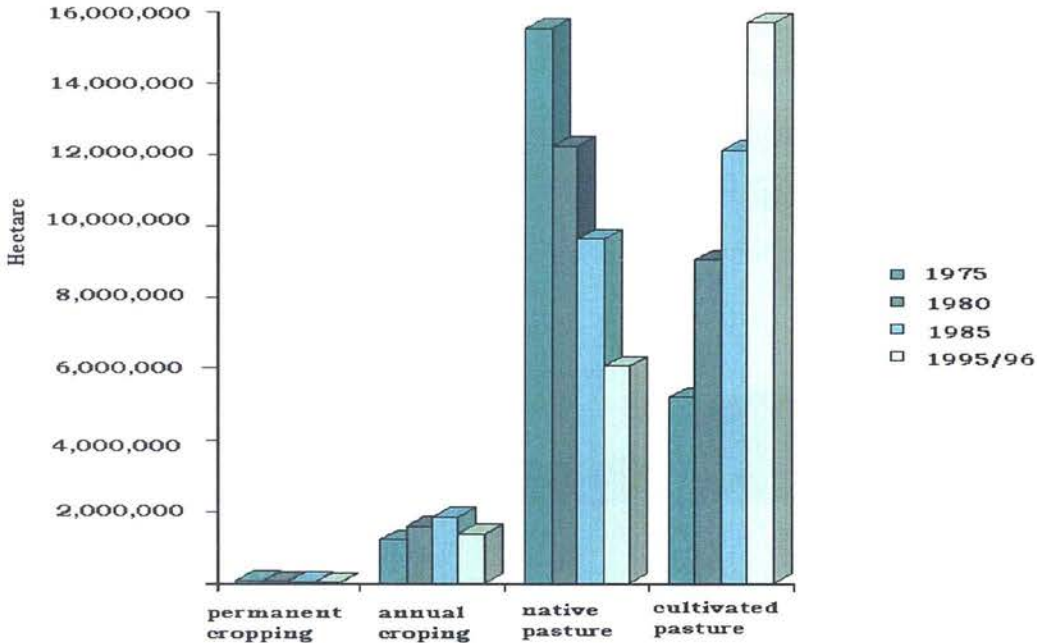
Source: IBGE (1998a)

#### 2.2.2.6 Land utilisation

Figure 2.2 shows that annual cropping and pastures are the dominant components of farming activities. The almost linear increase in the area of annual cropping from 1975 to 1985 was followed by a sharp decrease. However, annual cropping is still significant occupying 1,4 million ha, where soya beans, as first crop, represents 77.3 per cent of the area (IBGE, 1998a). Corn is in second place, followed by sugar cane, rice, beans and wheat. In addition, a strong expansion of cultivated pasture has

occurred inducing a decline of native pastures.

**Figure 2.2: Land utilisation in Mato Grosso do Sul (Source: IBGE, 1998b)**

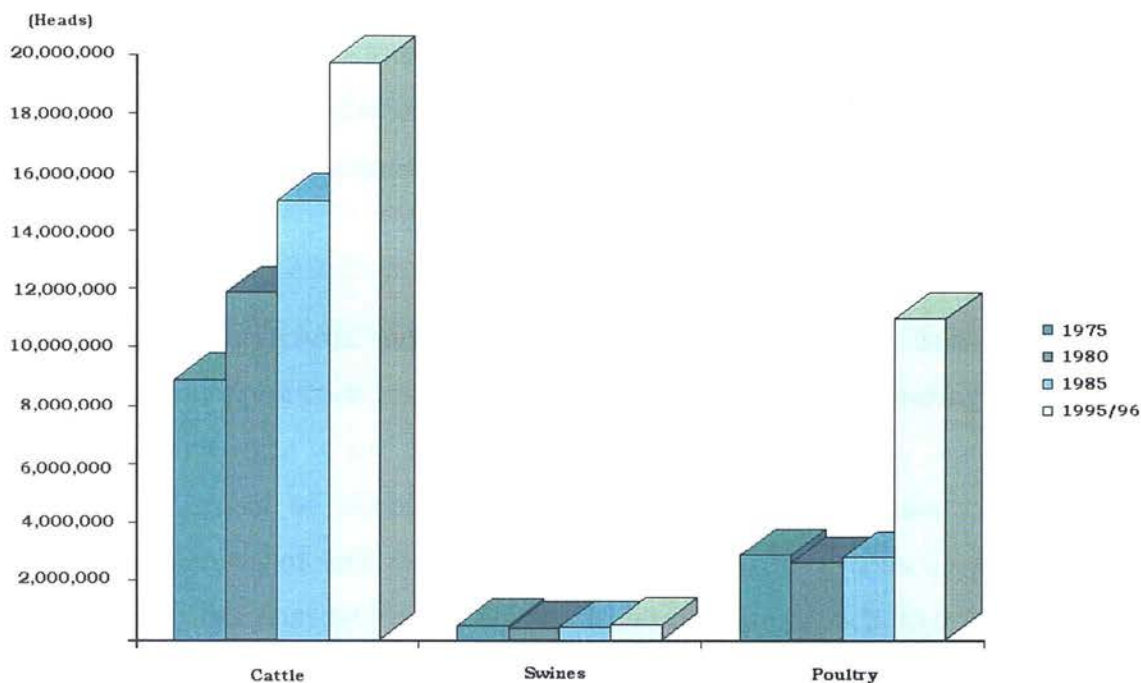


### 2.2.2.7 Livestock development

Figure 2.3 shows the development of the three main segments of livestock in the State. The cattle herd experienced steady growth in the last twenty years with an expansion of 31.5 per cent from 1985 to 1995 (IBGE, 1998a). This growth confirms the increase of cultivated pastures presented in last section. However, the highlight is the sharp increase in the poultry industry, which according to IBGE (1998a), increased 292 per cent in the same period.

The expansion of poultry industry in the State is linked strongly with grain production, market growth and the cost of commodity transport. In the past, the market was supplied from the South, where the majority of poultry industry was located. The above factors have stimulated the development and establishment of a slaughter industry in the State.

Figure 2.3: Livestock of Mato Grosso do Sul (Source: IBGE, 1998b)



#### 2.2.2.8 Beef cattle production systems

Beef production is based on grazing systems running through three phases: nursing, raising and fattening. However, these phases can be alone, or combined, providing different beef activities. For example, where native pasture is the main component, breeding cows are dominant. On the other hand, where cultivated pasture is available, fattening of males is run as an alternative, although other combinations can also be found. Cultivated pasture is introduced through direct establishment, or after annual cash cropping following land deforestation.

Sizes of typical beef cattle farms vary from 1,000 to more than 10,000 ha (Arruda and Simões, 1992) with ownership varying from single households, commercial companies, up to large enterprises each having different administration profiles, goals and objectives. In general, systems running breeding cows selling weaned calves provide low outcomes of between 21 kg to 38 kg carcass wt/ha/year (Cezar, 1995). Accepting that beef production can be represented conceptually as an interaction between components of the equations 1, 2 and 3, the State, despite



presenting high potential for beef cattle, also presents limitations of environment, management capabilities, animal genetic and market constraints.

$$\text{Beef production} = f(\text{animal performance} \times \text{management} \times \text{market}) \quad (1)$$

$$\text{Animal performance} = f(\text{environment} \times \text{animal genetics} \times \text{management}) \quad (2)$$

$$\text{Environment} = f(\text{climate} \times \text{nutrition} \times \text{health} \times \text{husbandry}) \quad (3)$$

### *Environment*

As part of the environment, nutrition is based mainly on pastures. Soil fertility problems, seasonal production imposed by a defined dry period, overgrazing and no practices of maintenance of soil fertility are the factors responsible for low pasture productivity. There is no doubt that overgrazing has been the main factor in accelerating processes of soil depletion and degradation. As a consequence, the carrying capacity based on natural fertility has decreased from 1.5 S.U. to 0.5 S.U./ha over a period approximately of ten years. Deficient sanitary practices, interacting with the unbalanced supply of mineral, energy and protein requirements, have also affected animal health.

Deficiency in husbandry practices has also limited reproductive performance of the production systems. A calving rate of 55 per cent to 65 per cent, and a calf mortality of 6 per cent to 8 per cent are results related to these limiting factors. This does not mean that there are no improved systems where feed supply in combination is used with adequate schedules of animal health.

### *Animal Genetics*

Despite animal improvements to the dominant and well-adapted Nelore breed, it is recognised that actually one of the most limiting parameters is its low growth rate. This, associated with restrictive levels of nutrition, is responsible for the advanced age of males at slaughter and females at first calving (48 and 36 months respectively) (Arruda and Correa, 1992; Cezar, 1995; Zimmer and Euclides, 1997).

### *Managerial Capabilities*

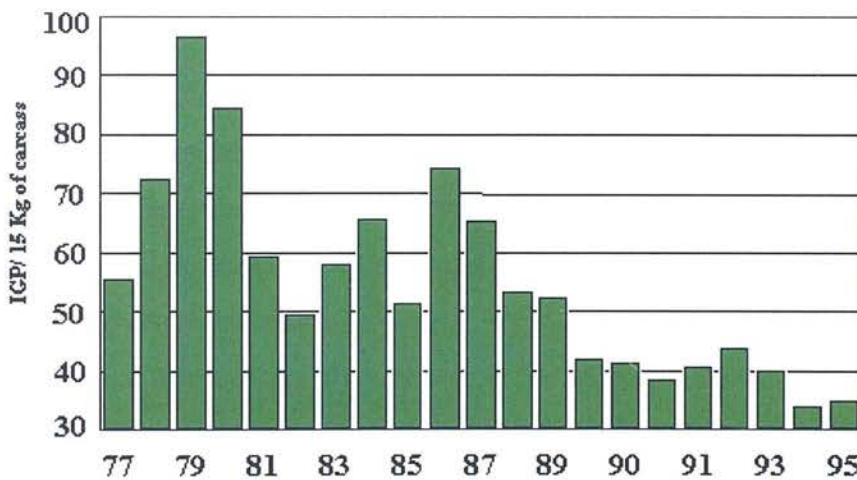
Considering the low productivity of the cattle herd and observed deficiencies of the cattle management, the managerial capabilities of the traditional farmers may be assumed to be limiting (Fernandes and Costa, 1983). They are considered to be

unfamiliar with new technologies, and have low formal education. These may be factors for being resistant to innovation and improving system efficiency. Although, entrepreneurs, professionals and cropping farmers have adopted new technologies in an attempt to obtain better outcomes, still there is room for improved efficiency (Zimmer and Euclides, 1997)

### Market

To some extent, the low purchasing power of the Brazilian people has inhibited farmers from adopting technology, leading to higher meat cost. Furthermore, historically, the internal price of beef meat to producers has decreased (see Figure 2.4). Actually, the real price is the lowest in the last twenty years. Therefore, farmers faced with these two socio-economic constraints are led to believe that improved technology can not be applied if it increases the cost of beef meat.

**Figure 2.4: Real prices of beef meat corrected by IGP (General Indices of Price), January 1980 = 100 (Source: ANUALPEC, 1998)**



### 2.3 Future scenarios for the beef industry

Despite the economic difficulties that the beef farmers are facing, the opportunities in the medium and long term are good, because an internal increase of meat demand is likely in the near future (Corrêa, 1994; Cezar, 1995). Additionally, opportunities in the international market are expected. This is because there are steady negotiation to reduce the trade tariffs of the member countries of the General Agreement on Tariffs and Trade (GATT) in Europe and USA (World Bank, 1995, cited by Ferreira, 1998),

1998), which implies a reduction of protective measures in the those countries and consequently reduction in their domestic production.

#### *Agricultural frontier*

Even though land in Brazil is not a constraint, the expansion of the agricultural frontier is limited. The reasons are: scarcity of financial resources to create an infrastructure in undeveloped areas; the high financial cost of incorporating new areas into the productive process; and strong pressure from environmentalists to preserve the natural resources.

#### *Land competition*

The demand for grain has increased due to internal population growth (1.42 per cent per year (IBGE, 1995)) and with opportunities to supply external markets. In addition, alcohol production from sugar cane, as part of the Brazilian policy for fuel, has competed for land. Beef cattle production has been displaced in order to provide land for grain and energy cropping activities.

#### *Sustainability*

Rotation systems combining cash cropping with beef cattle seem to be a way to locate a more sustainable agriculture, while still meeting food demands. There is a concern about the undesirable effects of continuous and sequential cropping, and at the same time, the disadvantages of loosing soil fertility by using pasture for long periods without fertiliser maintenance and erosion control.

#### *Competitiveness of another meats*

In the last ten years, internal poultry production has increased by 102 per cent, with an increment of 78 per cent in consumption (ANUALPEC, 1998). The pig industry also registered an increment of 76 per cent in production, with consumption gains of 30 per cent. However, the production and consumption of beef meat increased by only 26 per cent and 10 per cent respectively in the same period. It is known that the poultry and pig industries are extremely competitive, offering high quality products at low prices.

#### *Market competition*

Argentina and Uruguay are traditional producers and exporters of beef meat with high acceptance in the international market due to the quality of the products. Market facilities, created by MERCOSUL, have also brought opportunities for those

countries to increase meat exports to Brazil, thus taking a slice of the market.

#### *Market demands for quality*

The typical international buyers of beef meat are increasing their quality requirements, not only in terms of tenderness, but also in relation to animal health and residual controls. In addition, consumer's preference for meat from grazing systems has been recognised. To some extent, this preference is favourable to Brazilian meat. The internal market demands quantity, and this is guided by a code of consumers that by law guarantees Brazilian people the rights to have a healthy food supply. The quality of the product is imperative to sustain the agribusiness.

#### *Economic stability*

Brazilian inflation is now under control, running at a figure of only around 3 per cent a year, this represents the most important result of economic policies for Brazilian society in the last 20 years. The signs of economic stability have already affected the behaviour of the investors who now put more money into productive activities rather than financial speculation. Obviously, it is assumed that economic gains should come from efficiency, instead of from the financial market. Considering that beef cattle are a medium to long term activity, a horizon of economic stability is favourable for farm investments.

#### *Income distribution*

Brazilian society is very concerned about the current unjust internal distribution of income. The government is only sustainable if it is strongly committed to the solution of social problems. Basically, the solutions require economic stability, better wealth distribution and education. At any level of society, people are concerned that the living standard of workers has to be improved. The action of trade unions, supported by Brazilian Constitution, has played an important role in the wage negotiations. As expected, the purchasing power has improved and the first signs of increments have been observed in beef meat consumption due to its high elasticity. If the annual consumption increases up to 47 kg/capita, this will require more than 3.0 million tons of meat per year (Cezar, 1995). This means an increment in the annual slaughtering of 13.0 million head. Therefore, if the market is to be supplied by Brazilian meat, the beef industry needs to initiate deep production changes in order to attend to this potential demand.

## 2.4 Addressing issues for policy and farm decision-making

Despite the impressively large numbers and attached social benefits, the environmental and economical sustainability issues that resulted from such a rapid development of the beef industry in the Midwest are significant. At the present time, government, farmers and society are facing challenge of finding economic growth models to repair part of past environmental damage, keeping the agricultural sector sustainable and at same time minimising future depletion. In addition, recent political and economical changes at both national and international level have pointed in the direction of new scenarios. Competitiveness of the products, efficiency, and environmental questions are being brought into the main issues of farming systems as very strong factors for changing the “status quo”, of either continuing the depletion of natural resources or maintaining low productive systems.

In terms of market supply, it seems that the scenario points in direction for the intensification of the beef production systems, whether the policy would supply future increase of internal demand with Brazilian meat. On the other hand, the evidence shows that farmers have been resistant and are afraid to move in the direction of new production systems, even accepting that they need to improve the current pattern of beef production. Beef farmers should be conscious that individually they are being penalised by the low level of carrying capacity of degraded pastures, which decrease farm income and, as a group, are losing market competitiveness in relation to other meats.

This is the essence of a complex and challenging picture for technology development, where market pressure to increase food production is a strong driving variable; environment issues can no more to be left aside of the context, and the farmer’s objectives, goals, needs and attitudes must also be taken into account. No doubt remains that much more knowledge and information is being demanded than in the past, and information dissemination is now a key issue for institutions dealing with this complex challenge.

# Chapter 3

## Agricultural Research and Transfer of Technology: a General Overview and the Case of EMBRAPA

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### 3.1 General overview

#### 3.1.1 Research development

Agricultural development strongly depends on the combination of natural resources with other factors such as market systems, government policies, credit, inputs, transportation, storage, and technology. As agriculture expands and develops, farmers acquire more control over their environment. The greater their control, the more important knowledge and technology become as the major determinants of development (Jiggins, 1988 cited by Röling, 1990). The assumption that technology-driven development enhances competitiveness has been the major argument used by governments in the developed world to support expenditure on agricultural research (Röling, 1990). Internal rates of return of between 25 and 50 per cent to investment in research and extension in the United States have been cited by Sim and Gardner (1980), cited by Hildreth and Armbruster (1981).

However, in most developing countries, there is insufficient understanding of the potential contribution of research to increase food production (Pinstrup-Andersen, 1982). According to Anderson *et al.* (1994), despite US \$ 4.4 billion applied to agricultural research in developing countries in the middle 1980's, the resource allocation slowed down in comparison to the earlier rapid expansion in the 1960's and 70's. Although resources for agricultural research are scarce, public agencies are being asked to contribute to additional demands of new issues from environment, food security and quality, and rural development (Anderson *et al.*, 1994; Alston *et al.*, 1995).

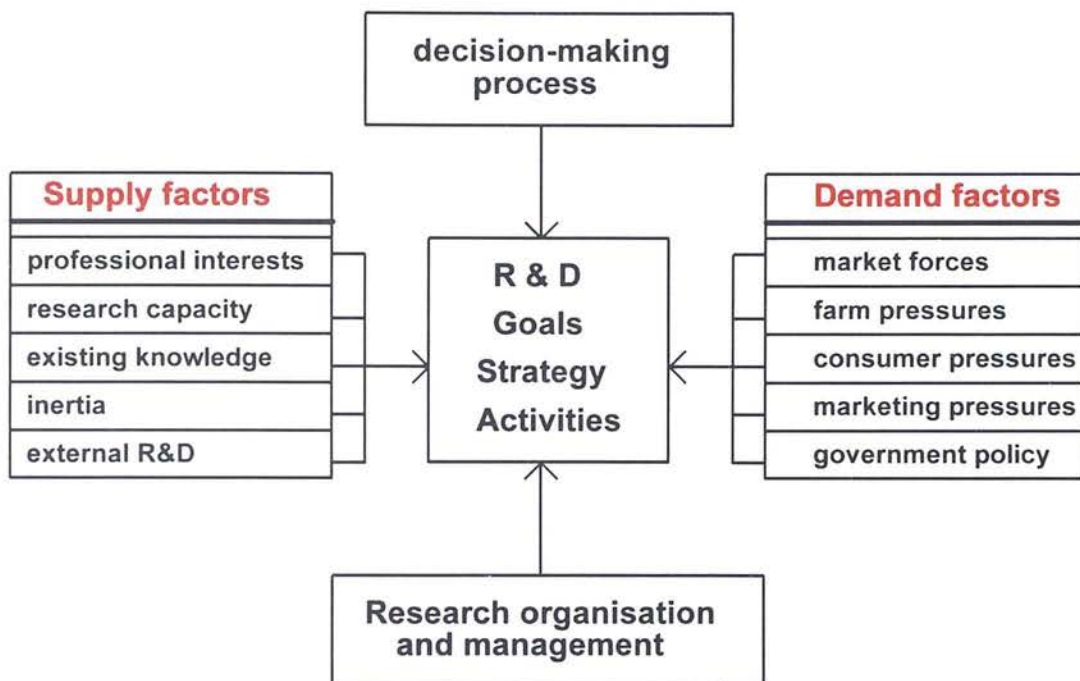
### 3.1.2 Client interest - a goal to be achieved

Although Alston *et al.* (1995) have addressed a number of important questions about the efficient use of resources, perhaps the most crucial decision for any administration of a public institution for agricultural research, is related to knowledge for the farmers. Therefore, “what” to research, and “how” to transfer technology, are important questions. It is obvious that both questions are closely related and the understanding of one can help to answer the other. The chances of research institutions continuing under public sponsorship increase as they meet the interests and needs of their main clients. A further issue relates to how research should be organised (Tripp, 1991a). Is it possible to ensure that the institutions’ culture is flexible enough to meet the dynamics of society’s demands? Developing a comprehensive understanding based on these questions is the central focus of this section and background of this present study.

### 3.1.3 Basic forces driving R&D

The approach to development is increasingly centred on sustainability, globalisation of economies and the need for more participation of society in decisions (Flores, 1991a). As a consequence, there is an urgent need to review many existing, and developing, agricultural systems for which an increasing amount of information is necessary within a short time frame (Jones, 1993). In this context, the factors influencing the goals, strategies and activities of agricultural research presented in the framework of Pinstrup-Andersen (1982), (Figure 3.1), seem to be adequate. *Demand factors*, represented by market forces and pressure from groups of farmers, consumer and marketing organisations, are expected to drive agricultural research goals, more than the traditional influences from *supply factors*. Public support for agricultural research is under review in most countries with a strong trend for the governments to attempt to share the costs with those who most directly benefit (Anderson *et al.*, 1994). Of course, trends have also pointed to less overall funding from government than in the past, but it is still expected that public institutions, particularly in developing countries, should support government policies.

**Figure 3.1: Factors influencing agricultural R&D, goals, strategy and activities (Pinstrup-Andersen, 1982)**



However, the re-orientation of resource allocation is likely to force research institutions into new opportunities for direct negotiation with clients. In so doing, there is no doubt that the institutions will become more efficient in the use of resources, since they will work for well-defined demands and will be accountable to specific clients. In this scenario, the funding for research can be provided by a wide range of sources and the research processes can be dominated, for example, by groups of *progressive* farmers (Röling, 1990) so that, the interest of the poor and less powerful farmers is neglected.

### **3.1.4 Research based on productivist model**

Historically, according to Dent *et al.* (1995), the main motivation to understand the dynamics and behaviour of agricultural systems has been the prediction of future food production and supply. This means that most research efforts dedicated to the



process of farm decision making were concerned mainly with physical and economic productivist approaches. Therefore, the orientation of most research institutions has been compatible with the international model of economic growth based on the “productivist” approach.

In this way, information and knowledge are directed to constantly increase the capacity to produce (Flores, 1991a; Okali *et al.*, 1994; Dent *et al.*, 1995). The basic implications of this model are to maximise short-run profit and usually to increase productive output under the assumption of “rational economic decision-making”. However, the diversity of objectives and goals of individual farm families are not taken into account (Gasson, 1973; Romero and Rehman, 1989; Jacobsen, 1994).

This model supported the commodity-orientated technology development of the green revolution in the 1960’s and 70’s with relative success, since a marked increase in world food production was registered (deWit, 1990; Okali *et al.*, 1994; van den Ban and Hawkins, 1996). However, according to WCED (1990), in the late 1980’s there were more hungry people in the world than ever before in history. In reality, the problem of hunger due to scarcity was partly solved, but the green revolution did not solve problems of hunger due to poverty (deWit, 1990).

### **3.1.5 “Top-down” strategy - technical priority**

Farmer’s knowledge, behaviour, attitudes, needs, goals and objectives have not been considered as key operational components of missions of agricultural research and extension institutions (Chambers, 1993). Furthermore, farmer’s social goals such as satisfaction, style of living, family security, etc. are not usually taken into account alongside economic and technical aspirations. Criticisms and serious questions have arisen concerning historical “top down” research strategies, neglecting as they do, “local” farmer’s knowledge and needs (Richards, 1985; Röling, 1988; Kaimowitz, 1991; Chambers, 1993; Chambers, 1994a; Chambers, 1994b; Scoones and Thompson, 1994a; Drinkwater, 1994a; Marsden, 1994; Weber, 1994; Skerratt and Dent, 1994).

A reversal situation is envisaged in which the era of defining problems and generating solutions based mainly in technical terms, has come to an end (van der Ploeg, 1993). On the other hand, according to Gibbon (1994) the incorporation of farmers into a process of research planning to assist in the setting of priorities has proved to be difficult, and final decisions still usually remain with researchers. As a consequence, conflicts between farmers, researchers and extension officers have arisen, and problems of “non-adoption” of new technologies and planning have become critical (Röling, 1988; Botchway, 1993; Skerratt and Dent, 1994). Conflicting objectives, including social goals and constraints, also should be considered when analysing agricultural technology impacts to assess land use for regional development (van Keulen, 1993; van Keulen and Veeneklaas, 1993).

### **3.1.6 Linear process - neglecting integration with farmers**

Traditionally, the development of agricultural technology is based on the researcher’s interpretation of farm production problems, on demands from scientific community, and on government policies for development programmes, without involvement from farming communities. The dominant assumption is the belief that the institutions “know what is the best for the farmers”. In the process of transfer of technology (TOT), farmers are seen only as “adopters” or “rejecters” of technology (Scoones and Thompson, 1994b).

A linear flow has been characterised where research creates, extension delivers and the farmer receives (Röling, 1990; Gartner, 1990; Röling and Engel, 1991; Kaimowitz, 1991; Chambers, 1993; Röling, 1994b; Pretty and Chambers, 1994). “Top-down” systems may have worked as meeting the demands of resource-rich farmers and producers of high-value commodities (Ewell, 1990). However, such a finding certainly cannot be generalised and does not apply in developing countries.

The implications and limitations of linear TOT have been well described by Röling and Engel (1991) as follows:

(a) as separated entities, research and extension must be linked with farmers;

- (b) to see farmers only as receivers and users of technology neglects the important fact that they are creative experimenters themselves
  - the collective creative capacity of farmers can not be neglected in a serious technology-mobilising effort; they create and share solutions in horizontal networks;
- (c) technology as a ready-made product neglects transformation
  - in the real world, as technology is diffused among farmers, it suffers transformations, in this process, information is aggregated and integrated into new knowledge;
- (d) information flows from farmers to researchers are equally important and should be integrated in a way of complementary knowledge development.

According to Röling and Engel (1991), TOT inhibits the expansion of agricultural knowledge systems (AKS) because the knowledge exchange and interactions are blocked. In addition, the authors reported that TOT is not appropriate to deal with the complexities of sustainable development, since relationships between social components and local knowledge on resource management are not, or not fully, taken into account. Top-down technology development is compatible with centralised institutions offering technological packages, in contrast to an approach more oriented to farmer's needs of local demands (Scoones and Thompson, 1994b).

### **3.1.7 Systems research applied to agriculture - an evolutionary approach to be improved**

The introduction of concepts and theory of systems, through analysis and synthesis of agricultural systems, brought marked advances in better understanding the functioning of farming complexities (Dent and Anderson, 1971; Dillon, 1971; Spedding, 1988). The basic concept underlying systems approach is the holistic view, which implies that isolated study of the parts does not provide the understanding of the system as a whole. Simulation models applied to agricultural research, as a consequence of the systems approach, gained space as a professional field of work and academic interest (Dent and Blackie, 1979). Increasingly,

simulation models have been developed by agricultural scientists in order to assess research, extension, farm decision making and policy.

The complexity of biological models has increased as the scientists attempt to simulate the real world to gain better insights of the interactions among components of biological systems. Grass growth simulated on the basis of photosynthesis activity (Jonhson and Thornley, 1985) and animal growth taking into account animal requirements (Sanders and Cartwright, 1979) are examples of advanced results of scientific modelling of biological components relevant to animal production.

Decision support systems based on complex cropping models such as the DSSAT (Jones, 1993), WOFOST (Supit *et al.*, 1994) and SARP (Riethoven *et al.*, 1995) and the extensive list of seventy nine models reviewed by Bywater (1990) relating sheep, cattle, pig, poultry, crop, and mixed crop and livestock activities, are examples of advances brought about by the systems approach which simulate systems as a whole.

Dent *et al.* (1994) present an extensive list of modelling individual components of livestock systems, as evidence of similar efforts among biologist. According to the authors, a common characteristic in this biological progress was that each model represented a new effort rather than using existing models. Chudleigh and Cezar (1982) have also pointed out the same consideration on a review of bio-economic simulation models for beef cattle as a way of exchanging experience, saving time and getting advances from the existing efforts on modelling. In this regard Dent *et al.* (1994) considered that although empirical models are easy to develop and to use, they almost never perform adequately outside the environment in which they were developed. Modelling biological components in a mechanistic manner can encourage the exchange of models (Dent *et al.*, 1994).

Discussion and questions on the feasibility of using complex biological models for advisory and farm decision making still remain. The primary discussion has been focused on data availability, but the overall question seems to be recently focused on the fact that farming decision making is not guided only or mainly on biological

components. According to Jiggins (1994), in order to operate a systems approach we must engage with the rural community, since modelling biological and economic components is not enough to explore agricultural reality. Socio-economic aspects are determinants of decision making. They must be introduced into an expanded model framework in order to understand better the process as a whole, and provide more realistic tools for farming decision making (Béranger and Vissac, 1994; Dent *et al.*, 1994; Dent *et al.*, 1995).

Ecological effects of agricultural activities, as already mentioned should be also brought into modelling, as shown by Dent *et al.* (1995) and Moxey *et al.* (1995). The changes in the operational environment, associated with the new ecological and social challenges, have emphasised that the approach of traditional science, concentrated on the farm as a unit of production rather than a socio-economic unit, no longer is accepted (Dent and McGregor, 1994). Therefore, the agricultural systems approach has not been only at a biological level but has extended to a wide view of agricultural issues as represented in the statement of Street and Jones (1990):

*"Most importantly, it has come to encompass the whole food chain, the ecosystem with which agriculture interacts and the economics of agriculture, and has extended into fields of education and extension to a remarkable degree."*

### **3.1.8 Farming systems research/extension (FSR/E)**

Farming systems research and extension (FSR/E) emerged in the late 1970's as a movement to overcome the limitations of TOT, and as a process to assist in the integration of research and farming (Jones and Wallace, 1986; Collinson, 1988; Hildebrand, 1990; Gartner, 1990; Tripp, 1991a; Sumberg and Okali, 1993; Amanor *et al.*, 1993; Cornwall *et al.*, 1994; Gibbon, 1994). Because of conflicting and confusing interpretations of FSR/E, it becomes difficult to establish a sharp characterisation of the approach, but it is clear that it is much more related with on-farm experimentation than on-station traditional trials. Perhaps Hildebrand (1990) is correct in reporting that FSR/E in a real sense is not a method, but rather a

philosophy based on several common methods and only one goal. This approach has been used mainly in the Third World as a major force in extension (Dent, 1990).

The movement is described by Tripp (1991a) where it is emphasised that FSR asks researchers to take into account the farm as a whole and to understand farm family welfare as a dependent from production systems. According to Merrill-Sands *et al.* (1991), the approach is a means of linking research with its clients, and it is expected to bring substantial change at the institutional level by making research more demand-driven (client-oriented).

For example, communication across disciplinary and commodity programmes has to be strengthened and the vertical flow of information needs to be expanded. At the same time, feedback from the farm becomes as relevant as the information flow from research. Besides this, it also requires decentralisation of decisions and development of human resources. In fact, the implementation of FSR/E has been developed under different forms, approaches and terms (Jones and Wallace, 1986; Tripp, 1991b; Sumberg and Okali, 1993; Gibbon, 1994). Although FSR is not strictly a sequential series of events (Dent 1990;1993), a general framework of farming systems research was shown by Jones and Wallace (1986) where the following phases were identified:

- (a) problem definition;
- (b) characterisation of the work area on a geographic and farming basis;
- (c) design the alternative technologies;
- (d) validation of technologies; and
- (e) recommendation of validated technologies.

In South America, farming systems research followed a dominant idea of experimenting with “physical models” as a synthesis phase of systems approach (Cezar, 1982b; Melo, 1982; Coelho, 1982; Cubillos, 1982; Villegas, 1982; Preston, 1982; Pereti, 1982; Ruiz, 1982; Arias, 1982; Laneri, 1982; Risso and Grierson, 1982, Capriles, 1982). In fact, physical models are units of production, implemented in the field, combining technologies and management strategies representing a whole-production system as a real farm, similar to the farmlets in New Zealand mentioned

by Dent (1990). Most of these experiences can also be considered as the “special units” described by Eponou (1993) for technology transfer.

For example, a case of Brazilian experience was developed from 1983 to 1991 by the implementation of a model of beef cattle on 556 hectares, at the National Centre for Beef Cattle Research-EMBRAPA (Corrêa *et al.*, 1985; Corrêa, 1986; Corrêa and Arruda, 1988; Arruda and Corrêa, 1992, Corrêa, 1994). This experience followed the same phases cited by Jones and Wallace (1986). Despite achieving the goals for testing, validating and transferring technology, it still remained as a “top down” experience where the farmers did not participate in the decisions (Cezar, Pers. Comm.).

Specific meetings about experiences of physical models have been promoted in South and Central America (Echeveria and Gardner, 1978; Instituto Interamericano de Cooperacion para la Agricultura (IICA), 1982; IICA, 1987; Centro de Gado de Leite-EMBRAPA, 1994). Several questions on the role such models have in the process of R&D of animal production have been brought to discussion. Cezar (1994) and Duran (1994) agreed that the physical models should be seen as a component in the process of R&D with the objective being to provide technological guidelines to the producers, not as a final goal of institutions. However, the main questions were outlined as:

- (a) high cost to implement and to maintain the physical models with bovines;
- (b) limitation to extrapolate results to other environments;
- (c) limitation to explore several combinations of technologies, and difficulties in deciding on which level of such technologies should be implemented;
- (d) a long period of maturation and stability to provide confidence in the results as a proper feature of breeding systems;
- (e) the difficulty in keeping a research team motivated to monitor the model;
- (f) the risk of the research being focused differently from the real problems, and motivated by problems only from the model;
- (g) the difficulty to decide on the life time of the implemented model; and
- (h) the difficulty in isolating effects.

### 3.1.9 Contribution, problems and issues from FSR/E

It is important to stress that farming systems research applications have used different methodologies from those of traditional research procedures: from designing the research projects to analysing the information. Tripp (1991b), Merrill-Sands *et al.* (1991), Low, *et al.* (1991) and Gibbon (1994) have shown the contributions and analysed the conceptual and operational problems of implementing FSR/E. However, the most important criticism is that the inclusion of the farmers in the process of technology development rarely occurs (Sumberg and Okali, 1993). Most of the activities have been understood as transplanted research objectives and methodologies from the experimental station to farm fields. In other words, experiments merely were implemented on farms to test scientific hypotheses or to test and validate new technologies. The role of farmers in the process often has been limited to collaborative action to allow the establishment of experiments on their farm and to provide labour, machinery and animals.

Cornwall, *et al.* (1994) have pointed out that FSR/E remains totally in the “research domain” where the flow of knowledge is generally in the direction of researcher to researcher and is largely insensitive to farmers’ knowledge for where the generated information is transferred. This observation means that, (a) farmers do not participate in the planning phase so as to decide on what to do, and (b) the results were not transferred to them in such way as to increase farmers’ knowledge. The sense of closed packages still remains.

Of course, such criticisms are an incentive to improve the methodology. For example, Low, *et al.* (1991) have also provided an extensive discussion and a categorisation of the problems of FSR/E into deficiencies of implementation, technology source (inadequacy) and technology delivery (top-down model regardless of diversity). Similar and well-documented considerations on the limitations of FSR/E are given by Tripp (1991b). A rich list of lessons on the management of research and resources for increasing the effectiveness and efficiency of on-farm research is found in Merrill-Sands *et al.* (1991).



However, from a scientific point view, a difficult problem is the repetitiveness of the results considering the limited sequences of climatic variation which occurs on on-farm demonstration experiences, even though the same problem occurs at experimental stations (Dent, 1993). In other words, the sequence involving experimentation and demonstration should be worked out over many years and yet such a time delay is rarely acceptable (Dent, 1990). Bywater (1990) has also pointed out that the dynamic interaction of a system's components to provide an adequate explanation of system behaviour is not well supported in systems trials. Furthermore, and in a similar sense, there is the problem of transferring localised results to other (perhaps physically close) locations with different soil and climate characteristics

From an operational point of view, a key issue affecting the future of FSR is its cost-effectiveness (Tripp, 1991a). According to Ashby (1991) there are worries about the additional cost of managing the intensive interaction with farmers from on-farm research although no empirical assessment exists of the cost-effectiveness in relation to technology adoption. The author's personal experiences suggest that the direct and indirect costs of implementing and monitoring on-farm trials are considerably higher than on-research station, due to transport and maintenance of researchers and staff personnel outside of the original work place (Cezar, Pers. comm.).

### **3.1.10 Simulation models: a solution to be complemented**

Simulation modelling of farming systems has been indicated as a methodological approach to overcome some of the difficulties and problems faced with FSR/E (Dent, 1990; 1993). One reported advantage of farm system modelling is the possibility of assessing *ex ante* a specific technology at an enterprise level and also at a whole-farm level (Dent, 1990). For example, Cezar (1981, 1982a) developed an *ex ante* evaluation of alternative management strategies for improvement of a beef grazing system in the Central Brazil Region using a simulation of farm as an enterprise.

A large number of models are available to assess technologies at farm enterprise level, but models to deal with a whole-farm, including socio-economic components,

have not been addressed (Dent, 1990; Dent, *et al.*, 1995). The lack of social data has been identified as a limitation to modelling whole-farm systems and it is not expected, in the short term, that social studies can provide data at the same level as is available for mechanistic biological models (Dent, 1990). However, it is necessary for researchers to understand the rules that govern farm decision making in the context of the farm family, in order to improve the feasibility of the simulation models.

### **3.2 The case of EMBRAPA.**

#### **3.2.1 Evolutionary changes.**

EMBRAPA, the most important Brazilian agricultural research institution, even though it has concentrated on solving farm problems using a systems approach, and adopted as the philosophical orientation that “the research starts and finishes with the farmer”, has also faced some of the issues outlined above. In other words, the circle model “farmer-back-to-farmer”, suggested by Rhoades and Booth (1982), has not been entirely followed. In addition, political, social, and economic changes have created new scenarios that have pushed EMBRAPA towards a proactive review of its mission and institutional policies (Flores, 1991a). There are demands that the institutional culture should be changed, in order to attend better the demands of society (Flores, 1991a). Internal discussions and external debates suggested that EMBRAPA should increase its research scope beyond farm gate (Flores and Silva, 1992). The view of product chains should be brought into the research programmes, not only to provide guidance for farm-oriented research projects, but also to consider other sectors as recipients of research activity.

The preferences and concerns of the consumer about healthy food should be incorporated in the research objectives. Current environmental issues must be strongly emphasised and integrated into the research projects priorities (Flores *et al.*, 1991). The sustainability of the agricultural systems as a whole should be focused as a main research goal. Finally, the enterprise should contribute to correcting the

unbalanced regional development in order to improve the equity of national social welfare.

A redirection for the 21<sup>st</sup> century became important for EMBRAPA, and “strategic planning” was adopted as the basic methodological approach to review the enterprise mission and policies. Following the steps of strategic planning methodology, each one of 42 EMBRAPA Research Centres identified and described their external and internal environments. The respective productive chains with component flow diagrams and relations were drawn up and described. The *weak* and *strong* points as well as the *opportunities* and *threats* were identified for each Research Centre taking into account the institutional interfaces.

These appraisal and research priorities were presented and discussed, at local workshops, with representative members of the main segments of the productive chains (production, industry, commerce, services, research and extension). The institution previously had never involved so many sectors around all country. In addition, the perceived broad societal demands were obtained at this time, a consuming and exhausting task.

Following strategic planning, a new planning research system (SEP) created tools and structures to increase the links between technological needs and the EMBRAPA’s Centres. A **participatory decision approach** was intended, by creating one National and five Regional Research Councils, assisted by representative members of the different segments of society involved directly or indirectly with the agricultural industry. This decision was undertaken in order to consolidate research priorities, to improve the linkages with society and to gain political support. The decision was welcomed by the Councils’ representative members, and EMBRAPA was considered by politicians as a good example of proactive public enterprise preparing its own way for the challenges ahead.

A computerised information system (SIP) started to be developed in order to improve the access and dissemination of internal and external information (Flores, 1991a).

The supporting idea behind the new system was to provide internal information at real time and to deal with generated information as the marketable product. EMBRAPA, as with any agricultural research institution, has also faced resource restriction. Partnership was encouraged as part of the solution and became almost a “miracle” word in order to diversify resource funds. Furthermore, the partnership would create opportunities to attend different demands from others sectors and a new institutional culture, “research for real demands”, would be strengthened.

Although an objective evaluation is not available, it seems to be a consensus that many positive benefits were gained from the institutional changes, including a recent implementation of a programme to improve the “quality” of institutional services as a whole. However, a set of questions and criticism has been raised to monitor the institutional action courses. Strategic planning, as a theoretical exercise, was successful and considerable experience was gained from all steps. Nevertheless, many of the suggestions recommended from the analysis still remain unsolved, for example:

- the changes happened in a very short period of time and they were not well absorbed by the researchers, traditionally oriented to solving farm problems; thus, the interpretation of needs from others sectors (product-chain) must be carefully worked with the research team;
- the Councils, as a *participatory approach* to elicit research priorities, took decisions on general research lines previously selected by researchers; the exercise to take decisions at lower levels of research priorities were not fully successful, and the Councils member did not have time to interact with the research team.

Therefore, the implementation of the changes has shown the lack of conceptual and operational tools to detect and to characterise the actual and future technological demands in a systematic way (Flores, 1995). The problem was more complex than in the past, since the view of the “productive chain” was introduced into research planning. The challenge of researching by demands must prevail, instead of the institutional behaviour of offering results based on a “top down” fashion.

### 3.2.2 Approach to identifying technological demands

To approach the problem of identifying research's demands, a methodological framework was developed within EMBRAPA in order to provide operational guidance (EMBRAPA-DPD, 1995). The approach takes into account prospective techniques based on the characterisation of: (a) *ecosystems*; (b) *productive chains*; (c) *production systems*; and (d) *knowledge chains*.

The characterisations are divided into specific steps starting at the definition and ending up with the demands where the contents, techniques and methods are specified for each step (see Table 3.1 to Table 3.4). A systematic procedure from *a* to *d* must be followed, where the later should aggregate the demands of *a*, *b*, and *c*. Even though the procedure is divided into specific steps, the demands for each characterisation should only be achieved after all steps are completed as result of a dependent process.

The above approach introduces the concept of a technological market and recognises agricultural production systems as the most important research clients and segments of this market. Furthermore, it is expected that the generated technology would be easily adopted by the farmers since the generation would be based on demands of the production systems (EMBRAPA-DPD, 1995). The approach also accepts that the consumer's preference, to some extent, defines agricultural products and consequently the technological demands of production systems.

However, when the methodology goes into the farm production systems analysis to define the research's demands, it suggests only a productivist approach based on input (costs) and output (income) relationships. This would be expressed by estimating the potential productivity, economic results and the identification of the actual and future critical variables affecting the systems' performances. Finally, the matrix for farmer typification, accepted by the approach (EMBRAPA-DPD, 1995), takes into account socio-economic parameters but it does not provide key insights on farmer's interests and attributes, such as goals, objectives, attitudes and knowledge.

**Table 3.1: Characterisation of Natural Systems**

PHASES	CONTENTS	METHODS AND TECHNIQUES
1- SET BOUNDARIES OF NATURAL SYSTEMS	<ul style="list-style-type: none"> <li>- Mapping the natural system and its subsystems, according to Institution's mission.</li> </ul>	<ul style="list-style-type: none"> <li>- Interdisciplinary work group</li> <li>- Literature review, agroecology zone</li> <li>- Collect data</li> <li>- Consult geographic system (SIGGEO)</li> <li>- Elicitation of mapping criteria</li> </ul>
2- SET SOCIAL OBJECTIVES OF NATURAL SYSTEMS	<ul style="list-style-type: none"> <li>- Interpretation of society's desire in relation to the utilisation of the natural system</li> </ul>	<ul style="list-style-type: none"> <li>- Interdisciplinary work group</li> <li>- Sampling and consulting of representative social segments</li> <li>- Syntheses of social segments' opinion in relation to the utilisation of natural system</li> </ul>
3- CHARACTERISATION OF NATURAL SYSTEMS. DEFINITION NATURAL CYCLES, COMPONENTS AND CRITICAL VARIABLES	<ul style="list-style-type: none"> <li>- Macro ecological diagnostic of the natural system and its subsystems without anthropic interference</li> <li>- Map of relation between components and variables for each subsystem</li> <li>- Restrictive variables/indicators to economic exploitation and sustainability</li> </ul>	<ul style="list-style-type: none"> <li>- Interdisciplinary work group</li> <li>- Literature review</li> <li>- Secondary data</li> <li>- Available surveys</li> <li>- Build matrix of relation between processes and main variables of the natural system</li> <li>- Field visits</li> </ul>
4- CHARACTERISATION OF ANTHROPIC INTERFERENCE (extractive systems, production systems, pollution/degradation)	<ul style="list-style-type: none"> <li>- extractive systems, production systems and economic situation</li> <li>- characterisation of pollution and degradation impacts. Environmental alteration and limits of sustainability</li> </ul>	<ul style="list-style-type: none"> <li>- Interdisciplinary work group</li> <li>- Literature review</li> <li>- Secondary data</li> <li>- Available surveys</li> <li>- Characterisation of chains and production/extractive systems</li> <li>- Scenarios and trends</li> <li>- Environment monitoring techniques</li> <li>- Correlation and regression studies</li> </ul>
5- DETERMINATION OF ACTUAL/FUTURE PARAMETERS OF SUSTAINABILITY	<ul style="list-style-type: none"> <li>- Environment critical factors in relation to the actual, future and potential anthropic action</li> <li>- Maps and agro-ecological classification</li> <li>- Syntheses of critical factors with positive and negative influence on social objectives of the natural system, under view of sustainability</li> </ul>	<ul style="list-style-type: none"> <li>- Phases 5 to 7</li> <li>- Make agr-ecological and socio-economical maps</li> <li>- Scenarios and trends</li> <li>- Delphi techniques to prioritise the demands</li> <li>- Studies of degradation resistance</li> <li>- Work groups and group discussion.</li> </ul>
6- DEFINITION OF OPPORTUNITIES AND THREATS OF THE NATURAL SYSTEM	<ul style="list-style-type: none"> <li>- Opportunities and threats</li> </ul>	
7- DEFINITION OF DEMANDS	<ul style="list-style-type: none"> <li>- Indication of demands for which the solutions provide support to achieve the objectives of the natural system</li> </ul>	

Source: EMBRAPA-DPD (1995)

**Table 3.2: Characterisation of productive chains of the agricultural industry complex**

PHASES	CONTENTS	METHODS AND TECHNIQUES
1- DEFINITION OF PRODUCTIVE CHAINS IN RELATION TO OBJECTIVES	<ul style="list-style-type: none"> <li>- Choice of the product(s) of the productive chain(CPs)</li> <li>- Definition of consumer expectation in relation to the productive system (actual and future)</li> <li>- Analysis and definition of opportunities, threats and the constraints</li> </ul>	<p>Phases 1 to 4</p> <ul style="list-style-type: none"> <li>- Interdisciplinary work group</li> </ul>
2- RELATIVE IMPORTANCE OF THE PRODUCTIVE CHAINS IN RELATION TO THE AGRICULTURAL INDUSTRY COMPLEX	<ul style="list-style-type: none"> <li>- Participation of the CPs in the agricultural industry complex</li> <li>- Intensity of the relation and trade off between the productive chain and agricultural industry complex</li> <li>- Mapping of different final products</li> </ul>	<ul style="list-style-type: none"> <li>- Literature review and secondary data</li> <li>- Using of flow diagram</li> <li>- Consult to representative segments of the chain</li> <li>- Techniques of analysis and syntheses</li> </ul>
3- SET BOUNDARIES OF THE PRODUCTIVE CHAIN. GENERAL CHARACTERISATION	<ul style="list-style-type: none"> <li>- Identify the natural ecosystems where the productive chain works</li> <li>- Identify the socio-economic context where the chain works</li> <li>- Social and economic characteristics of the productive chain's components</li> </ul>	
4- DEFINITION OF PRODUCTIVE CHAIN'S COMPONENTS AND CRITICAL VARIABLES	<ul style="list-style-type: none"> <li>- Identify productive chain's components, inputs, products and by-products</li> <li>- Identify the relation (transaction) among the components</li> </ul>	
5- MEASUREMENT OF GENERAL AND INTERNAL EFFICIENCY OF PRODUCTIVE CHAINS - IDENTIFICATION OF THE LIMITS	<ul style="list-style-type: none"> <li>- Characterisation of performance and processes of the CPs</li> <li>- Define technological pattern of the components and compare with similar pattern in productive chains of reference</li> <li>- Identify the limit factors responsible by low efficiency</li> </ul>	<p>Phases 5 and 6</p> <ul style="list-style-type: none"> <li>- Interdisciplinary work group</li> <li>- Consult to specialists (questionnaire, interview, Delphi method, case study, etc.)</li> <li>- Literature review</li> <li>- Construction of capital flow diagram and transaction</li> <li>- Group discussion</li> </ul>
6- PROSPECTING OF ACTUAL AND FUTURE IMPACTS OF THE LIMITATIONS ON EFFICIENCY, QUALITY AND EQUITY OF THE PRODUCTIVE CHAIN	<ul style="list-style-type: none"> <li>- Sensitivity of the CP by reducing the limitations</li> <li>- Future perspectives of the behaviour of critical variables and identification of their impacts on efficiency, quality and equity of the CP</li> </ul>	
7- DEFINITION OF ACTUAL AND POTENTIAL DEMANDS OF THE PRODUCTIVE CHAIN	<ul style="list-style-type: none"> <li>- Determination of actual and potential economic efficiency</li> <li>- Definition of limiting factors (critical variables)</li> </ul>	

Source: EMBRAPA-DPD (1995)

**Table 3.3: Characterisation of agricultural production systems (SP)**

PHASES	CONTENTS	METHODS AND TECHNIQUES
1- DEFINITION OF THE PRODUCTIVE SYSTEMS (SPs) ACCORDING TO THEIR OBJECTIVES	<ul style="list-style-type: none"> <li>- Choice of product(s) of the productive system (SP)</li> <li>- Expectation of the productive chain's components, mainly the consumers, in relation to the production system</li> <li>- Analysis and definition of the productive system's objectives</li> </ul>	<ul style="list-style-type: none"> <li>- Interdisciplinary work group</li> <li>- Literature review about productive chain</li> <li>- Interview to specialists of the chain's components</li> </ul>
2- HIERARCHY OF THE SPs IN THE PRODUCTIVE CHAIN	<ul style="list-style-type: none"> <li>- Position of SPs in the productive chain</li> <li>- Identification of structure of the productive chain and their transaction with SP(s)</li> </ul>	<ul style="list-style-type: none"> <li>- Interdisciplinary work group</li> <li>- Literature review about productive chain</li> <li>- Interview to specialists of the chain's components</li> </ul>
3- SET BOUNDARIES OF THE PRODUCTIVE SYSTEM GENERAL CHARACTERISATION	<ul style="list-style-type: none"> <li>- Identification of the natural ecosystem where the SP works</li> <li>- Identification of socio-economic context where the SP works</li> <li>- Specific social and economic characteristics of the SP</li> </ul>	<ul style="list-style-type: none"> <li>- Flow diagram of productive chain</li> <li>- Interdisciplinary work group</li> <li>- Literature review</li> </ul>
4- DEFINITION OF PRODUCTIVE SYSTEM'S COMPONENTS AND CRITICAL VARIABLES	<ul style="list-style-type: none"> <li>- Identification of system's compounds (inputs, processes and by-products)</li> <li>- Identification of the relation among components</li> </ul>	<ul style="list-style-type: none"> <li>- Block and flow diagrams</li> <li>- Interdisciplinary work group</li> <li>- Field visits</li> <li>- Literature review</li> </ul>
5- CLASSIFICATION OF THE SPs	<ul style="list-style-type: none"> <li>- Definition of productive systems taking account common socio-economic and agricultural characteristics</li> </ul>	<ul style="list-style-type: none"> <li>- Techniques of stratification and classification</li> <li>- Interdisciplinary work group</li> </ul>
6- MEASUREMENT OF GENERAL AND INTERNAL EFFICIENCY OF PRODUCTIVE SYSTEM - IDENTIFICATION OF THE LIMITS	<ul style="list-style-type: none"> <li>- Characterisation of performance of the SP</li> <li>- Compare the performance with similar pattern established as SP reference</li> <li>- Identify the limiting factors responsible for low efficiency</li> </ul>	<ul style="list-style-type: none"> <li>- Literature review</li> <li>- Field survey</li> <li>- Survey using Delphi</li> <li>- Simulation models</li> <li>- Interdisciplinary work group</li> </ul>
7- PROSPECTING OF ACTUAL AND FUTURE IMPACTS OF THE LIMITATIONS ON EFFICIENCY, QUALITY AND EQUITY OF THE PRODUCTIVE SYSTEM	<ul style="list-style-type: none"> <li>- Sensitivity of the SP to critical variables</li> <li>- Future perspectives of the behaviour of critical variables and intensification of their impacts on efficiency/sustainability /quality of the SP</li> </ul>	<ul style="list-style-type: none"> <li>- Literature review</li> <li>- Delphi technique</li> <li>- Sensibility analysis</li> <li>- Trends projection</li> <li>- Interdisciplinary work group</li> </ul>
8- DEFINITION OF ACTUAL AND FUTURE DEMANDS OF THE PRODUCTIVE SYSTEM	<ul style="list-style-type: none"> <li>- Determination of actual and potential economic efficiency</li> <li>- Definition of limiting factors (critical variables) on efficiency, quality and sustainability of the SP</li> </ul>	<ul style="list-style-type: none"> <li>- Mathematical models</li> <li>- Delphi technique</li> <li>- Field validation</li> <li>- Interdisciplinary work group</li> <li>- Group discussion</li> </ul>

Source: EMBRAPA-DPD (1995)



**Table 3.4: Characterisation of the knowledge chain**

PHASES	CONTENTS OF PHASE/PRODUCT
<p>1. CHARACTERISATION OF KNOWLEDGE FUTURE DEMANDS</p> <ul style="list-style-type: none"> <li>• NATURAL SYSTEMS</li> <li>• PRODUCTIVE CHAINS</li> <li>• PRODUCTIVE SYSTEMS</li> </ul>	<ol style="list-style-type: none"> <li>1. Listing of technology demands</li> <li>2. Analysis of demands and classification of necessary knowledge               <ol style="list-style-type: none"> <li>a) engineering, test and improvement of production systems, technical services, etc.</li> <li>b) new technological components necessary to the systems; applied technological research</li> <li>c) new technological beliefs by using new theory or scientific principles.</li> </ol> </li> </ol>
<p>2. TECHNOLOGICAL TRENDS</p>	<ol style="list-style-type: none"> <li>1. Identification of key indicators of technological or economical performance related to the theme (i.e. disease resistant, aluminium tolerance, etc.)</li> <li>2. Survey of the historical series of the indicators, determination of coefficients and trend projections for 5 to 10 years</li> <li>3. Impact analysis of the expected indicators on the production systems (productivity, costs)</li> <li>4. Identification of technological alternatives that would reach the expected performance</li> <li>5. Analyse and prioritise the technological alternatives</li> </ol>
<p>3. IMPACTS OF SCIENCE ADVANCES</p>	<ol style="list-style-type: none"> <li>1. Identification and mapping of scientific knowledge areas which are important to the theme</li> <li>2. Identification of science advances (theory, principles and methods) for each knowledge area</li> <li>3. Analysis of the progress obtained from transforming the scientific advances into technological advances:               <ol style="list-style-type: none"> <li>a) coefficients of tech-economic performance (potential versus actual)</li> <li>b) methods and equipment for research</li> <li>c) object of research</li> </ol> </li> <li>4. Specification of gaps, delays and opportunities of using the science advance for technological progress</li> <li>5. Analysis of the impacts from technological progress:               <ol style="list-style-type: none"> <li>a) in the process of research and technological development</li> <li>b) in the results of R&amp;D, indicating that technological areas potentially benefited</li> </ol> </li> </ol>

Source: Johnson, Marcovitch (1994) cited by EMBRAPA -DPD (1995)

### 3.3 Concluding remarks

Farming systems research has taken us so far. It has gone through the process of rapid rural appraisal to determine the resources available to farmers in the area, it has used this as a basis of trying to determine researchable constraints which are effectively bottlenecks in the system, and then it has used experimentation processes in research stations and then in farmer's fields, to try and provide information to farmers which undo, or break, the bottlenecks. Effectively, we have left farmers to assimilate the new technology presented, either by the research stations or by experimentation in a farmer's field, or being presented through the extension services. We have left farmers to take that information into their own minds and into the context of their own systems without any assistance. We have not bridged the gap between farmers and the research process. There seems to be major gap in the technology transfer process, and this is caused by the fact that we do not understand the decision making process of farmers satisfactorily. According to Amanor (1993a) there is a failure to incorporate an understanding of local knowledge into policy frameworks, planning and implementation of projects.

A considerable evolution in the planning system has been registered, but the effort in looking for ways and methodologies to reach EMBRAPA's client interest seems to be a continuing challenge. The methodological approach, presented in EMBRAPA-DPD (1995), fails in defining the real demands of the production systems because it does not take into account a method to detect the deep interest and needs of farmers in a participatory and learning sense. At same time, the farmer is concerned as the most important client for "marketable" generated information: again the approach fails by lack of explicit method or intention to understand farmers' information systems. The usual methods to transfer technology considers farmers as *passive receivers* and are based on field days, talking meetings, publications, TV programmes, radio programmes, physical models of production systems, technological packages and letter replies. The following chapter will attempt to analyse the decision making process, specifically with reference to new technology as well as the remaining issues in order to integrate the farmer's knowledge, practice and needs into the development of agricultural participatory knowledge information system.

# Chapter 4

## Decision Making Process and Farmer's Knowledge Information Systems

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### 4.1 Farm decision complexities

Farm decision-making, as an intrinsic part of management, must pursue the basic principles of efficiently allocating the limited supplies of physical, financial and human resources so as to best achieve a set of objectives (Dent *et al.*, 1986). The neo-classical economic theory assuming single linear criteria of profit maximisation to explain the farmer's objective function are clearly unsatisfactory (Gasson, 1973; Romero and Rehman, 1989). In addition, the biological nature of agricultural systems, together with climatic variability, and economic and political context, have been defined as the main background, and uncertain context, for farmer's decisions.

According to Dent *et al.* (1995), the social aspects of the farm household interacting with the external environment and ecological components of agricultural systems, have not been worked out satisfactory. Personal goals, objectives, family needs, behaviour and attitudes, as intrinsic decision components of farm management, have not been fully considered in attempting to understand the process of farm decision making (Gasson, 1973). The behavioural assumptions that underlie theories about the decisions and choices have made psychologists and economists pay closer attention to the matter in recent years (Weber, 1994). More recently, factors related to human attitudes and behaviour in farming have been studied by Willock *et al.* (1994) McGregor *et al.* (1995) and McGregor *et al.* (1996).

Farmers have been recognised as the prime users and managers of natural resources (Bunting, 1992; ISNAR, 1995). According to Röling (1994a) it is no longer sufficient to consider farmers as primary producers, entrepreneurs, or farm managers: nowadays they must also be accepted as managers of ecosystems. This implies that the management of natural resources is fundamentally dependent on the decisions of

the farmers. Therefore, farm decision-making has been recognised as a complex process (Dent and Anderson, 1971; Wright, 1971; Douglas, 1986; Sutherland *et al.*, 1996), which must be understood in order to face new paradigms for agricultural development.

## **4.2 The development of decision process**

### **4.2.1 Setting stages**

The decision process begins with the perception of some sort of stimulus which suggests to the manager that a decision has to be taken in order to achieve some goal or to adjust the environment to a new situation (Morris, 1971; O'Dell, 1992). According to Checkland and Scholes (1993) the manager faces everyday life with a flux of interacting events and tries to improve situations, which are considered problematical. It is expected from problem perception that the manager forms an initial conceptualisation of the situation about which a decision may be taken. Morris (1971) pointed out that there is a rather complex set of interactions among the processes of perception, recall and conceptualisation. Under a normative and linear approach, van den Ban and Hawkins (1996) have identified sequential stages (see Figure 4.1), through which the process of the decision making should pass in order to achieve desired goals. These stages also can be considered as the farmer problem-solving cycle discussed by Rölting (1988) or similar sequential components outlined by Giles and Stanfield (1990).

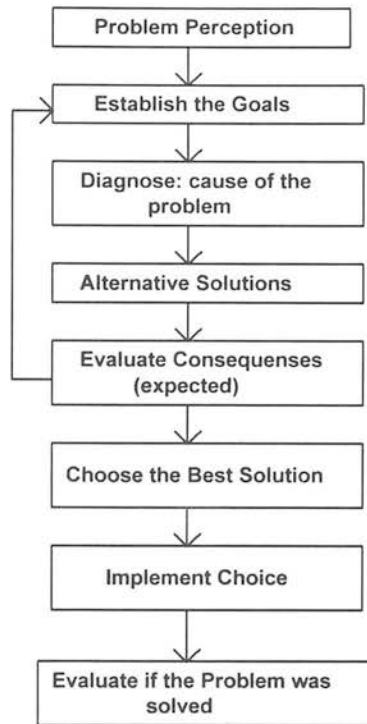
### **4.2.2 Describing stages**

According to van den Ban and Hawkins (1996) the decision process is encompassed by the following description.

(a) Firstly, the decision maker has to become aware of the problem (perception): whether the present situation is unsatisfactory, or if the decision maker considers that the continuation of the current situation will lead to future difficulties or if the decision maker becomes aware of new solutions to the problem.

Figure 4.1: Stages of decision process

(Adapted from van den Ban and Hawkins, 1996)



(b) The second stage is concerned about the goals and objectives. This can be considered as the central part of the process from where all orientation is derived. Often, several goals are set, conflicting with each other, so that not all can be achieved at the same time (Perkin and Rehman, 1994).

(c) Diagnosis is the following stage. An adequate identification of the cause is the most important way to find a satisfactory solution to a problem.

(d) The next step has a cognitive dimension guided by a mental review of possible alternative solutions taking into account the expected consequences from each one. The expected consequences have to be evaluated against the criteria established in the second stage in order to find a good solution. However, according to Errington (1985a, 1985b), “external” and “internal” information are brought into the process in order to find the best choice. Forb and Babb (1989) have pointed out that the performance of any enterprise is dependent on the relation between decisions and information. Errington (1985a) has classified as external all information, which

originates from outside farmer, while internal is related to the decision-maker himself, or more commonly labelled “experience”. The external information usually includes significant elements coming from “trusted people” (Ferreira, 1997), or even from “significant others” (Gasson 1971) belonging to the same social context in which the decisions are taken (Skerratt, 1995).

(e) Choose the best solution, implement the choice, and evaluate if the expected results have been achieved and whether the problem was solved are the later sequential stages. Implementing the solution means transforming the decision process into action. In this way, Errington (1985a, 1985b) has brought forward the idea that actions can follow different courses: being entirely taken by the decision-maker; part being *allocated* to other members of the workforce; and total or part being *delegated* to someone who the owner has assigned authority to take decisions. The first situation is to be found in most of small farm business and the others in larger farms where there is some scope of labour division.

#### **4.2.3 Farmer advice**

It must be understood by those (outsiders), who in some way are involved with farmer advice, that the stages in Figure 4.1 represent the process of solving the farmer’s problem and as such the perception, goals, values and final decision belong exclusively to the farmer. This means that a strong social component must be considered in the decision process. The analysis of farmer’s decision process must be as stated by Le Gal (1995):

*“Giving farmers solutions and recommendations, even though they may be based on a correct diagnosis, will have little impact in solving the complex problems of management when the environment is uncertain. The relative positions of farmers and advisers have to be reconsidered in a way that stimulates farmers’ learning processes through (a) a better understanding of their own knowledge and decision-making processes, and (b) a methodology able to assess the consequences of innovations on the present organisation at the risk level chosen by the farmer.”*

Therefore, the outsiders should only help the farmer to improve his decision process in order that the farmer's goals are achieved more satisfactorily (van den Ban and Hawkins, 1996). Many people involved with advisory services implicitly assume that the farmer has the same goals as they have. According to van den Ban and Hawkins (1996) this attitude from outsiders only can be accepted (if ever) when the problem is focused on "lower level" decisions as, for example, on plant protection. It is not acceptable to make such an assumption when involving farmer's objectives.

### 4.3 Multiple goals and objectives

Normative models based on neo-classical economic theory and single decision criterion (objective) pursuing optimal solution of profit maximisation are clearly inadequate to understand the decision behaviour of farmers (Gasson, 1973; Romero and Rehman, 1989). On the other hand, multiple objectives of the farmers are a rule rather than exception and have been recognised and pointed out as an appropriate framework for decision-making (Romero and Rehman, 1989).

According to Perkin and Rehman (1994) the objectives of farming operators are not only numerous, but often divergent and conflicting. This does not mean that all objectives carry monetary values. Gasson (1973) considered that dominant values and farmer's beliefs are likely to be associated with farming occupation and classified goals into: *instrumental* (farming is oriented to obtain income); *social* (getting recognition, belonging to the farm community, etc.); *expressive* (feeling pride of ownership, to be creative, etc.) and *intrinsic* (enjoyment of work, etc.).

Dent *et al.* (1986) have pointed out also several non-monetary reasons why people take up on farming such as: "way of life"; attraction to work out doors; be one's own boss or even because of the family tradition. However, according to the authors, it should be accepted that once in the farming business those people are strongly motivated to increase income. The effort of a farm decision-maker to accommodate monetary and non-monetary objectives is well presented in the review comments of Perkin and Rehman (1994) as:

*“The common feature of the above studies is the nearly universal conclusion that personal, family and farm business objectives are not independent of each other and need to be considered together and that the highest ranked objectives reflect a combination of lifestyle and economic goals.”*

#### **4.4 Rationality of decisions**

Decision making has been defined as a process when considering farmer’s objectives, in which various courses of action are selected from a set of available alternatives and are pursued (see Douglas, 1986). The assumption that farmers make rational decisions has oriented most economic analyses (Jacobsen, 1994). This approach relies on the neo-classical economic concept that people make choices guided by self-interest of maximising their individual utility. In this regard, Douglas (1986) pointed out that choice is considered rational if it is consistent with the decision-maker’s objectives. Theoretical background presented by Jacobsen (1994):

*“Neo-classical production economics is based on the assumption that profit maximisation is the only goal, and that the decision maker lives in a world with full certainty, full knowledge of all alternatives and their implications and, finally, that the decision maker is able to rank them in an unambiguous manner.”*

However, it is argued that these conditions are very different from the farming situation where a farmer does not access all important information, has many alternatives each with uncertain outcomes (Jacobsen, 1994). Anderson *et al.* (1977) stated that a good decision is a considered choice based on a rational interpretation of the available information. To some extent, it is in agreement with Simon (1990), cited by Sutherland *et al.* (1996), where the limited power of processing information has bounded individuals in their capacity to make decisions.

Therefore, it is easy to agree with Jacobsen’s (1994) statements: (a) that all decision makers want to appear to make rational decisions (b) a rational decision does not



always lead to goal fulfilment and (c) assessing whether it is a rational decision depends on who is judging it. Human decisions depend on problem, goal and on resources available allocated by the decision-maker (Svenson, 1990, cited by Sipiläinen, 1994). The “best” alternative may be chosen differently among managers considering different choice and preference judgements (Sipiläinen, 1994).

#### **4.5 Dynamics of the process**

The sequence of the different stages presented by van den Ban and Hawkins (1996) in Figure 4.1 is a linear presentation, which has been used in management theory to provide a conceptual framework to understand and to study decision making process. Morris (1971) also presents similar understanding for a course of decision actions. Despite the linearity, the dynamic behaviour of the decision process as well as an intrinsic feature of learning - as a whole can be easily identified in the approach.

Once the problem is perceived and the process starts, two main dynamic elements are engaged. The first is related to the movement from one stage to another. The second is characterised by a mental and cognitive iterative process of “trial and error”. It is concerned with searching for alternative solutions, evaluating the expected consequences and reviewing goals. At this point a dynamic element related to the whole process can be identified. In reality, decisions are continually being made only because something is happening all the time (Giles and Stanfield, 1990).

#### **4.6 Dynamics of decisions, goals and objectives**

Planning, implementation and control are usual procedures of farm management in order to achieve desired goals and objectives. According to Dent *et al.* (1986) this broad sequential classification can be misleading unless the component relationships are clearly recognised. Farming systems operate within a changeable and dynamic environment driven by external (political, social and economic) and internal (productive, social and structural) factors. The direct, indirect and interaction effects of these factors lead to a dynamic process of decision making which is narrowly

related to the dynamic evolution of attached goals and objectives. Figure 4.2 represents, through time, the dynamics of goals and objectives resulting from dynamic behaviour of components of decision environment. The manager is placed at the centre of the diagram observing, monitoring and checking if the goals and objectives are being achieved in order to take a decision to accommodate pressures and effects from the different components. The key understanding of the dynamic behaviour is to perceive the continuous change in the decision environment even though a decision may not taken.

Figure 4.2: Diagram of dynamics of goals and objectives



Socio-economic evolution, external demands, and needs of farming households are probably the most important factors in defining and inducing modification of goals and objectives. The decisions, as a result of the related modified goals and objectives, also are expected to change. For example, Errington and Gasson (1994), analysing farm family business, pointed out that the objectives may change over the family cycle as one generation is born, grows up and eventually succeeds the predecessors. Events that normally occur within a family, such as education of children, engagement, marriage of children or even death of any family member affect objectives of the family.

The dynamics of decision making may be associated with the farmer's economic evolution. In the shorter term, the level of farmer satisfaction may change after an exceptional or unexpected economic performance. A new tractor or even a summer

holiday for all the family, may be a change of decision following a profitable good year.

However, even without exceptional conditions, it is natural to expect changes to occur in the goals and objectives of farmers as a result of ageing. According to Errington and Gasson (1994), farm family decisions are taken as a function of family cycle in relation to the division of labour, labour productivity, inheritance and retirement. Older farmers may prefer the security of short-term income than economic returns in long run. This can be considered as an effect of age since as the farmer get older he is less interested in long term development projects (Sipiläinen, 1994). While it may make sense to reinvest in the business rather than in some external fund, the investment preferences of the older generation will conflict with the desire of new generation to expand the farm business.

On the other hand, in the Brazilian Midwest Region, successful farmers, guided to profit maximisation in the past, have exploited the natural resource base, yet now they have changed their goals and objectives to regenerate the farm in order to facilitate the transference of ownership to the successors. The motivation behind this kind of decision may be to guarantee an expected economic success for the next generation or to demonstrate personal pride (Cezar, Pers. comm.).

#### **4.7 Time scale influences on the dynamics of decisions**

Decisions on long term investment are commonly taken in the farming business: they are related to achievement of long term goals and objectives under strategic planning. Errington and Gasson (1994) have distinguished the time scale preferences between entrepreneur farmer and farm family. The expected stream of future income arising from investments, oriented to profitability taking into account time preference and cost of capital, are characteristics of investment behaviour of the entrepreneur. On the other hand, the investment behaviour of the farm family is much more concerned with the stage of family cycle in order to maximise the family's opportunities. Among the opportunities, Errington and Gasson (1994) identified the efficient use of



available family labour and extra income when the child finishes education, comes home and gets married. Potter and Lobley (1992) have reported that an important characteristic of farmer life cycle is concerned with his decisions considering the presence or absence of successors. These authors have found that farmers, without a successor or with a low expectation that a successor will appear, are significantly more likely to simplify the farm structure in later years and to make the farm less intensive than before. This kind of insight becomes important in understanding the process of decision making at individual level or even for environment perspectives.

#### **4.8 Uncertainty and risk**

A decision-maker does not find it difficult to take decisions if there is no uncertainty about the consequences of an action course and if he has only a single goal (Dillon, 1971). However, this can change drastically in a complex (realistic) situation if several (conflicting) goals are to be considered and if there are uncertainties related with the actions (Dillon, 1971).

The understanding of this matter, according to Anderson *et al.* (1977) is based on the simplification that in decision problems there are two main components, *actions* and *states*. The *actions* (alternatives) should be thought of as exhaustive in order to select the most appropriate alternative(s), but they must be mutually exclusive in order to solve the problem. The *states* also must be defined by a mutually exclusive and exhaustive listing. If the decision-maker is not sure about which state will prevail from the alternative action course, the situation is considered under risk (Anderson *et al.*, 1977).

Dillon (1971) presented a comprehensive understanding of the logical procedures of a decision-maker facing the latter situation as follows. The presence of uncertainty forces the manager to predict and to decide what outcomes are possible. For consistency, the manager has to specify his belief about the occurrences of these uncertain outcomes. In this case, for each action, which is supposed to be undertaken, the manager has to specify a subjective probability distribution for the set of

consequences that he believes may arise. At first, it is thought that the assessment of alternative risky choices to be so complex and complicated as to be impossible, but if this were so, all managers would be psychologically disturbed, frustrated or unsuccessful given the existing uncertainty in the real world (Dillon, 1971).

Uncertainty and risk has become an important area of academic and theoretical study in order to understand and to provide methodological tools to assess decision-making (Dillon, 1971; Anderson *et al.*, 1977). Even though a large body of studies have been developed and related to the theory of probabilities, the most difficult and complex aspects rely on the behaviour of the decision-maker. The behavioural component is based on identification of the utility function of the decision-maker. Utility function theory is based on personal attributes of choices preferences (Dillon, 1971) and is a complex of conflicting goals that often are not fully articulated.

#### **4.9 The nature of farm decision making**

The nature of farm decision making can be classified according to Boehlje and Eidman (1984), cited by van Huylenbroeck (1994), as operational (daily), tactical (short run) and strategic (long run). Giles and Stanfield (1990) have also pointed out a similar classification for short and long term decisions. However, from an economic point of view, the profitability of farm operations are influenced mainly by operational and tactical decisions while the survival, continuity and growth of farm businesses are associated with strategic decisions (van Huylenbroeck, 1994).

The goals and objectives of decisions in the short and long term are not necessarily related to monetary expectations. When the decisions are concerned with long term investments there are several aspects to be considered which differ from short-term decisions. Expectation of long term of course is more uncertain due to the long time horizon (Sipiläinen, 1994). Family influences in this case may be a strong part of the process because the decision involves questions of the future of family security, standard of living, and social standing. These aspects are emphasised by relatively large size of investment compared with farm economy, problems involving more

than one family generation, time preference and threat to family survival if decision turns out to be poor (Sipiläinen, 1994).

Jacobsen (1994), seeking to describe the way that Danish farmers take decisions, found different procedures among short, intermediate and long run decisions. For example, for short run decisions the author found that the farmers develop a certain kind of routine in relation to negotiations for buying inputs. Younger farmers obtain more discounts than older farmers because they spend more time negotiating. The interaction effects like those found by Jacobsen should be explored in order to gain insights and to improve our understanding.

#### **4.10 The farmer's knowledge information systems**

##### **4.10.1 Creating, experimenting, learning, adapting and deciding.**

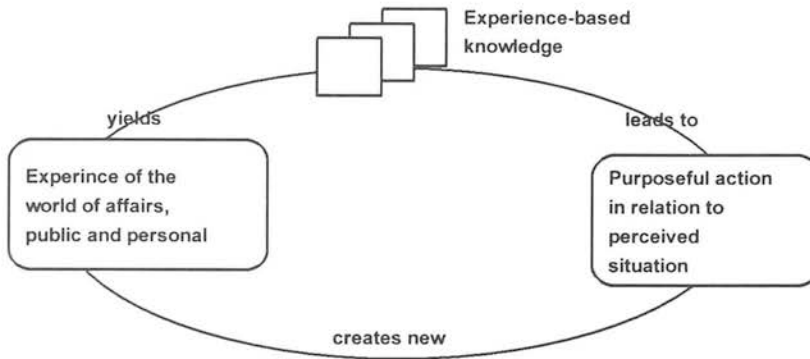
While the “intuitive” approach of a manager facing important decision seems to be an “art”, behind the decision lies a considerable amount of learning and experience (Morris, 1971; Errington, 1985a). According to Jacobsen (1990), cited by Jacobsen (1994), farmers' decisions appear to be taken on the basis of “rules of thumb” and simple mental calculation perhaps allowing for, but still hiding the complexities involved. Historically, considering the household nature of farming and that farming has evolved with man in total interdependency, there is no doubt that learning and experience have guided farmer decision making. Bennett (1986) pointed out: *“agriculture as human activity has existed for at least 6,000 years while true scientific research on agriculture has existed for little more than a century”*. Farmers, traditionally, have learned their occupation by farming, observing results of their labours under their individual cognitive styles (van den Ban and Hawkins, 1996).

Each farmer develops a specific action model to take decision, which is based on his own experience and knowledge (Le Gal, 1995). These observations on the learning process of farmers are in agreement with “experience-based knowledge” outlined by

Checkland and Scholes (1993) where the acquisition of knowledge is placed in a cycle (see Figure 4.3). This approach implies that purposeful action derived from experience-based knowledge will itself result in new experience. A learning process is established due to the continually changing content.

**Figure 4.3: The experience-action cycle**

Source: Checkland and Scholes, 1993



Accounting and budgeting have been used to describe and predict behaviour and consequences of ex-post and ex-ante decisions, but they are not adequate to understand the complexity of decision which the farmer face in the real world (Lund, 1994). Then, to deal with complex decision situations and to reduce errors incurred by such “black box models” as much as possible, Lund (1994) suggested that the true nature of the problem should be revealed to create models which are able to explain *how* to solve the farmer’s actual problem. In this way, Lund (1994) pointed out that theoretical reasoning to approach complex problem solving is not looked upon as something separated from reality and stated:

*“Solving complex problems by a rational procedure is only possible on the basis of theoretical knowledge of the structures and rules governing the practice of farmers while on the other hand such structures and rules can only be gained by knowledge of practice.”*

The above statement is in contrast with the “top down” concept, which has guided most of the methodological approaches applied to understand farmer’s decision making and to recommend solutions. A new way is being pursued to find agricultural

solutions based on the philosophy “farmer first”, defined by Chambers (1993), in which the farmer’s knowledge and experience must be brought into institutional organisations. According to Le Gal (1995) the relationship between farmers and advisers can be deeply modified by focusing on the farmers’ learning processes rather than recommending technical institutional solutions. Evidence relating to the capacity of farmers for creating, experimenting and adapting have been reported from several parts of the world (Rhoades and Booth, 1982; Richards, 1985; Hildebrand, 1990; Ashby, 1991; Rhoades, 1993; Maurya, 1993; Gupta, 1993; Box, 1993; Franco and Schmidt, 1985, cited by Prain, 1993; Salas, 1994).

Farmers take decisions based on the best of their knowledge, beliefs, and values at the time according to the available resources. The problems of non-adoption of research recommendations have been attributed to several factors such as farmers’ ignorance, conservatism, poor extension education and on-farm constraints (van den Ban and Hawkins, 1996). However, from the early 1980’s a new interpretation has emerged that the problem is neither the farmer nor the farm but also involves inadequacy of the technology (Chambers *et al.*, 1993).

Assuming the above interpretation and the importance of involving farmers directly in research decisions, the advocates of the ideas have not suggested a complete replacement of the commodity-based research on-station and in-laboratory. However, they have emphasised that the research should be complemented with the farmers’ knowledge and priorities (Chambers *et al.*, 1993; Rhoades, 1993; Maurya, 1993; Drinkwater, 1994a). It is important to recognise that most of these issues have been detected and brought for discussion by social scientists as a very significant contribution to agricultural research and development. This is underlined by van der Ploeg (1993) in his statement:

*“Rural sociology can play an important role in the construction of adequate relations between research carried out in scientific institutions and the rich and varied laboratory that can be distinguished in practice.”*



In summary, improvement in technology development should have two elements: (a) insights into the dynamics of farmer knowledge systems and objectives; and (b) understanding of pathways between formal scientific and farmer knowledge.

#### 4.10.2 Defining knowledge and information

Röling (1988), Röling and Engel (1991), Leeuwis (1993), Long and Villareal (1994) and Scoones and Thompson (1994b) have discussed conceptual aspects of knowledge and information in the agricultural context. This discussion stems from communication issues as a result of increasing research dealing with farmer's knowledge and with the complex links between research institutions, extension services and farmers (Long and Villareal, 1994).

According to Röling (1988) *knowledge* cannot be transferred because it is an attribute of the mind which is developed in close relationship to people's environment. Thus *knowledge* is identified as "*existing between the ears which cannot be heard, seen, touched, or smelt*" (Röling and Engel, 1991). These authors have pointed out that *knowledge* is used to give meaning to the world and to make predictions if any action is implemented towards achieving some goal. While *information* has been recognised as difficult concept (Röling, 1988), it is considered as patterned or formatted data which improves the goodness-of-fit of interfaces between knowledge and real world, since people observe, get feedback, communicate and learn (Röling and Engel, 1991). This is in agreement with van den Ban and Hawkins (1996) that *information* is passed through sensory inputs of seeing, hearing, touching, tasting and smelling.

However, Leeuwis (1990, 1993) is not in line with Röling and Engel's definitions because he does not agree with sharp distinction between the terms. Leeuwis (1990) argued that describing knowledge in that way tends to over-estimate the individual-cognitive components at the expense of processes of social and cultural production. Information defined on a base of sensory input is not accepted because people can only interpret and assign meaning to the inputs on the basis of a knowledge and

experience already existing; “*information has no meaning if it can not be internalised and by being internalised it becomes part of knowledge*” (Leeuwis, 1990). Further discussion and arguments lead Leeuwis (1990) to the conclusion that it is not helpful to separate knowledge and information.

This seems to be a complex field for discussion which is outside the scope of this section. However, more specifically, according to Long and Villareal (1994), knowledge must not be treated as a commodity, which means that someone having knowledge does not imply that others are without it or that it can easily be traded. The most important point, however, is that knowledge must be understood in a broad sense within a social context as of interest and emerging as a product of the interaction and dialogue between specific actors (Long and Villareal, 1994).

The above interpretation is in agreement with Brouwers (1993) and Scoones and Thompson (1994b) who view *knowledge* as a social process (action and experience) and a *knowledge system* as a multiplicity of actors and networks dynamically communicating and negotiating technical and social *information* not as single, cohesive structures, stocks or stores. According to Röling (1988), even though no satisfactory way has been found to deal with linguistic and conceptual confusion, which arises from the expression *information system* and *knowledge system*, both are aspects of same social phenomena. However, Röling (1988) has differentiated the expressions, for example, *information system* was interpreted as:

*“a system in which agricultural information is generated, transformed, consolidated, received and fed back in such a manner that these processes function synergically to underpin knowledge utilisation by agricultural producers.”*

In this case, Röling pointed out that the focus is on elements involved in generating, transforming and receiving information as well as information flows and linkage mechanisms. On the other hand, *agricultural knowledge system* was interpreted as:

*“a system of beliefs, cognition, models, theories, concepts, and others products of the mind in which the (vicarious) experience of a person or group with respect to agricultural production is accumulated.”*

According to Rölöing (1988) in the above concept, the cognitive system, its structure and the order is imposed upon the environment, in the sense that different groups of people have knowledge systems. However, the extended importance of the human being in the following statement of Long and Villareal (1994) brings to this matter the central issue:

*“...without giving sufficient attention to human agency and the transformation of meaning at the point of intersection between different actors’ lifeworlds, and without analysing the social interactions involved, we will have missed the significance of knowledge itself”*

#### **4.10.3 Understanding how the farmer’s knowledge is socially developed**

Whatever the final philosophical definitions of *knowledge* and *information* are, it seems to be equally important to understand *how the farmer’s knowledge is socially developed* in order to find better ways to integrate researcher and farmer. In this way several questions related with the creation, sharing and transmission of farmer’s knowledge have arisen in order to develop a participatory partnership between researcher and farmer. It has been understood that knowledge is socially and politically constructed and according to Scoones and Thompson (1994b) knowledge is held, controlled and generated by different people in a society.

The aspects mentioned above imply that the creation and utilisation of knowledge is not a matter that is merely instrumental or technical, but also involves questions of authority and power (Long and Villareal, 1994b). For example, according to Scoones and Thompson (1994b) the simplification in labelling “farmer’s knowledge” presents problems and the following questions arise: who is the farmer whose knowledge should be put first? Male or female? Rich or poor? Old or young? Influential or powerless? Further, in indigenous and traditional rural communities, knowledge is not evenly distributed among individuals and those who know more about specific things are considered as “experts” (Winarto, 1994). This suggests that the dynamics of transfer of knowledge can be related with community norms and member’s power,

inducing the following questions: who controls the flow of information and who imposes an interpretation style on its transmission? (Scoones and Thompson, 1994b).

Richards (1993), Longley and Richards (1993) and Pottier (1994) have shown social influences and labour division through which farmers in African communities select and conserve rice and bean genetic materials. For example, there is a narrow association of household dependants with rice of long-duration cycle and flood tolerance while experimentation with beans is made under a family secret and direct participation of the women. Further, Millar (1993); Salas (1994) and Matose and Mukamuri (1994) have pointed out some aspects of the cultural dimension of rural people's knowledge, such as spirituality influencing experimentation, and participation of older and expert farmers in the definition of cropping practices and forest management. Understanding the construction of rural knowledge according to Scoones and Thompson (1994b) is not a simple task; it demands social differentiation and political ways of analysis.

In less developed communities, traditional cultures have a strong influence on social organisation, behaviour and attitudes of individuals providing agricultural knowledge under rigid control and social norms as means of power, prestige and authority. It is believed that in more developed and modernised communities, farmer's knowledge is not under the strong influence and rigid norms of cultural traditions. According to Bennett (1986) much of the content of "indigenous" knowledge, in a developed economy, stems from scientific sources, where a constant flow of expertise occurs into the ethnoscience of local communities. On the other hand, this author has reported that there is not sufficient awareness of this transformation into indigenous knowledge, in the way, knowledge is enlarged and extended (Bennett, 1986; Röling 1990). However, it is expected that each community has its own particular social interaction and dialogue between actors (Röling, 1990).

Knowledge is multi-layered, fragmented and diffused rather than systematised and unitary (Long and Villareal, 1994). Box (1989), cited by Long and Villareal (1994), has also pointed out that instead of one knowledge system there are many complex

networks which lack articulation among each other, concluding that:

*“The lifeworlds of the participants, or their values, norms and interests, differ so greatly that they do not allow for communication and interaction between the parties”*

Therefore, *social interfaces* and *linkages* between the main actors (farmers, extension officers and researchers) are the main issues to be explored in order to increase the efficiency of the creation and dissemination of local agricultural knowledge, but communication problems should be understood and solved (Cobbe, 1993).

#### **4.10.4 Communication problems: understanding and exchanging rural knowledge**

Different cultural backgrounds, socio-economic positions, symbolic systems and appreciation of risk make communication difficult between farmers and scientists in the understanding and exchange of knowledge (van Dusseldorp and Box, 1993; Chambers, 1993). Scoones and Thompson (1994b) and van Dusseldorp and Box (1993) have made important considerations, which should be taken into account in identifying the construction of farmer's knowledge. For example, what people *do* is not necessarily what people *know*, even though knowledge is bound up with action. Articulation and transmission of information and knowledge may be done in many ways and often they are not understood correctly (Cobbe, 1993).

Communication problems can arise from a cognitive point of view or because of a lack of common ground (Cobbe, 1993; van den Ban and Hawkins, 1996). In other words, rural people's knowledge is often expressed in their domains and in their own ways which becomes difficult for “outsiders” to understand or to decipher. To the same extent, rural people face difficulties in understanding technical and scientific terms and meanings. The farmers' views about their agricultural practice, adaptation, procedures and experiments are considered as normal in the day to day activities, and therefore they do not describe their experiences in terms of creativity.

Local knowledge has been reported as holistic, in which farmers and families seldom isolate effects of factors on system performance, while the scientific knowledge is segmented (Scoones and Thompson, 1994b). Risk assessment for farmers can be different from the researcher view (Bennett, 1986), and it becomes an important factor influencing a farmer's decision to implement new elements from scientific knowledge.

The reactive behaviour and logical thinking of rural people has been underestimated. Often, either passive and submissive behaviour in the face of the presentation of an "imposed" new technology, or elusive, enigmatic and circular answers about their livelihood, are both considered as strategies used by rural people to overcome the embarrassment of one-way communication from outsiders (Scoones and Thompson, 1994b).

The illustration, through the above problems, suggests that communication must be changed, in order for a common ground and for a real "dialogue", if advantages are to be obtained from relationships between farmers and researchers (Cobbe, 1993). The experience of Box (1993), expressed in the statement from a farmer, translates properly the direction towards which the relationships between farmers and researchers should be guided:

*"speak with me; don't speak to me like others did".*

Röling (1994b) has emphasised that for sustainable agriculture, technical information alone is not sufficient. If some policy is to be implemented, farmers nowadays want to know the nature of the policy and the extent to which it may affect their lives. This means that communication has to be transparent, trustworthy and not uni-directional: it is necessary to negotiate, share and exchange experiences not only in the Western (Röling, 1994b; Röling, 1998) but in the Third World as well (Matose and Mukamuri, 1994). In fact, the *two-way* model should be seen not only in terms of interpersonal or mass communication, but also at a higher level of understanding to guide the institutional processes for technology development (Röling, 1988).

#### 4.10.5 Dynamics of farmer's knowledge

Scoones and Thompson (1994b) have reported that studies exploring dynamics of farmer experimentation show that rural people empirically analyse alternatives. This procedure leads to the development of a dynamic process of learning in which knowledge is not static or tied up in its historical past. The dynamics of farmer's knowledge, therefore, is given by reworking, updating and changing their practices as result of environmental effects (biophysical) (Bebbington, 1994) or based on social demands of family, community and markets (Long and Villareal, 1994).

The study developed by Amanor (1993b), with a traditional community in Ghana, shows that farming knowledge was adaptive, interactive and innovative following environment changes as a result of agricultural activities, population pressure and environment degradation. Effectively, a farmer takes decisions based upon value preferences, available knowledge, resources and relationships. In doing so, he processes information, brings together the elements necessary for operating the farm, and locally constructs his own knowledge base (Long and Villareal, 1994).

*“different people know different things in different places, and learn new things in different ways”* (Chambers, 1994b).

Bebbington (1994) summarises and complements the interpretation of dynamics of the knowledge locally constructed on farmer's practices as *“situated agents”*:

*“ As **agent**, because they are actively engaged in the generation, acquisition and classification of knowledge; and as **situated agents** because this engagement occurs in cultural, economic, agroecological and socio-political contexts that are products of local and non-local processes. These processes have had a socially differentiated influence: different rural people have different livelihood strategies, different identities and different goals. They also have different capabilities to address what they perceive as problems. Finally, this social history is ongoing - people have to continue acting in a changing context, much of whose change is beyond their control”.*

The dynamic embodied in farmers' activities and capabilities, as a result of environment changes, is an important factor to be explored by research, in order to overcome some of institutional criticism of concentrating on the commodity-oriented approach and relying on local results from a research station. In reality, new approaches are needed in order to practice an interactive relationship with farmers in order to overcome the imbalances, which make the extension of the scientific networks precarious among farmers (Clark and Murdoch, 1997).

The approach must keep a spirit of discovery, enquiry and enabling the adaptive abilities of farmers, to promote a dynamic process of innovation and adaptation based on interaction of farming and environment (Amanor, 1993b). Attempting to force knowledge and capabilities of rural people into a straight jacket imposed by a formal framework of science is unlikely to work in any articulation; instead, productive engagement is only possible when common ground is found (Scoones and Thompson, 1994b).

#### **4.11 Participatory approaches: integration, complementation and learning**

##### **4.11.1 Levels of participation and relationships**

Contractual, consultative, collaborative and collegial models of participation have been identified and described by Biggs (1989), cited by Merrill-Sands *et al.* (1991); Cornwall *et al.* (1994); and Okali *et al.* (1994), as the levels of relationships often develop between farmers and researchers. In the *contractual* mode, normally the farmers provide land, animals and services; *consultative*, the farmer's problems are detected and the researcher tries to find solution; *collaborative*, farmer and researcher are partners in the research process with continuous collaborative activities; *collegial*, researchers encourage group discussion and R&D is developed in the field. It has been realised that the intensity of relationships increases along the way from contractual to collegial mode.



The above typology has been expanded by Farrington et al. (1993), cited by Okali *et al.* (1994), to “depth of interaction”: running from shallow to deep modes with scope for interaction ranging from narrow to wide. It has been pointed out that deeper levels of participation tend to be developed with group, rather than with individual approaches. However, each kind of relationship has assumed significant steps in the context to decrease the distance between farmers and researchers but it is recognised that the first three (contractual, consultative and collaborative) are concerned with technical problems and do not help to understand the main issues of farmer’s decision making.

#### **4.11.2 Group discussion: the basic concept**

*Collegial relationships* have increased for developing participatory studies and institutional arrangements to strengthen the role of farmers in setting and prioritising research activities (Wellard, 1993; Cornwall *et al.*, 1994; Okali *et al.*, 1994). A great number of participatory studies have been developed exploring the advantages of *group discussion*. These advantages have been outlined as “to increase knowledge and to change attitude and behaviour” (IDS Workshop, 1993; and van den Ban and Hawkins, 1996). Increasing knowledge can be summarised here as being the opportunity to ask questions and to add information from several actors, since this point will be focused later.

Therefore, it is important to bring to this section several functions of group discussion that can fulfil the process of attitude change highlighted by van den Ban and Hawkins (1996):

##### *(a) Creating awareness of problems and feelings*

Group discussion can create an atmosphere of mutual trust helping to identify and face up to problems, working out probable solutions and implications of changes for each member or partner. It is believed that sometimes it is easier for someone to acknowledge his feeling in a group where other members openly discuss their own feelings. In others words, it is much easier to help farmers to solve a problem once they have faced their problems openly and realistically and see that they are not the

only one who has the problem.

*(b) Concrete formulation of the problems*

Here is the central issue because the more clearly a problem is defined, the more likely a solution will be found. The group discussion can specify the problem more realistically and with more details, aggregating opinions from several sides and identifying angles of the problem definition more than with individual discussions.

*(c) Change in norms*

Norms generally have important influences on our behaviour. Norms do not change if an outsider says they are old fashioned, but they change if the group itself concludes that they should change. Group discussion facilitates identification of these norms.

*(d) Formation of opinion*

Group discussion enables participants to form an opinion about a specific issue, new development policy or even a new technology to be used as a group (e.g. soil conservation). Formation of opinion results from mutual ideas among group members. However, this does not mean that the opinions are necessarily the same for everybody but it does ensure all group members have considered them more carefully.

The purposes of any group discussion are not static and inflexible; new aims and issues may emerge during the course of a meeting, especially as member's desires change (IDS Workshop, 1993). To explore properly the advantages of group discussion, attention should be paid to several issues related to the setting up and functioning of the group (IDS Workshop, 1993). For example, appropriate size, membership and selection procedures, deserve careful attention. Equality of composition and dialogue should be ensured in the group in order to promote a free feeling to participate and avoid exclusion of other community members.

Epodou (1993) analysing linkage mechanisms between research and extension has pointed out several reasons why meetings for joint planning are not always effective. Most of the reasons were related to the above factors, but operating rules must pay special attention to balance considering the frequently found situation of giving too

much authority control to one part in detriment to another. Of course, despite available techniques to work with groups, one of the most important and innovative characteristics to be used from outsiders is sense of learning and listening in participatory approaches. Chambers (1993) has summarised that the role of outsiders is to elicit, encourage, facilitate and promote analysis by farmers, choice and experimentation and, where necessary, providing the stimulus, the occasion and the incentive for group discussion.

#### **4.11.3 Extended objectives of participatory approaches**

Although farmer participatory research has been the central focus for technological development, it has been understood also as a larger agenda. According to Okali *et al.* (1994) the participatory approach aims to generate, test and disseminate technology, but also to change the orientation of research institutions, develop a sustainable agriculture based on community capability and create new social and political institutions. The term has also been used to describe and refer to activities related with organisation and education of poor farmers.

The above discussion implies that the participatory approach has achieved a wide debate about farmer empowerment, social justice and community development (Okali *et al.*, 1994). In others words, the focus of farmer participatory research is at the same time, guided as much on political, social and institutional issues as on the development and testing of agricultural technology. For example, it is accepted that the objective of many institutions has been primarily empowerment of local people through the implementation of a participatory agenda, to which agricultural research is a superficial means.

Aspects others than technical were important to be brought into this section given the diversity of participatory applications and methods which have been experimented, even though the central focus of this thesis is about technological development.

#### 4.11.4 Participatory approaches: evolution and experiences

The recent reviews of Cornwall *et al.* (1994) and Okali *et al.* (1994) show a rapid evolution and an increased documentation on conceptual, and particularly on field experiences, of participatory approaches from later the 1970's and early 1980's. The Workshop on "The Use of Indigenous Technical Knowledge" held at the Institute of Development Studies (IDS) in 1978 and the volume edited by Brokensha *et al.* (1980) on "Indigenous Knowledge Systems and Development" were cited by Okali *et al.* (1994) as the first references that have raised most of the issues for participatory research and the stimulus for later meetings and papers.

Cornwall *et al.* (1994) identified twenty-nine methods of participatory approaches applied to agriculture, developed from 1980's to 90's. Such a large list can appear rhetorical and to some extent confusing and repetitive, but on the other hand, it is a positive sign of recognising participation as a central issue for change. A point of criticism, however, is that participatory methods might change the style of interaction with farmers, although in certain cases the principles upon which research and extension are based remain unchanged keeping a linear top-down relationship (Cornwall *et al.*, 1994). This implies that the actors involved in these processes are not convinced of the real pragmatic objectives of participatory approaches.

Initially, Farmer Participatory Research (FPR) approach moved beyond *contractual* and *consultative* Farming System Research/Extension (FSR/E) to involve farmers more closely in on-farm research viewing the context of agricultural production as interactions between resource management strategies (Cornwall *et al.*, 1994). The recognition of farmer's knowledge and capabilities of experimentation led to a focus more on *collaborative* and *collegial* relationships already referred to as "farmer first" thinking (Chambers *et al.*, 1993). This shift included reversals from top-down to bottom-up for which not only technical but also social aspects of farmer and farm family should be taken into account for research development. Linking with this, there have also small changes in modes of learning from formal survey questionnaires towards participatory appraisals (Chambers, 1992).

Rapid Rural Appraisal (RRA), therefore, emerged as a need to make appraisals of rural life more effective and timely, less costly and lengthy (Conlin and Wiggins, 1979; Chambers 1992) and as an alternative and complement to conventional survey methods (Theis and Grady, 1991). Earlier justification and application of this approach to agricultural development and decision making were reported in the Workshop and in the Conference on “Rapid Rural Appraisal” held at the Institute of Development Studies in 1978 and 1979 respectively (Belshaw, 1978; Jackson *et al.*, 1978; Clay, 1978; Swift, 1978; Bartlett and Ikeorgu, 1979; Collinson, 1979; Conlin and Wiggins, 1979; Wood, 1979).

Principles for RRA were established, methods evolved and a marked increase in the application of methods have been registered by Chambers (1992). According to Cornwall *et al.* (1994) RRA combined a range of methods for rapid and cumulative data collection where farmers generated data and discussed research findings, but do not participate in the analysis. However, RRA has been considered as an efficient way for outsiders to learn and to gain information and insights from rural people (Chambers, 1992).

An evolutionary path has shifted from rapid data collection to Participatory Rural Appraisal (PRA) which has been described as: “*a family of approaches and methods to enable rural people to share, enhance, and analyse their knowledge of life and conditions, to plan and to act*” (Chambers, 1992). Although, both are closely related to each other, the basic distinction from RRA is that in PRA people take part in the analysis and decisions as result of empowerment and the outsiders act as catalysts, facilitators, learners and consultants. This approach had as its historic reference “The 1985 Khoen Kaen International Conference” (Chambers, 1992) from which an explosion of innovation and application have been registered in undeveloped regions of the Third World (Chambers, 1992).

In reality, PRA has been developed to help poor communities mobilise their human and natural resources to define problems, consider previous successes, evaluate local institutional capacities, prioritise opportunities, and prepare systematic and site-

specific plans of action (The National Environment Secretariat *et al.*, 1990; Theis and Grady, 1991). PRA implies multidisciplinary teams of specialists and rural leaders working more closely together and understanding better the problems, needs and opportunities for rural development.

According to Theis and Grady (1991) PRA is much more related to anthropology and ethnographic research methods than to sociology and survey research. These authors have pointed out that the purpose of PRA is not to gather highly accurate statistics on some variables but to gain an understanding of the complexities of a particular topic in a specific location. The National Environment Secretariat *et al.* (1990) and Theis and Grady (1991) have published systematic procedures for implementation of PRA. However, Theis and Grady (1991) have reported that one of the main tools in which PRA is rooted is the semi-structured interview. It is a form of guided interviewing where only some questions are predetermined.

Participatory research demands that the researcher is oriented to open-ended questions and learning attitudes in order to understand farmers' multiple knowledge and perspectives (Freudenberger, 1994). Individual interviews and discussion can and do take place, but PRA approach uses relatively more group activity (Chambers, 1992). Of course, individual interviews can provide deep insights from different types of community members, while group discussion can better identify and analyse common problems.

#### **4.11.5 Challenges for participatory methods**

According to Scoones and Thompson (1994a) methodological advances have been achieved in the elaboration of techniques and tools for efficient extraction of information, which have grown faster than our understanding of *how* we learn about farmer's knowledge. Methodological changes to participatory approaches, as shown in the last sections, have been presented as an open line to break down the boundaries between researcher, extension officer and farmer. These methods stimulate the development of systems to integrate farmers into agricultural research

and promote technology transfer. However, some dangers and challenges for RRA and PRA have been outlined in relation to the credibility and effectiveness of the methods (Chambers, 1992; Cornwall *et al.*, 1994; Drinkwater, 1994b).

Cornwall *et al.* (1994) have discussed three kinds of methodological challenge for participatory approaches related with knowledge perception and power. The first question is, do farmers and research scientists share the same conception of what is understood by an experiment or an innovation? Farmers see the performance of agricultural production as adjustments for a specific situation while researchers look at production as result of a designed sequence of events of experiments (Richards, 1993).

A second set of difficulties arise from communication problems due to different cultural backgrounds (van Dusseldorp and Box, 1993; Chambers, 1993), already discussed in previous section. The third challenge outlined by Cornwall *et al.* (1994) is related with the issue of power and control over knowledge. This is the case where the farmer develops knowledge as a "family secret" which cannot be dispersed simply as if it was common property without bringing social and political problems (Pottier, 1994).

Finally, Freudenberger (1994) has pointed out that recognising the need to probe more deeply, rather than merely surveying local practices, may constitute the greatest challenge. However, it is expected that part of these challenges can be reduced if the target farmer communities are more developed and the distance between cultural backgrounds are not so accentuated as in undeveloped regions.

#### **4.11.6 Extending participatory approaches to well-situated farmer**

In general, the implementation of participatory approaches have been concerned with "low-income rural people" developing agricultural activities described as "low-resource", "resource-poor", "undervalued-resource" or "risk-prone" in marginal and difficult areas of the Third World (Chambers *et al.*, 1993; Okali *et al.*, 1994). The

main arguments suggesting that participatory approaches are to be applied to poor farmers come from the beliefs that their production systems are too complex, difficult to understand and for which technology development has been inadequate and insufficient (Chambers *et al.*, 1993; Chambers, 1993; Röling, 1994a). In addition, food security and high pressure on environment, invoking urgent attitudes to reduce resource degradation from their agricultural activities (Babu *et al.*, 1996) have been central issues for implementing participatory research approaches.

Successful and accumulated experiences with participatory approaches in different fields of agricultural development have been reported such as soil and water conservation in India (Shah, 1994); food security in Zambia (Drinkwater, 1994b); resource management at Andean Region in Equator (Thrupp *et al.*, 1994); irrigation management in Sri Lanka (Uphoff, 1994); the experiences at national and international researcher centres CIMMYT, ICRAF, WARDA, CIP and IRRI (Fujisaka, 1994); and integrated pest management in Indonesia (Winarto, 1994).

While these points have been commonly understood as referential for farmer participatory approaches, according to Okali *et al.* (1994) there has been no accepted statement of the limits within which the approach is to be applied. From the point of view of global sustainable development, “low-income” production systems have had high priority, but it does not necessarily mean that participatory research and informational approaches are not needed and suitable for more developed and modern production systems.

Top-down agricultural research supported the “success” of industrialised regions and the green revolution in the past (Chambers *et al.*, 1993). However, new challenges and undesirable effects of “top-down” research decisions, also require that institutional research changes to meet better the farmers’ needs and accomplish demands of the society. In addition, the expectations of limited benefits from a participatory research approach applied to more developed farmers’ communities should not be generalised, considering the world-wide diversity of situations and technological demands.



Therefore, the central focus of this thesis is to gain insights for the development of a dynamic and participatory information system for well-situated beef cattle farmers. The system must take into account the farmers' knowledge, their flow of information and how their knowledge is socially built. It is expected that at the end a system can be proposed to create and disseminate information under a learning process, which better meets beef farmers' needs. The next section, therefore, focuses on the development of knowledge information systems as the final goal of this chapter.

#### **4.12 Integrating knowledge information systems and thesis hypotheses**

Access to information, knowledge, perception and methods vary with personal attributes such as motivation, age, education, background, values and beliefs. Farmers commonly develop their own information systems based on complex information networks. It has been shown that the development and transfer of information based on top-down systems are unlikely to be useful in facing the new challenges for food production and rural development.

Therefore, the key issue is to improve the functioning of relationships between research and farmers, to increase the quantity and quality of the information to help farm decision making and provide a dynamic and continuous feed back for research. In this way, the background of this study has evolved to an approach which must integrate farmer's knowledge, practice and needs into technology development (Chambers, 1990; Kloppenburg, 1991). The main characteristic of such an approach should pursue a learning process in a *two directional model* between research and farmers such as has been suggested by Havelock (1986), cited by Röling (1990).

Röling (1985, 1988, 1990, 1994a) and Röling and Engel (1991), based on a systems approach, have discussed the concepts and the functioning of an Agricultural Knowledge Information System (AKIS), which, by the following definition, would meet purposeful means to integrate all the actors into an efficient system for development and transfer of information:

*“a set of agricultural organisational and/or persons, and the links and interactions between them, engaged in such processes as the generation, transformation, transmission, storage, retrieval, integration, diffusion and utilisation of knowledge and information, with the purpose of working synergically to support decision making, problem solving and innovation in a given country’s agriculture or a domain thereof.”*

According to Rölöing (1990) it is important to distinguish this concept from a management information system, since the AKIS is the entire system that produces the knowledge to be used in agricultural activities. Rölöing (1990) has argued that a *management information system* is concerned with the evaluation of productivity and other aspects of an enterprise in order to facilitate management decisions. In reality, a management information system can be considered as a sub system inside AKIS.

Agricultural Knowledge Information System is a conceptual framework to study and to improve the interface between research and technology transfer. This interface has been the focus of attention because research-technology transfer is crucial in determining the performance of the whole system (Rölöing, 1990). It has been considered crucial, according to the author, because all major transformation of knowledge, information and technology takes place in that complex interface and consequently any barrier in its flow affects the whole system.

Hence, understanding and analysing the information network of a farmer community seems to be the starting point to design any improvement of an already existing AKIS. According to Leeuwis (1990) the recognition of the social, historical, and spatial nature of the networks is crucial to understand knowledge issues and to design and to implement interventions in the systems. In this way, Rölöing (1990) has pointed out that an important goal of analysis, design and management of a system is to increase the synergy of its components. By definition, synergism is a system state in which the combined contribution of the actors is more than the sum of their individual contributions - the whole is more than the sum of the parts (Rölöing, 1992).

From analysis, important observations can arise such as research results or knowledge unused, and strong and weak points in the interrelationship among the system's actors. In successful systems, users have considerable control over the whole process, which helps to ensure synergetic functioning and monitoring (Röling, 1988). The main advice is to take all key components into consideration together rather than individually, when seeking to improve the system.

Agricultural innovation as a benefit, according to Röling (1988), occurs in highly inter-connected systems that allows exchanges between users, researchers, extension agents, agricultural media, institutions for delivery, distribution and marketing. Röling (1990) has pointed out that if the AKIS is effective, probably farmers are very active in developing and adapting information and demanding new information which they believe is useful for them. Then, synergism should be kept in the basic processes of generation, transformation, integration, storage and retrieval of the knowledge in order to provide a continuum and an effective flow of information (Röling, 1990).

Knowledge generation in the past has been attributed only to researchers, but as has already been discussed in this chapter, farmers have managed agriculture for thousands of years and proved their own capabilities of creating new knowledge and distributing it. Little doubt remains that the knowledge generation process appears to be more effective when taking into account farmers' circumstances and practice and when being carried out in-groups rather than individually.

Röling (1990) considers the transformation of knowledge as the most crucial process taking place in the AKIS. This implies that the knowledge generated in one component of the system becomes information to be used in another part. According to Röling (1990) this transformation process is not well understood. He has suggested however that the following transformations take place within an AKIS:

- (a) from information on local farming system to research problems;
- (b) from research problems to research findings;

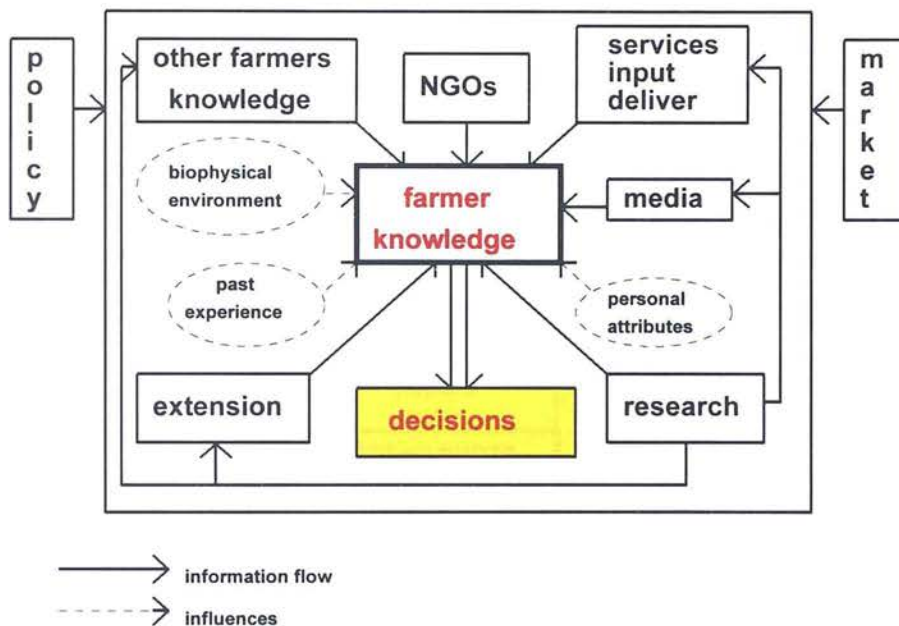
- (c) from research findings to tentative technologies;
- (d) from technologies to prototype recommendations for testing in farmer's fields;
- (e) from recommendations to observations of farmer behaviour;
- (f) from technical recommendations to information services (inputs and marketing);
- (g) from adapted recommendations to information dissemination by extension;
- (h) from extension information to farmer knowledge.

Therefore, transformation and integration of information to farmer utilisation is the most important issue. Rölöing (1990) has pointed out that multidisciplinary research teams have been engaged in a continuous effort to integrate research results from different disciplines, but little is known about how farmers integrate knowledge and information. It is thought that the farmer tries to integrate information from many sources to his own needs, taking into account his practical knowledge. From this observation a hypothesis can be formulated that the farmers, through their knowledge information systems, adjust the technologies and research findings to their specific situation and conveniences better than the formal researchers.

Answering the question of *why* adaptation occurs is fundamental to understanding the process of farmer decision making. The processes of storage and knowledge retrieval are central and universal activities within the farm family (Rölöing, 1990). Researchers who have neglected the development of such knowledge and modelling of Decision Support Systems (DSSs) have been criticised (Cox, 1996). However, more recently, computerised knowledge-based systems including acquisition, storage and retrieval of farmers' knowledge, and from other components of agricultural system, are becoming the focus of management information technologies in order to facilitate effective integration of knowledge (Walker *et al.*, 1995a; Benfer and Furbee, 1990 and Walker *et al.*, 1995b). A hypothesis of this thesis is that an a priori understanding of how farmers' knowledge information system is developed can facilitate the process of knowledge acquisition from farmers. Probably in a successful system many linkages will be found between the different elements which can be in the form of co-operation officers and institutions, information channels, or of personal unions and informal channels and networks (Rölöing, 1988). Whatever the

system is and on whatever level of sophistication it is studied closer research is needed to analyse the different linkage mechanisms and their effectiveness in order to explore better knowledge exchange and to improve the system. It is believed that the elements in Figure 4.4 represent the main components of a farmer knowledge information system with respective flows and influences in the process of decision making.

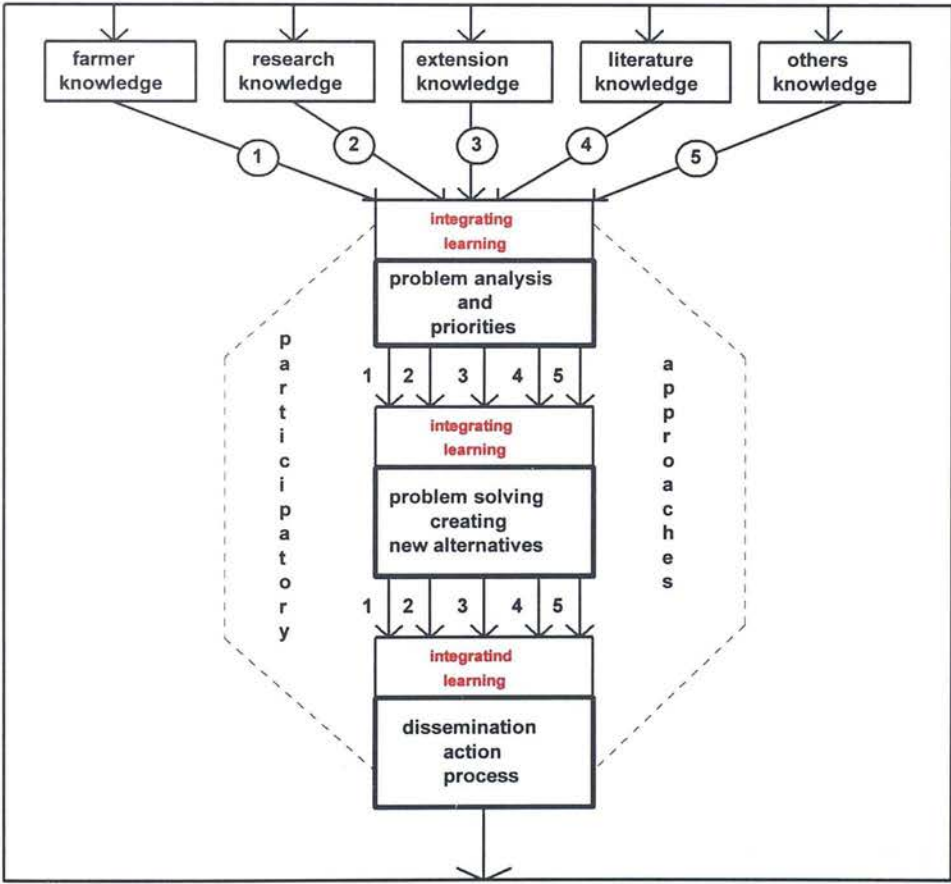
**Figure 4.4: Components of farmer knowledge information system in the process of decision making**



It is expected that the intensity and importance of each element (component) can vary from farmer to farmer. Of course, each farming community has its own system with specific components that are mobilised by the farmers depending on their needs. However, considering the dynamics of knowledge development also it is expected that to obtain new information and knowledge farmers are strongly influenced by personal attributes such as culture, education, attitudes, motivation, interest, age, skills, personality, goals and objectives. Past experience and biophysical environment (natural resources and production activities) are also central to updating farmer knowledge. The boundary of the operational system should be placed up to the limits where effective information flows occur and where any kind of information agent that is able to modify the farmers' knowledge can be identified. It

has been understood that the concepts and purposeful functioning underlying AKIS should be applied to integrate available knowledge and information in order to increase the effectiveness of agricultural development and, at a lower level, farm decision making. However, a framework is necessary for institutional planning, implementing, monitoring and controlling. A diagram for integrating the different sources of knowledge in the process of problem analysis, generation and dissemination of new knowledge is shown in Figure 4.5, where participatory approaches are represented in the all phases of the process. In fact, this framework comprises the phases of farming systems research (Jones and Wallace, 1986).

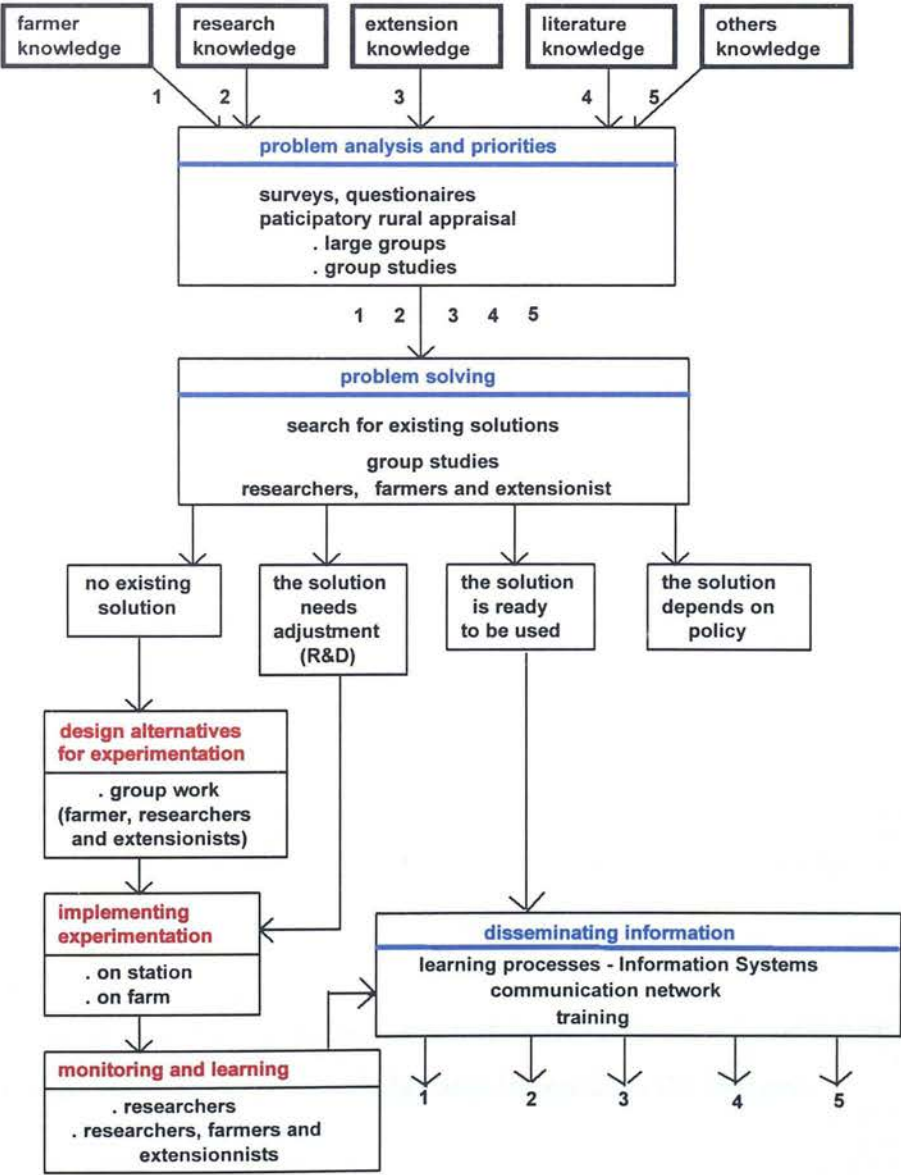
Figure 4.5: Diagram of integrating, learning, creating and disseminating new knowledge



Although the principles do not change, the design or improvement of the systems must be adequate for each particular situation. For example, an AKIS should encompass farmers belonging to a similar social status, located within a similar

ecosystem and involved with similar production activities. Moreover, Röling (1990) has pointed out that when modelling an AKIS, it is important to bear in mind that the system will take place in a larger context from which it is not separated. The framework outlined in Figure 4.6 is an extension of Figure 4.5 indicating mechanisms of participatory appraisal which can be used in the different phases of the process. It is important to point out that the farmer is involved in all phases starting from problem analysis to being responsible for action, in which learning and exchange experiences must be the main characteristics underlying in this system.

Figure 4.6: Diagram of phases and mechanisms to integrate knowledges in the process of creating and disseminating new information



The four alternatives outlined for problem solving phase in Figure 4.6, as a result of searching for existing solutions, are commonly found when discussing farmer's problems. In the first instance, the solution of some problems depends on government policy, which is always outside of research scope. A second condition is where the solution already exists and action should begin. For the third case, the solution exists but needs adjustment in the widest sense (R&D), which can be developed on farm and/or research station or through change agents. Finally, the fourth case, when no existing solution can be found in the local knowledge, generation of solutions starting with design and discussion of alternatives for experimentation must be implemented on basis of participatory procedures, taking into account farmers' experiences.

It should be understood from Figure 4.6 that conceptually it was intended to incorporate into a simple framework the logical sequences for development of an integrated and participatory AKIS. Nevertheless such a system development can not be effectively successful if the cultural tradition of researchers is not changed from a top-down approach to learning and integrated approaches. Therefore, it is believed that a logical sequence of creating an AKIS to start with, understands the development of the farmers knowledge information system. This has become the main focus of this study. Taking the National Centre for Beef Cattle Research - EMBRAPA as a case study with two different eco-regions of beef cattle production in Central Region of Brazil the following hypotheses have been arisen.

### *Knowledge and information*

#### Hypothesis 1:

The existing knowledge information systems of beef cattle farmers are complex networks of diverse sources and communication channels in which the participation of EMBRAPA has been peripheral.

#### Sub-hypothesis 1.1:

A priori understanding of the format of farmers' knowledge information can facilitate the process of knowledge acquisition from the farmers.



### *Problems and technology development*

#### Hypothesis 2:

Technology development by EMBRAPA has not fully met the needs of the majority of beef farmers in the selected regions. This is because farmers have not participated effectively in the decisions of EMBRAPA due to inadequacy of adopted institutional participatory approaches, and top-down decisions.

#### Sub-hypothesis 2.1:

Farmers adjust technologies and research findings to their specific situations and conveniences better than formal researchers.

### *Environment concerns*

#### Hypothesis 3:

Farmers running beef cattle systems dependent on native pasture are more concerned about environmental conservation than farmers running systems on cultivated pastures.

#### Sub-hypothesis 3.1:

The ecosystem has a strong effect on farmers' attitudes, goals, objectives, and decisions, as well as in the structure of their knowledge information systems.

### *Synthesis – a conceptual model*

#### Hypothesis 4:

A dynamic, participatory and learning knowledge information system, taking into account the characteristics of information and knowledge flows of beef cattle farmers can be proposed to create and disseminate information and technologies which better meet farmer's need in the region.

The next Chapter outlines the methodological approaches, which were selected in order to address the above hypotheses.

# Chapter 5

## Methodology

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### 5.1 Introduction

The initial background of this thesis began broadly, the logic of the research problem evolution led to the formulation of hypotheses focusing on: the understanding of farmers' actual information systems, farmers' attitudes, and expectations and their relations with EMBRAPA. This focus constitutes the basis for the proposal of an integrated and participatory beef cattle information system, in order to improve the efficiency of research and transfer of technology. However, the essence of the problem relies on how the information networks of the beef cattle farmers' are socially constructed. The aim of this Chapter is to present the methodological approach applied to the research problem.

### 5.2 Overview: how to address the research problem

#### 5.2.1 Introductory background

The research problem requires a combination of methods, which focus on socio-economic rather than biological information. In fact, the hypotheses can be characterised as needing to be answered through a *qualitative research* approach. Beef cattle farmers, as the target, are considered as the main source of data. In the language of social sciences, data collection is named "field research". How to deal with field research has been extensively described in the literature of social sciences (Cicourel, 1967; Burgess, 1982; Patton, 1983; Yin, 1984; Brenner, 1985; McGraw and Harbison-Briggs, 1989; Patton, 1990; Moris and Copestake, 1993; Foddy, 1995; Canter *et al.*, 1985; Robson, 1996).

The main strategies have been identified as: *experiment, survey, archival analysis, case study and history*. According to Yin (1984), the objectives of the studies may be *exploratory, descriptive or explanatory*. Three conditions were described to select the appropriate approach: (a) *the type of research question posed*, (b) *the extent of control that an investigator has over actual behavioural events*, and (c) *the degree of focus on contemporary as opposed to historical events*. Figure 5.1 shows the relation between these three conditions and strategies providing an overall picture of a decision matrix.

Although implications, advantages and disadvantages associated with each strategy have been reported in the literature (Yin, 1984; Robson, 1996), the decision to follow any particular methodological approach is not clear-cut. Careful analysis has been suggested where the appropriateness of each method and strategy must be weighed against the objective of the study. However, considerations such as resources, time, trained personal, communication, access and ethics also comprise strong components of such a strategy decision.

**Figure 5.1: Relevant situations for different research strategies**

STRATEGY	FORM OF RESEARCH QUESTION	REQUIRES CONTROL OVER BEHAVIOURAL EVENTS?	FOCUS: CONTEMPORARY EVENTS?
<b>Experiment</b>	<b>how, why</b>	<b>Yes</b>	<b>Yes</b>
<b>Survey</b>	<b>who, what, where, how many, how much</b>	<b>No</b>	<b>Yes</b>
<b>Archival analysis</b>	<b>who, what, where, how many, how much</b>	<b>No</b>	<b>Yes/no</b>
<b>History</b>	<b>how, why</b>	<b>No</b>	<b>No</b>
<b>Case study</b>	<b>how, why</b>	<b>No</b>	<b>Yes</b>

Source: Yin (1984)

In many cases, field research relies on inquiry methods where the questionnaire (survey) and the deep interview (case study) are used to access data of quantitative and qualitative variables respectively.

### 5.3 Research methods and strategies to elicit data

A combination of survey (questionnaire) and case study were considered to be a complementary and suitable methodological strategy to elicit the required research data and to understand in depth the issues outlined in the hypotheses. The questionnaire was chosen as a cross-sectional procedure in order to elicit information from the farmer population. In fact, the questionnaire (survey) was also chosen to gain an understanding of the general characteristics of the target populations in relation to farm decision making, to bring evidence for testing the hypotheses, to locate any differences between the two regions, and at same time to generate data to identify possible farmer groups. As a scientific procedure, the underlying logic was that the survey applied on a random sample basis would produce representative information on the socio-economic characteristics of the target population.

Multivariate techniques factor and cluster analysis, were applied to survey data as methodological tools to identify possible farmer groups for case studies. The identification of farmers groups is justified in the context of EMBRAPA policies. Research priorities and decisions must be made fundamentally taking into account the characteristics, goals, objectives and demands of the different production systems, where the farmer is the most important component.

The review presented in the Chapter 4 highlighted the evidence that knowledge is constructed within a social context. However, according to Arce and Long (1994) the creation and transformation of knowledge can only be understood through an appreciation of how the social actors build the links and manage critical interfaces. This means there is a need to give close attention to the practices of an actor's everyday social life through ethnographic studies (Arce and Long, 1994).

Contrasting with general information from a large sample, the in-depth qualitative study of a few cases, narrowing the focus on the social construction of the information networks, comprises the second stage of this research. The *case study* approach is applied in this study in order to obtain better insights into the social

characteristics of the farmers' knowledge information network, and to aggregate data for testing the thesis hypotheses outlined in Chapter 4. This decision was taken since it was recognised that the data provided by the survey would not be sufficient to test the hypotheses and to achieve the goals of this research. Patton (1983) stated that *"the major way in which the qualitative methodologist seeks to understand the perceptions, feelings, and knowledge of people is through in-depth, intensive interviewing"*. In-depth interviewing, therefore, was clearly necessary in order to understand better how farmers' knowledge information systems are developed.

The combination of quantitative and qualitative methods in this research is supported in the literature (Patton, 1983; Creswell, 1994). Patton (1983) recognised that from a methodology considered to be ideal in a practical context, the investigator can focus on verifying and elucidating what appears to be emerging, moving from an inductive to a deductive model. In addition, Patton also accepts that the practice of evaluation of research requires more flexibility than is likely to be provided by a single model. Patton (1983) gives an explicit recognition of flexibility, where a combination of mixed models was accepted as compatible with "ideal-typical qualitative methods".

Mason (1994) brought a substantial contribution in this way through combining quantitative (survey) with qualitative (case study) models. A number of opinions from several authors has indicated that there is no simple answer concerning which methodological strategy is the best (Patton, 1983; Yin, 1984; Bryman and Burgess, 1994; Robson 1996). The answer in each case has been indicated as dependent on: what we want to know, the research purpose, available resources, and context.

This research was designed in order to know the main network components and "how" and "why" the components are related with one other in the different information networks. In this way, a deep understanding is necessary, which is only possible through in-depth interview using qualitative research methods. Considering this study as an example of applied research, the aim is not to open a discussion on the sharp distinction between the principles ruling quantitative (survey) and qualitative (case study) research analyses, which has been defended and emphasised

in the literature (Strauss, 1987; Strauss and Corbin, 1990; Patton 1983). According to Mitchell (1983) the distinction between those who prefer to rely on survey techniques and those who prefer to rely on observation and a verbal type of analysis has had a long history. Mitchell (1983) concludes that case studies of whatever form are a reliable and respectable procedure of social analysis and the criticism has been based on a misconception of the basis upon which the analyst may justify extrapolation from an individual case study to the social process in general.

Hammersley (1989) has pointed out that understanding human activity requires that we examine its development over time, at its environment, at the configuration of social factors in which the situation occurs, and the way in which these factors interact. These aspects are subjective and can not be stated numerically for statistical analysis. Recent contributions in this way are also found in Bryman and Burgess (1994), Okely (1994) and Hughes (1994).

The hypotheses in this research were based on a theoretical background and the author's experience, without establishing a rigid and fixed framework of variable relationships, but according to a defined purpose. However, this does not mean that other hypotheses and dimensions are unlikely to emerge from data collection and from a better understanding of the real world. Also, it is not anticipated that this research will be the end of the line or even exhaustive, but rather that, it will lead to deep insights through a combination of quantitative and qualitative methods.

### **5.3.1 Questionnaire (surveys) - technique background**

The term *survey*, according to Robson (1996), is used in a variety of ways, but commonly refers to the collection of standardised information from a specific population. The questionnaire, as with any other instrument of data collection, is primarily designed to provide information for measurement. According to Robson (1996) the design of a questionnaire has tended to be an art form, but a reasonable body of experimental evidence has provided conceptual, theoretical and practical orientation (Sheastley, 1983; Patton, 1983; Molenaar, 1991; Foddy, 1995; Robson,

1996). The questionnaire must meet research objectives and obtain the most complete and accurate information possible within limits of time and resource. Figure 5.2 shows the advantages and disadvantages of the three ways of using questionnaire: (a) *self-administered*, (b) *personal interview*, and (c) *telephone interview*.

**Figure 5.2: Advantages and disadvantages of different uses of questionnaire (Bryman, 1989)**

	SELF-ADMINISTERED (e.g. Postal)	PERSONAL INTERVIEW	TELEPHONE INTERVIEW
A D V A N T A G E S	<ul style="list-style-type: none"> <li>● Cheap</li> <li>● Quicker than interview</li> <li>● No interviewer</li> <li>● Covers large geographical areas</li> </ul>	<ul style="list-style-type: none"> <li>● Collection of additional data is possible</li> <li>● Interviewer can assist respondent in answering</li> <li>● Control over who answers the questionnaire and over order of question is possible</li> </ul>	<ul style="list-style-type: none"> <li>● Relatively cheap</li> <li>● Quicker than personal interview</li> <li>● Can be used to confirm existing findings</li> <li>● Coverage of large areas at low cost</li> <li>● Interviews easier to supervise</li> <li>● Influence of interviewer is diminished</li> <li>● Response rates can be as good as those of the personal interview</li> <li>● Can be used for selection of samples</li> </ul>
D I S A D V A N T A G E S	<ul style="list-style-type: none"> <li>● Respondent has no assistance so the need for unambiguous question is even greater</li> <li>● Last questions can influence respondent's answers as he/she is free to read whole questionnaire before answering it</li> <li>● No certainty as to whom really answered the questions</li> <li>● No possibility to collect additional data (observational)</li> <li>● Low responses rates (always lower than personal interview even with techniques aimed at increasing it)</li> </ul>	<ul style="list-style-type: none"> <li>● Requires hiring of interviewer if large sample or large area to cover</li> <li>● Evidence that interviewer's characteristics can influence respondent</li> </ul>	<ul style="list-style-type: none"> <li>● Collection of observational data is not possible</li> </ul>

Common problems in questionnaire construction have been identified as vague and ambiguous wording; difficult vocabulary; lengthy questions; and questions that may bias response (Robson, 1996). According to Robson (1996), general rules about sequencing questions have not been supported by research, beyond the suggestion

that general questions should precede specific ones. Other aspects in questionnaire format should include ease of coding, ease of use and the need to establish a good impression with the respondent. However, pre-testing has been identified as an important phase of inquiry that should be carried out with a representative sample of the target population.

A striking aspect of questionnaire design that has generated debate among social scientists is in regard to *open vs closed questions*. According to Foddy (1995), proponents of each side have often defended their position through articles of faith rather than through evidence. The comments of Foddy are that proponents of the *open question* claim that this approach allows the respondents to say what they really think without any influence from a researcher and that, as opposed to *closed questions* the respondent is not locked into arbitrary alternatives. On the other hand, Foddy (1995) also added that survey researchers, who constitute the group of advocates of the *closed question*, claim that the *open questions* produce material which is extremely variable and therefore not reliable and difficult to code. Therefore, this discussion does not give a clear-cut position. Figure 5.3 displays the main claims regarding *closed* and *open format* and how a combination of both methods can be suitable for a variety of situations.

**Figure 5.3: Main claims regarding open and closed questions (Adapted from Foddy, 1993)**

OPEN QUESTIONS	CLOSED QUESTIONS
<ul style="list-style-type: none"> <li>● Allow respondents to express themselves in their own words.</li> <li>● Do not suggest answers.               <ul style="list-style-type: none"> <li>. indicate respondent's level of information</li> <li>. indicate what is salient in the respondent's mind</li> <li>. indicate strength of respondent's feelings</li> </ul> </li> <li>● Avoid format effects.</li> <li>● Allow complex motivational influences and frames of references to be identified.</li> <li>● Necessary prerequisite for the proper development of sets of response options for closed questions.</li> <li>● Aid in the interpretation of deviant responses to closed questions.</li> </ul>	<ul style="list-style-type: none"> <li>● Allow the respondent to answer the <i>same</i> question so that the answers can be meaningfully compared.</li> <li>● Produce less variable answers.</li> <li>● Present a recognition, as opposed to a recall, task to respondents and for this reason respondent finds them much easier to answer.</li> <li>● Produce answers that are much easier to computerise and analyse</li> </ul>



### 5.3.2 Factor analysis – technique background

Factor analysis is a multivariate statistical technique particularly suitable for analysing complex multidimensional problems with a large number of interrelated variables (Manly, 1986; Hair *et al.*, 1987; Child, 1990; SPSS, 1993). The basic purpose of factor analysis is data reduction and summary. The essence of this methodology relies on analysing the interrelationships among a large number of variables and explaining them according to their common underlying dimensions (Hair *et al.*, 1987). This means that the basic assumption behind factor analysis is that the underlying dimensions (factors) can be used to explain complex phenomena (SPSS, 1993).

According to Manly (1986) the objective of factor analysis, therefore, is to take  $p$  variables  $x_1, x_2, \dots, x_p$  and find combination among them in order to produce  $p-n$  indices  $z_1, z_2, \dots, z_{p-n}$  that are not correlated. In fact, the goal of factor analysis is to identify non-observable factors based on a set of observable variables with a minimum loss of information (Hair *et al.*, 1987). The reported explanation is that the factors are independent from each other, and each one ends up as a linear combination of all variables while keeping the maximum of information in terms of total variance of the original variables.

The approach is that the observed variation is redistributed so as to obtain orthogonal non-correlated vectors (Regazzi, 1996). This mathematical problem is solved through a covariance or correlation matrix (Regazzi, 1996). The algorithms behind the mathematical and statistical solutions are complex. An in-depth explanation is found in Krzanowski (1996). However, computational facilities available in SPSS and SAS are easy ways for applied researchers to deal with these complexities.

Factor analysis has been reported as having four main steps: *correlation matrix*, *factor extraction*, *rotation factors*, and *interpreting and naming factors*. A general description of these steps is presented in Appendix 5.1. Factor analysis is a more complex topic than represented in the broad outline given above. Implications such

as measurement scales and the relation between sample size and number of variables have to be considered in order to obtain meaningful results. It is also understood from this review that there are controversies in relation to the best technique: on subjective aspects of how many factors to extract, about which technique should be used to rotate and about which factor loadings are significant (Hair *et al.*, 1987). However, the summary presented here underpins the procedures for factor analysis in this thesis.

### **5.3.3 Cluster analysis - technique background**

Cluster analysis has been described as a technique for grouping individuals or objects into distinct clusters according to their similarity (Hair *et al.*, 1987). In fact, the technique is to determine whether distinct groupings can be identified within a data set (Morgan *et al.*, 1996). Hence, the purpose of cluster analysis is to place objects into groups, such that objects in a given cluster tend to be similar to each other in some sense, and objects in different cluster tend to be dissimilar from them (SAS, 1985).

Cluster analysis may be a useful method for data reduction (Manly, 1986; Hair *et al.*, 1987). This means that, if the method separates individuals of a population into groups according to their similarities, *representative individuals from each group can be chosen in order to represent the groups*. In doing so, data reduction can be completed because instead of taking information, measurement or any kind of data from all elements, only one or few cases from each group can be used as source of complementary data information.

The methods of cluster analysis were developed on concepts of distance and similarity (Manly, 1986; Hair *et al.*, 1987; SPSS, 1993; Krzanowski, 1996). In fact, distance is defined as a measure of how “far” apart two entities are from each other (SPSS, 1993). In this way, similar objects would have a small “distance” between them while dissimilar ones would have a large “distance”. A graphic configuration of a pattern is that similar individuals should be represented by points that are close

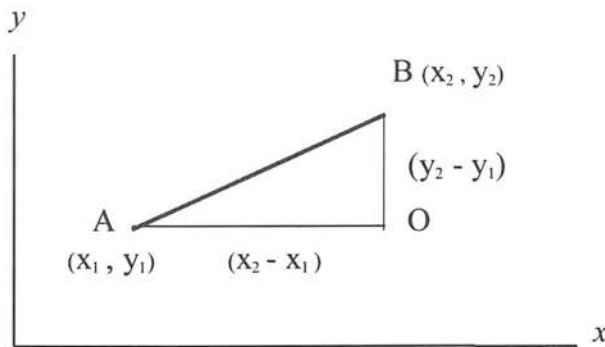
together, and the more dissimilar the individuals are, the more distant should be the points representing them (Krzanowski, 1996). Correlation is indicative of similarity (Hair *et al.*, 1987).

According to Manly (1986) the relationships between objects can be shown in one, two and three dimensions if the objects lie on a line, a plane and in space respectively, or in a higher number of dimensions in which case an immediate geometrical representation is not possible. However, the distance between objects is an indicative of relationship. A commonly used measure of distance is *Euclidean distance* (Manly, 1986; Hair *et al.*, 1987; SPSS, 1993; Krzanowski, 1996).

An example how this distance is obtained is represented graphically in Figure 5.4. Imagine that two objects A and B, measured by two variables (two dimensions - a plane) and being represented by the co-ordinates  $(x_1, y_1)$  and  $(x_2, y_2)$  respectively. The Euclidean distance between the two objects is given by length of the hypotenuse AB (distance between A and B) of the right triangle AOB.

$$\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

**Figure 5.4: Euclidean distance between two points (Hair, *et al.*, 1987)**



Options other than *Euclidean distance* have been reported. One alternative is the sum of squared differences between the points (co-ordinates). Another option involves replacing the squared differences by the sum of absolute differences of the co-ordinates, which is referred to as the *absolute or city-block distance* function.

Whatever the procedure, a matrix including the distances between all objects is the numerical basis for cluster analysis.

The implications of the different distance measurements are found in Hair *et al.*, (1987). However, it is important to point out that the rules of the methods for cluster analysis differ depending on how the distances are computed. Another important point is related to the measurement scales. If the variables are measured on different scales, those represented by bigger numbers will certainly have more influence on the clusters. A usual way to eliminate such inconvenience is to standardise all variables to mean zero and variance 1 before running the cluster analysis (Manly, 1986; Hair *et al.*, 1987; Krzanowski, 1996). Standardisation is particularly advisable when the range of one variable is much larger than of others (Hair *et al.*, 1987). However, standardisation has the effect of minimising group differences (Manly, 1986), and it can not be the best strategy, since the variability of a particular measure can provide useful information (SPSS, 1993).

Several algorithms are available for cluster analysis (Manly, 1986; Hair *et al.*, 1987; SPSS, 1993; Krzanowski, 1996). However, the most important question is what algorithm is most appropriate to place similar individuals or objects into groups or clusters? This is not a simple question because there is common agreement that different methods are unlikely to provide exactly the same results on a given data set (Manly, 1986; Hair *et al.*, 1987; SPSS, 1993; Krzanowski, 1996). In addition, a subjective element is often present in the assessment of the results from any particular method (Manly, 1987). The approaches and implications of different methods of clusters are described in the literature (Krzanowski, 1996; Hair *et al.*, 1987; Manly, 1986; Child, 1990; SPSS, 1993; SAS, 1985).

A commonly used approach is the *agglomerative hierarchical method* (Manly, 1986; Hair *et al.*, 1987; SPSS, 1993; Krzanowski, 1996). In this method each object, individual or observation starts as its own cluster. At the first step, the two closest individuals are aggregated into a single cluster. At second step, either a third individual is added to a cluster already containing two individuals or other

individuals are merged to form a new cluster. This means that, at every sequential step, either an individual case is added to existing clusters, or two existing clusters are aggregated until all individuals are members of a single cluster. The five most used *agglomerative* procedures, according to Hair *et al.*, (1987) are *single linkage*, *complete linkage*, *average linkage*, *Ward's method* and *the centroid method*. A general description of each one is presented in Appendix 5.2.

Another important issue for all clustering techniques relates to the number of clusters that should be formed. A standard and objective procedure does not exist (Hair *et al.*, 1987; Krzanowski, 1996; Manly, 1986; Child, 1990; SPSS, 1993; SAS, 1985). However, the computer packages commonly display the steps of the agglomeration process including stages, cluster numbers and distance coefficient (i.e. *squared Euclidean distance*) in which the clusters are being combined. This distance has been indicated as a useful guideline, and the analyst may choose to stop agglomeration as soon as the distance increase between two adjacent clusters becomes large (sudden jump). A *Dendrogram* is a useful way of graphically displaying the steps of hierarchical clustering. The dendrogram indicates not only which individuals or clusters are being combined but also the distances (i.e. *squared Euclidean distance*) at which they are being linked.

### **5.3.4 Case studies (qualitative research) – technique background**

#### **5.3.4.1 Fundamentals of qualitative research**

Qualitative research is based primarily on the concepts of grounded theory (Strauss and Corbin, 1990). According to Strauss and Corbin (1990), "*the grounded theory approach is a qualitative research method that uses a systematic set of procedures to develop an inductively derived grounded theory about a phenomenon*". The theoretical formulation of the reality, which is being investigated, is constituted by the research findings rather than based on numbers (Strauss and Corbin, 1990). This is in agreement with the concepts of Patton (1983), where a qualitative research strategy is an inductive one, in which the researcher attempts to interpret the situation

without imposing a previously existing expectation of research findings. Patton (1983) has also pointed out that this approach contrasts with deductive approach of experimental designs where hypothesis statements are specified before data collection<sup>1</sup>. According to Patton “*the strategy in qualitative designs is to allow the important dimensions to emerge from analysis of the cases under study without presupposing in advance what those important dimensions will be*”.

The *case study* method is oriented to key informants: individual, group and organisation (Yin, 1984; Robson, 1996). In general, the case study is the preferred strategy when “how” or “why” questions are being posed, when the investigator has little control over events, and when the focus is on contemporary phenomenon within some real life context (Yin, 1984). According to Moris and Copestake (1993) *qualitative* information is thought of as subjective, verbal and descriptive contrasting with *quantitative* information that is assumed objective, numerical, and amenable to mathematical analysis<sup>2</sup>.

*Case study* methodology is orientated to deal with circumstances which need to be traced over time, rather than frequencies or incidences at a single point in time (Yin, 1984). Normally, a large amount of information is provided from a *case study* and different methods for recording data can be used. According to Robson (1996), a kind of interacting interview, different from one which utilises a questionnaire, is often used in the *case study*, and is a flexible and adaptable way of finding things out. Face-to-face interviews offer the possibility of modifying the line of inquiry, if the interviewer is interested in investigating the underlying motives of a particular response in a way that is not possible with questionnaire.

Therefore, the distinction between interviews is based on the degree of structure or formality (Robson, 1996). According to Robson (1996), at one extreme is the *fully structured interview*, with a predetermined set of questions asked and responses

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<sup>1</sup> This is an “unstructured” approach. However, this thesis has followed a “semi-structured” approach because, in fact, the hypotheses were used to focus the case study inquiry.

<sup>2</sup> However, there is still an ongoing debate concerning the extent to which quantitative data are, in fact, “objective” (for example, see Midmore, 1998).

recorded on a standardised schedule. An intermediate format is the *semi-structured interview*, where the interviewer has worked out a set of questions in advance, but is free to modify order according to the perception of what seems most appropriate. At the other extreme is the *unstructured interview*, where the interviewer has a general area of interests and concern, but the conversation runs free.

Sudan and Bradburn (1977) have identified three types of task variables as important in influencing the accuracy of the responses: (a) task structure, (b) problems of self-presentation and, (c) the saliency to the respondent of the requested information. In this way, several sources of personal influences affecting rapport and responses have been pointed out such as: origin, social status, education, verbal and non verbal (head nods, pauses, inflections, body movements, facial expressions) communication, cognitive interpretation, bias, attitude, behaviour, empathy, sex and age.

#### **5.3.4.2 Meaning of qualitative measurement and analysis**

According to Kirk and Miller (1986), technically, a qualitative observation identifies the presence or absence of something, contrasting to quantitative observation, which involves measuring the degree to which a feature is present. Kirk and Miller (1986) have discussed the validity of such a distinction in qualitative research, since they pointed out that “*qualitative research is an empirical, socially located phenomenon, defined by its own history, not simply a residual grab-bag comprising all things that are not quantitative*”.

In fact, the focus of qualitative data is upon detailed description of situations, events, people, interactions and observed behaviours (Patton, 1983). Qualitative measurement generates a kind of data or information which constitutes the base for case studies (Patton, 1983; Yin, 1984, 1993). “Direct quotations” from people about their experiences, attitudes, beliefs, and thoughts and “excerpts” from documentary materials have been reported as qualitative measurements, which constitute the raw data from empirical world (Patton, 1983). In these terms, these kinds of data differ from those collected through predetermined standardised categories of response

choices imposed by closed questions of questionnaires and submitted to statistical analysis.

The analysis of qualitative measures has been reported as more difficult because the data are more detailed and variable in content, where the respondents have entire freedom to express their own views and opinions. According to Brenner *et al.*, (1978), as far as social inquiry is concerned, the validity and applicability of natural science criteria (statistical analysis) have been questioned because the data are obtained through social interaction with people under study. However Patton (1980) pointed out that *“in order to analyse and interpret qualitative data the evaluator must have some sense of purpose and direction”*.

Patton (1980) continues: *“...analysis, interpretation, and evaluation are not simple, technical processes. There are no formal, universal rules to follow in analysing, interpreting, and evaluating qualitative data. Analysis is the process of bringing order to the data, organising what is there into patterns, categories, and basic descriptive units. Interpretation involves attaching meaning and significance to the analysis, explaining descriptive patterns, and looking for relationships and linkages among descriptive dimensions. Evaluation involves making judgements about and assigning value to what has been analysed”*.

Yin (1984) also reported that analysing case study evidence *“consists of examining, categorising, tabulating, or otherwise recombining the evidence, to address the initial propositions of a study. Analysing case study evidence is especially difficult because the strategies and techniques have not been well defined in the past”*.

However, substantial experiences have been presented within the literature (Patton, 1983; Yin, 1984; Dey, 1993; Robson, 1996; Okely, 1994; Mason, 1994; Hughes, 1994), and the debate provides orientations on how to initialise data analysis from case studies. Such analysis from qualitative data sets involves a great deal of description and interpretation. Once the data from the case studies have been collected the first task is to write down a case record. This record should organise the data into a comprehensive format bringing in all the major information for each specific case. Robson (1996) has outlined four basic approaches for qualitative analysis, which were grouped by Tesch (1990): (a) the characteristics of language;



(b) the discovery of irregularities: (c) the comprehension of the meaning of text or action; and (d) reflection. These groupings according to Robson represent a progression from more to less structured and formal, where the last grouping (reflection) represent the approach from proponents who are resistant to systematisation of analytical process.

However, a central orientation is to find answers to the research questions (Robson, 1996). This creates the major influence on the analysis procedure. Considering that the analysis is based on what people said, the analysis should treat the evidence without bias. A common orientation in applied “real world” studies is to work towards issue analysis, where the issues (questions) are used as a means of organising and selecting the data. Themes can be identified which may form the basis for a workable descriptive framework. This procedure is described as a coding process. It is argued that the real work of qualitative data analysis begins at this stage (Mostyn, 1985). Robson (1996) has defined coding as providing “*a symbol applied to a group of words to classify or categorise them*”. A comprehensive insight into coding is found in Dey (1993) and Seidel (1995).

These overviews provided a background on how to deal with these techniques and to take decisions in applying them in this social research. However, before the details of the application of the questionnaire (survey), factor and cluster analysis, and case studies, is presented, the following section outlines the methodological orientation which were considered appropriate to this research problematic as outlined above.

#### **5.4 Basic orientation and objectives**

It is argued that the methodological choices support the accessing of the required data and information to support the two basic orientations of this study, which are the *systems approach* and the *farm family* as the unit of decision-making (Gasson, 1973; Dent, 1991; Errington and Tranter, 1991; Gasson and Errington, 1993; Dent, *et al.*, 1994). The farmer, representing the farm family’s decision-making unit, is the main but not sole source of information. As part of a system approach, an *analytical phase*

is dedicated to learn and understand the farmer's information systems, objectives, goals, and decisions according to the environment and the interactions with farmers' profiles. In addition, a *synthesis phase* is implemented to propose a general methodological approach for EMBRAPA's research and technology transfer, taking into account the characteristics of the farmers' information systems. Such conceptual emphases define the boundaries of the methodological approaches to be used in this study and influence the methods for data collection (see below); specifically, they reflect the following objectives:

- (a) to learn and understand how the farmers' information flows are socially developed, in relation to the process of decision making;
- (b) to identify and describe the structure of beef farmers' information systems;
- (c) to analyse relationships between "farmer" knowledge information systems and EMBRAPA's technologies;
- (d) to identify beef cattle farmer's goals, objectives, and understanding on environmental conservation in relation to pasture degradation and soil erosion;
- (e) to develop a methodological learning approach adapted to the regional beef cattle farmers in order to detect the information demands and to improve the process to generate and transfer technology.

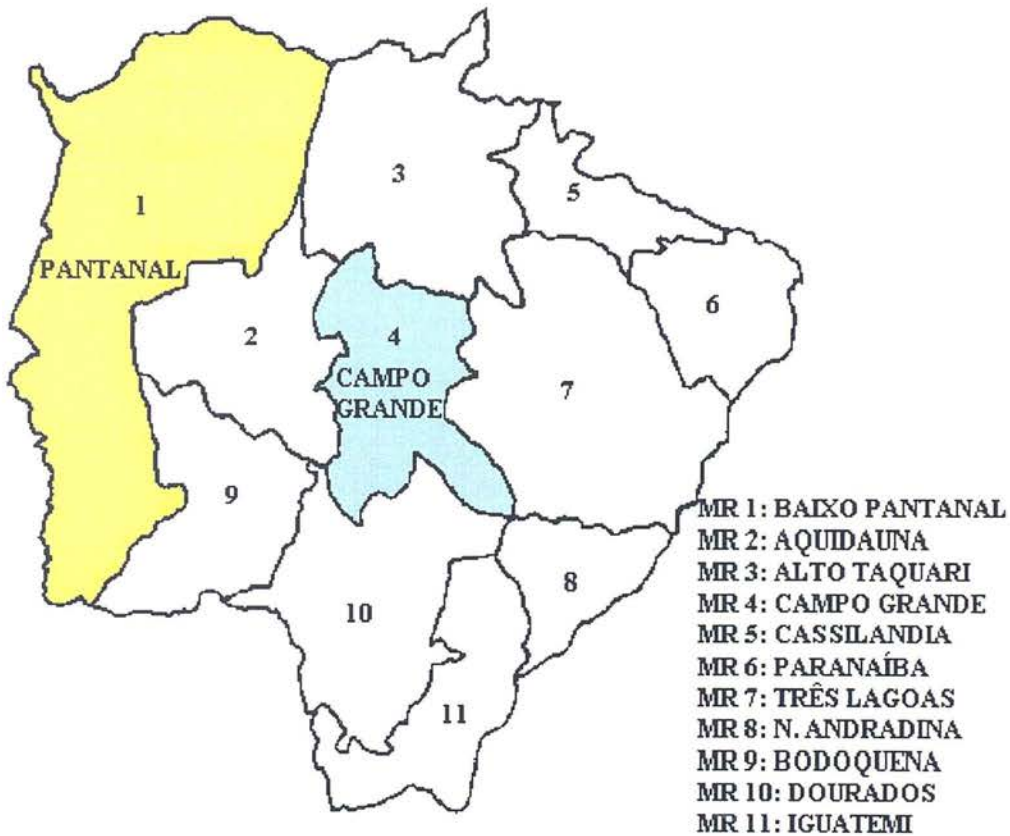
### **5.5 Target population**

Farmers from two distinct socio-economic and environmental regions of beef cattle production in the State of Mato Grosso do Sul, owning herds of at least 500 head, were chosen as the target population for this study. According to Arruda and Correa (1992) smaller herds, in general, are not considered true representatives of beef cattle farms in the region and are below economic viability. The micro Regions of Campo Grande and Pantanal were chosen to represent the distinctive environment and socio-economic diversities. Figure 5.5 shows the geographical positions in the State.

The Campo Grande region represents arable areas where beef cattle production systems are based mainly on improved pastures (see Figure 5.6). In this region, a large number of farms belong to immigrant families from different parts of Brazil,

mainly growers from the South, who have moved to the Region in the last 30 years. Campo Grande is representative of the fast development and transformation process of the savannah and forest vegetation of the Midwest Region into cropping and improved pasture. Figure 5.7 illustrates signs of pasture degradation, which have been indicative of resource depletion as a consequence of farming activities.

**Figure 5.5: Micro-regions of State Mato Grosso do Sul**



The Pantanal, predominantly occupied by extensive beef cattle production, run mainly on native pasture, (see Figure 5.8). Figure 5.9 illustrates the annual inundation that has “imposed” on the farmers the main “rules” for living with this resource. Inundation is probably the most important component of this ecosystem; it occurs because the Paraguay River, as the main drain of the river basin, does not have the capacity to drain the water at the same rate as flows into the area from the catchment. Farmers in Pantanal learnt that their farm decisions must take account of this natural phenomenon.

Beef farm families have occupied the Pantanal for more than 200 years, where the farm ownership has predominantly passed from generation to generation (Ribeiro, 1984 and Barros, 1998). A peculiar characteristic is that the Region has not shown strong signs of environment depletion from cattle activities. This seems to be indicative that these farm families are more concerned with the environment interdependence for their livelihood than the farm families from the Region of Campo Grande. These apparent differences concerning environment and farm family behaviour were the main reasons why the regions were selected for this study.

**Figure 5.6: Beef cattle system on cultivated pasture – Campo Grande**



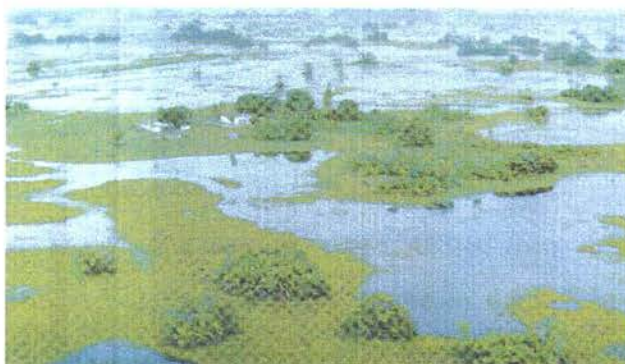
**Figure 5.7: Degraded pasture – Campo Grande**



**Figure 5.8 Beef cattle system on native pasture - Pantanal**



**Figure 5.9: Annual inundation in Pantanal**



## **5.6 Technologies developed by EMBRAPA**

A set of EMBRAPA's technologies was selected in order to ascertain farmers' opinion, to gain insights into the farmer's adoption process, and to evaluate the adequacy of the technologies to meet the farmer's needs. The criteria for selecting the technologies were based on the author's understanding of the way in which EMBRAPA has devoted its greater effort to generate and transfer such technologies. This understanding is supported by the author's twenty-five year working experience at the National Centre for Beef Cattle Research-EMBRAPA as a member of the research team, and also eight years as General Director.

The list of the selected technologies is the following:

- Selected improved grasses (Braquiarão, Andropogon, Tanzânia, Mombaça, Vencedor, and Mineirão);
- Pasture recovering (technology to recuperate degraded pasture);
- Ranking of bulls for selection and breeding;
- Cross-breeding techniques;
- Control of endoparasites;
- Provision of mineral supplements;
- Provision of protein and energy supply to grazing young steers;
- Production of young steers high quality beef.

## 5.7 Survey

### 5.7.1 Sampling frame

A nominal list of a population of 1209 farmers with herds of and greater than 500 head, and indicating size of land holding was obtained from the Tax Office of the State of Mato Grosso do Sul as a sampling frame of the *Micro Region of Campo Grande*. A similar list for the *Pantanal Region*, with a population of 335 farmers, was obtained from the Animal Health Service of the State of Mato Grosso Do Sul.

### 5.7.2 General procedures

Although farms identified as enterprises (Company Ltd) represent around seven per cent of the population, it was decided not to include them in the study, since their objectives and decisions are supposedly different from those of a farm family (the focus of this thesis). Regionally, the majority of the enterprises have been recognised as economic diversification of companies from other sectors of the economy. At a lower incidence than the previous case, farms identified under condition as placed in escrow were also not included. Although it is realised that such a condition is part of the cycle of the farm family, this selection procedure was undertaken due to the

temporary and special condition of the decisions and objectives. Most of these cases are concerned to keep the farm as property for the future division among the heirs.

### 5.7.3 Sample stratification for survey

Herd size is considered to be the variable which truly represents the dimension of beef farm businesses. It is believed that the size of herd has effects on social status, behaviour, goals and objectives of the farmers: empirical observations and the relationship of the author with the target communities, have provided strong evidence to support stratification of the sample by herd size as an appropriate methodological procedure for guaranteeing a representative sample of the population. Hence, farms were stratified into classes between 500 to 1000, 1001 to 2000 and more than 2000 head in both locations. The frequency distributions and the proportion of farmers within each class are shown in Table 5.1.

**Table 5.1: Frequency distribution of the farmers according to classes of head of cattle**

Classes (cattle head)	Campo Grande		Pantanal	
	Number of Farmers	%	Number of Farmers	%
500 to 1000	622	51.45	104	31.05
1001 to 2000	396	32.75	91	27.16
> 2000	191	15.80	140	41.79
Total	1209	100.00	335	100.00

### 5.7.4 Sample size

Considering that no other data about the farms in either region were available, a formal statistical procedure could not be used to define the sample size for the survey. In addition, it would be difficult to select a variable that would have a high correlation with the great diversity of variables involved in this kind of study. Therefore, the sample size was defined according to size of population in each eco-region, the proportion of farms in each stratum, taking into account the available time and resources, and indications from literature and similar experiences. A sample of

five per cent from the eco-region of Campo Grande provided a reasonable number of farms in the total and in each stratum. However, due to the size of farm population in the eco-region of Pantanal, this percentage was increased to ten per cent in order to guarantee a representative number in each stratum.

Therefore, a total sample of 94 farmers was considered satisfactory (60 from Campo Grande and 34 from Pantanal), where the proportion of each class was incorporated into each sample according to its specific region (see Table 5.2). Taking into account these sample structures a random procedure for each strata was used to sample the required number of farmers.

**Table 5.2: Composition of the sample**

Classes (heads of cattle)	Campo Grande		Pantanal	
	% of population	N° Farmers (sample)	% of population	N° Farmers (sample)
500 to 1000	51.45	31	31.05	11
1001 to 2000	32.75	19	27.16	9
> 2000	15.80	10	41.79	14
Total	100.00	60	100.00	34

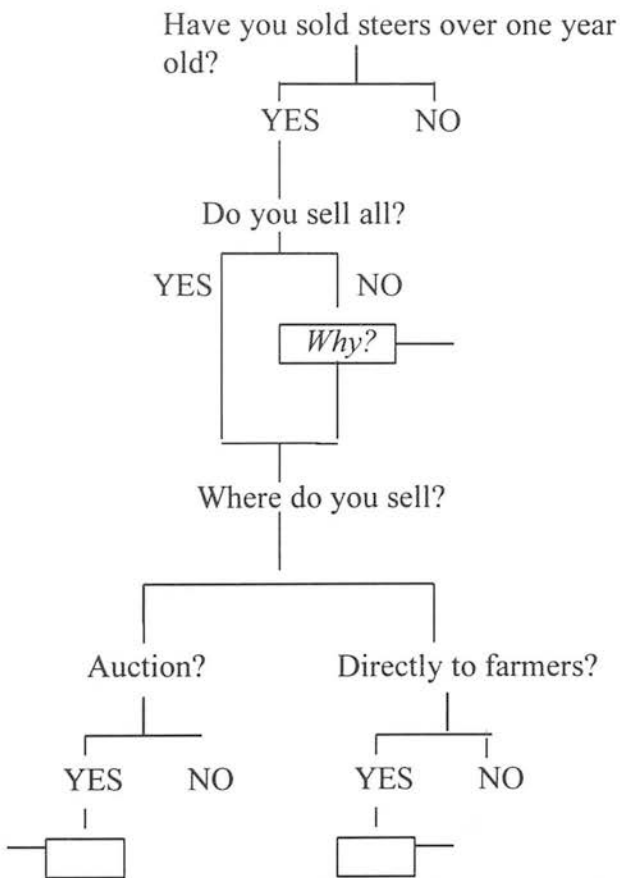
### 5.7.5 Questionnaire design

A structured questionnaire, as a cross-sectional procedure, was designed to elicit from the farmer sample general information on population characteristics and information relevant to the thesis hypotheses. The basic assumption behind the hypotheses is that the farmers develop their information systems to assist decision-making. Firstly, it was necessary that the questionnaire be constructed to represent the context in which farmers make decisions. This context also was created in order to provide a common ground on which farmers could be willing to spend time answering the questions. In this way, the majority of usual farm activities related with strategic (long term), tactical (short term) and operational (daily) decisions were incorporated into the questionnaire. At this point, ethnographic principles of decision tree modelling reported by Gladwin (1989) were followed.



A decision tree diagram was drawn for each decision taken from a previously constructed list. Action courses related with the decisions such as investments for recuperation of pastures, animal breeding, buying and selling cattle, etc., were represented in order to gain insights to design the questionnaire. Questions on the use of technologies developed by EMBRAPA were to be an important part of the questionnaire. Questions that represented detailed and lower levels of decisions were not incorporated to avoid an extended questionnaire. However, the decision tree exercise was useful for the questionnaire design and helped to orient the questions for case studies. Figure 5.10 shows an example of the decision to sell steers over one year old, where the locale of selling can be considered as lower level of decision.

**Figure 5.10: Decision tree for selling steers over one year old**



Finally, a first draft of the questionnaire was submitted for the appreciation of: colleagues belonging the research staff of EMBRAPA, extension agents of the State

of Mato Grosso do Sul who are familiar with beef cattle production in the regions, a social scientist expert in questionnaire design, and other researchers. Suggestions and criticism were analysed and introduced, where appropriate, in order to improve the draft. The most common suggestion was to reduce the size of the questionnaire.

The first draft, therefore, involved 168 questions and 528 variables distributed in nine main sections. The first sections covered identification, ownership, farm resources, economic activities and demographic information on farmer and family. The central sections were concerned with goals and objectives, decisions and people involved in the decisions. The last sections were dedicated towards detecting information demands and methods that the farmer had established and farmer's satisfaction. The questionnaire was directed towards obtaining quantitative and qualitative information, where the majority of the questions were of a closed kind and a few open questions completed the overall content. A rating scale was largely used to provide the flexibility to detect different degrees and position levels of the farmers in relation to responses of qualitative questions.

#### **5.7.6 Pilot test**

A pilot test was carried out with three farmers from the sample population. The farmers were chosen in order to represent three education profiles (low, medium and high). Each farmer was contacted previously for the purpose of the interview. The time spent in each interview was almost three hours. The time spent was found to be a major obstacle. It was realised that the farmers from the middle to the end of the interview demonstrated tiredness and lack of concentration.

Notes on difficulties or signs of discomfort in answering the questions were taken and coded into the questionnaire. After completing the interview, a general appreciation of the interview was asked of the farmers. The first common appreciation was related with the time spent and that they felt too tired to answer so many questions. The second criticism was the similarity of the questions related to

each decision and that this was a problem. However, they appreciated the way that the questionnaire covered so many common things of their life as a farmer.

The pilot test was a worthwhile experience and decisive for this thesis. The questionnaire was reviewed in order to adjust it and take into account the observations from the pilot test. Hence, the decision was to reduce the size of the questionnaire while attempting to improve the overall quality of the answers. Some questions were modified and finally, without losing the original structure, the questionnaire was reduced to 130 questions and 380 variables. A version in English is available in the Appendix 5.3, since the questionnaire was obviously applied in Portuguese.

### **5.7.7 Data collection**

A random sample three times greater than the original planned sample was drawn for each stratum and region. This decision was taken bearing in mind the possible difficulties in contacting and meeting farmers and to guarantee the previously defined sample size. However, to avoid bias, it was determined that the contacts must follow the order of a provided random name list. In other words, if the first farmer of the list was not found, the second must be contacted and thus successively.

The author carried out the survey with three assistants from the Veterinary Faculty of the Federal University of Mato Grosso do Sul. The assistants were recommended based on their previous experiences in surveying and knowledge of the area. In addition, a discussion seminar was carried out with the interviewers, on topics to avoid personal biases that could have affected responses from the farmers.

Also, to avoid bias, a list proportional to the three strata in each region was distributed evenly among interviewers. The majority of the first contacts to arrange the interview were made by telephone. An introductory letter from the Director of the National Centre for Beef Cattle Research - EMBRAPA confirming the institutional involvement, objectives, confidential character and collaboration

recognition was delivered to each farmer before starting the interview. At same time, as a “souvenir”, a package with publications from The National Centre for Beef Cattle Research was also delivered in order to create a positive atmosphere for the interview.

All the interviews were undertaken at the farmer’s house or in his office. It is important to point out that only two contacted farmers refused to participate in the survey. The time spent in most of the interviews ranged from 1.00 to 1.50 hours. The data collection period was from March to April of 1997.

### **5.7.8 Checking and coding questionnaire answers**

As soon as the questionnaires were completed, a concomitant procedure to check inconsistencies and to clean the data was implemented. In general, the data were well collected and checking was not a difficult task. The most striking difficulty was related to the open questions. A large of number of farmers experienced difficulty in answering them. On the other hand, the diversity of responses was indicative of different interpretations. It is realised that for these questions, the interviewer should provide additional information to make the interpretation more clear. Afterwards, little could be coded for analysis from the six open questions, but it was possible to have a general view of the farmers who answered these particular questions.

### **5.7.9 Database and analysis**

It was decided to use the package SPSS (SSPS Inc., 1993) for data analysis since the facilities offered to create and edit data files are developed in a “user friendly” way. Also, this package allows interchange of information with files generated by other software. In this way, the database was developed and created in EXCEL. The data are stored in the format of the spreadsheet following the order in which they were answered in the questionnaire. The database is facilitated by a numerical order of each answer specified in the layout of the questionnaire. A procedure for checking the data input in order to avoid mistakes was also implemented.

Firstly, a series of cross-tabulations were explored in order to check inconsistent relationships and unexpected averages. Nominal variables were analysed through cross-tabulation and frequency distribution. The analysis of ordinal variables relied on examining the mean, cross-tabulations, and bar charts. The Chi-Squared Test was used to compare frequencies from the two independent samples as well as the t-test of averages, which was employed. The analysis and description of the sample populations is presented in Chapter 6. Having completed primary analysis of the data from the survey, the next steps were concerned with factor and cluster analysis in order to identify possible groups of farmers, and to select representative farmers.

## **5.8 Application of factor and cluster analysis on the data survey**

In this research, factor analysis is applied primarily to reduce the number of variables to be used in cluster analysis, since a large number of variables can be represented by a smaller number of factors. In this way, the cluster analysis was carried out using the factors from the factor analysis, instead of the original variables. The factor scores of each case (farmer), were the numerical values used in cluster analysis. In doing so, a considerable data reduction was achieved in order to facilitate the cluster interpretation without losing information from the original variables.

### **5.8.1 Selecting variables**

From the large amount of information in the survey, variables were selected for this analysis according to the purpose of the research, which is to identify possible groups of farmers according to characteristics of two components: *informational* and *social* attributes. In this way, two groups of variables should form the “components” of the analysis: (a) *sources and mechanisms used to obtain information*, and (b) *social attributes* such as *education, motivation, openness to external assessment, and objectives*. However, within these components, a large number of variables were still involved. A decision was taken to reduce the number of variables for analysis bearing in mind the number of data sets available following Hair *et al.* (1987). This involved maintaining the above major components and selecting variables to

represent them in the analysis. In this way, thirty-three variables were finally chosen in a subjective way according to their perceived relevance (Chapter 6).

### 5.8.2 Analyses criteria, interpretation and selection of representative cases

Factor analysis was carried out separately with each group of variables (*information* and *social*, see Chapter 7). Factor extraction was based on factor *eigenvalues*, percentage of cumulative explained variance, and *scree plots*. The Varimax method was used for orthogonal rotation in order to facilitate factor interpretation. See Appendix 5.2. Obviously, there is a trade-off to be made between the number of factors selected and the cumulative variance explained. The visual nature of *scree plots* assists in this judgmental decision.

In Cluster analysis the *squared Euclidean distance* has been commonly used in social research to measure the similarity between the individuals (SPSS, 1993). Based on the literature review (Milligan, 1981; SAS, 1985; Manly, 1986; Child, 1990; and Hair *et al.*, 1987), *Ward's method* was accepted as adequate to identify possible farmer clusters in this research. The *dendrogram* was used as graphic representation to locate the cluster-solutions. According to Hair *et al.* (1987) acceptable cluster-solutions are found if the clusters are easily interpreted, and occurring before the distances become large, at which the clusters are formed.

Once the satisfactory solutions were met, the problem centered on how to select representative farmers for case study. The procedure was based on the distances between the cases (farmers) and the "centroid" of the multidimensional clusters' universe. The multidimensional space of the clusters, in this case, was formed by nine vectors or dimensions (extracted factors). The fundamental assumption of this approach is that those individuals closer to the centre of the cluster are the most representatives of this cluster. Given this procedure, it was possible to calculate a preferential order of representative farmers for each cluster, in order to carry out the

case studies. Only one representative farmer for case study was selected from each cluster due to the limitation of resources and available time<sup>3</sup>.

## 5.9 Case Studies (qualitative research)

### 5.9.1 Structure of the in-depth interviews

A semi-structured approach was selected to carry out the in-depth interviews, in order to focus the case study inquiry on the research hypotheses. Although this approach is not totally in line with the principles of qualitative research outlined by Patton (1983) (see section 5.3.4.1), because the hypotheses were formulated prior to the in-depth interviews, this does not mean that other hypotheses could not emerge from the case studies. Other authors (Robson, 1996; Sherratt, 1998) have argued that a semi-structured interview is an approach applicable to case study.

To facilitate a semi-structured interview and analysis, the hypotheses were grouped into three categories: *knowledge and information, problems and technology development, and environmental concerns*. The questions related to the first category of hypotheses were formulated to trace back the evolution of the farmers' farming knowledge; that is to identify their initial learning about farming, the usual sources of information need to take decisions, and sources of information associated with their good and bad experiences. Following the same focus, the second category of hypotheses was concerned with questions on problems, sources of solutions for these problems, and particularly the relationship between EMBRAPA's technologies and decisions taken. Finally, the questions of the third category were focused on the farmer's attitudes and understanding of nature conservation and related sources of information.

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<sup>3</sup> However, it is realised that in the context of EMBRAPA, the in-depth information could be extended and complemented with a greater number of case studies, as this would increase the theoretical and analytical insights concerning the local information networks. At this point in time, however, exploratory research of a few cases focusing on social characteristics of the information networks can build a base for theoretical understanding.

Using this framework a set of thirteen basic open questions was devised in order to guide the interviews. Following Yin (1984) the characteristics of the questions were associated with “how” and “why” strategies<sup>4</sup>. Moreover, the idea was to stimulate the informants to speak with freedom, without the constraints imposed by the closed questions (Yin, 1984; Foddy, 1993; Robson, 1996) of the previous survey.

### 5.9.2 Target sample

According to arguments presented in section 5.3.3, one case study per farmer group was decided as being suitable for complementary investigation, with a total of six cases comprising the target sample for case studies. The cases were identified according to a preferential order mentioned in section 5.8.2 and Chapter 7. If, for any reason, the first of each group could not be involved in the research, a descending order of selection was applied. In this way, the preferential orders of cases were accomplished for each cluster in the Campo Grande region, where the first representative cases of lists were available for interview. However, in the Pantanal the first and second of the lists of clusters 1 and 3 were not available and interviews were made with the third. Therefore, in the Pantanal, only for cluster 2 was the first in the preferential order applied.

Considering that qualitative research is also a process of discovery and that the qualitative research strategy should be flexible to elucidate research questions, and further, given that the main focus is to understand the social construction of the information networks, it was decided to extend the interviews to the “trusted people” nominated by the cases studies (section 8.3 in Chapter 8). This decision was made after all the case interviews had been completed, in order to trace back the social interaction within the information networks. A total of four “trusted people” were interviewed, being two in Campo Grande (cluster 1 and 3) and two in Pantanal (cluster 1 and 3). Although these interviews had not been initially planned, it

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<sup>4</sup> The questions and the structure of the interview, in relation to the hypotheses, are presented in Chapter 8.



emerged as a natural characteristic of the iterative process of qualitative research (Patton, 1983).

### **5.9.3 Implementation of the in-depth interviews**

The author of this thesis made the first contacts with the farmers (case studies) and carried out all the subsequent interviews. The goals in relation to the previous survey were patiently explained as preparatory phase to each interview. Two visits were necessary in the majority of the case studies to obtain the required information. The second visit was required for two main reasons. Firstly, because in some cases the farmer presented signs of tiredness before all aspects could be discussed in the first interview. Secondly, it was necessary to clarify points, which had arisen from the analysis of the first interview. The time spent in each interview session was around two hours. In addition, the author of this thesis carried out the first contacts and the interviews of the “trusted people”. During the first contact the reason for selection and the goal was explained. In view of the complementary nature of these interviews, only questions related to knowledge and information were selected. The interviews were accomplished in one visit of approximately two hours.

### **5.9.4 Data collection**

Listening and observing were fundamental orientations in carrying out the case studies (Patton, 1983). A tape recorder was used as the main “tool” to collect the data. This alternative was chosen in order to avoid loss of information, since the emphasis was on farmers talking. This approach has marked advantages in comparison to hand written notes but it also has the disadvantage of inhibiting the informer. Some people do not feel relaxed when speaking in front of a tape recorder, particularly farmers who, in general, are introspective by nature. Having this in mind, before initiating the interview, some “exercises” were carried out in order to establish a rapport between interviewer and informant. The tapes were identified with codes in order to maintain individuality of the information and also the anonymous nature of the research.

### 5.9.5 Data retrieving, coding and analysis

The overall process, from initial contacts to final coding, was completed in a four-month period, from December 1997 to March 1998. Immediately after each interview, a full transcription was processed using the text editor *The Ethnograph v.4* in order to aid content analysis. This software has been used by social researchers and is recognised as appropriate to deal with qualitative data (Seidel, *et al.*, 1995; Robson, 1996; Skerratt, 1995). A coding procedure was implemented after transcriptions were completed. In order to facilitate the description and data analysis, codes were assigned to groups of words, in order to express the meaning of something which was noted. The codes were concerned with the themes of the questions and related with other themes, which emerged from the interviews. For example, the code for the answer to the question “how did you start to learn about farming” was assigned *initial learning*.

The interpretation of the data was focused on the main research themes. Quotations (transcripts) were selected to link the thinking of interviewees in relation to the central research themes. In fact, the data selection followed the approach reported by Skerratt (1995) that is:

*“ The purpose of data selection in this context is to highlight such themes, without also implying a homogeneity of interviewee response within those themes. That is, the selected quotes are not intended as indicative of a uniform ‘voice’ ”.*

In those cases where the answers were not related to the focus of the questions, the case and respective transcripts are omitted from the theme under discussion. The transcripts were translated from Portuguese to English. It is realised that in doing so, the original wording is masked and this could limit interpretation and content analysis. However, the translation was made keeping as much similarity as possible with local manner of speaking, and without losing the meaning. In addition, analysis and interpretation were also carried out taking into account the original language. The data presentation, interpretation and discussion are presented in Chapter 8.

# Chapter 6

## Survey Results: Describing the Sample

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### 6.1 Introduction

This Chapter is concerned with a general description of the sample population according to the questionnaire answers. The main focus is to bring to discussion the characteristics of the sample trying to identify and to point out differences between regions with their respective strata. The description will follow the structure of the questionnaire and will apply frequencies, mean and statistic tests as methods of analysis and comparison.

### 6.2 Resources

The average size of the farms was found to be related to the size of the herds (strata) independent of the region under study. Although, in both regions the size of the farms increases from strata 1 to 3, a large variation was found in each stratum (Table 6.1). The survey confirmed the expectation that the average size of the farms in Pantanal is greater than in Campo Grande. The largest variation was found in the strata 3 of Pantanal, which includes one farm with 28,000 ha, and another with 65,000 ha. The mean number of cattle within strata was similar between regions (Figure 6.1). However, a large variation was found at strata 3 in both regions.

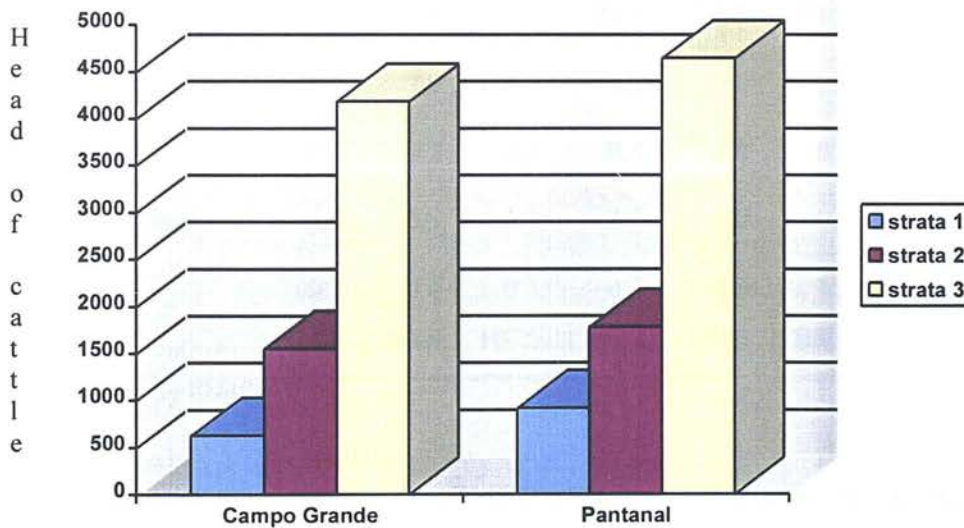
Cropping is a common activity in only 38 per cent of the cases in Campo Grande. However, within strata 3 such activity is represented in 80 per cent of the farms. On the other hand, in the region of Pantanal cropping was not detected as a component of the production systems in any strata. As mentioned in earlier parts of this thesis, the beef cattle activity in these regions is based on grazing systems. Therefore, the identification of pasture characteristics was important at this stage. Natural pasture is the dominant vegetation in the Pantanal covering 87 per cent of farmed areas while in Campo Grande it is only 7 per cent. The opposite situation was found for improved pasture: in Campo Grande, improved pasture is spread over 71 per cent of

the area while in the Pantanal it covers only 6 per cent. There is a marked difference between regions in terms of frequencies of natural pasture on the farms. 94 per cent of the cases in the Pantanal had natural pasture present but this decreased to 23 per cent in Campo Grande. On the other hand, such marked difference is not found in relation to frequency of improved pasture. Improved pasture was located on all farms in Campo Grande and 85 per cent in the Pantanal, even though the area of improved pasture in the later is small.

**Table 6.1: Average size of farms (ha)**

Specification	Campo Grande		Pantanal	
	Mean	<i>Std Dev</i>	Mean	<i>Std Dev</i>
<b>Region</b>	<b>2,128.33</b>	<b>2,086.23</b>	<b>11,032.67</b>	<b>10,942.71</b>
Strata 1 (500 -1,000 heads)	1,002.4	641.6	5,763.5	4,070.1
Strata 2 (1,001 - 2,000 heads)	2,182.3	940.3	8,901.4	3,285.8
Strata 3 (> 2,000 heads)	5,516.2	2,875.0	16,542.8	15,007.2

**Figure 6.1: Mean of heads of cattle per strata and regions**



Identification of grass species being used to establish cultivated pasture was introduced into the questionnaire in order to find out farmer preferences according to regions and to indicate level of adoption of the species selected by EMBRAPA. Table 6.2 summarises the distribution of grass species as percentage of the total area

of improved pasture. It is realised that in Campo Grande *Brachiaria decumbens* occurs in approximately 50 per cent that, added to *Brachiaria brizantha* sums up 70 to 80 per cent of the area of improved pastures. In the Pantanal, *Brachiaria humidicola* is the most representative species and together with *Brachiaria brizantha* and *Panicum maximum* (cv Colonião) account for more than 80 per cent of the improved pastures. The preference of *Brachiaria humidicola* in the Pantanal is due its high tolerance to excess of water in the soils while acceptance of *Panicum maximum* and *B. brizantha* is related to those farms where the soils of uplands are medium to high fertility.

**Table 6.2: Distribution (%) of grass species in the total area of improved pasture according to Regions and Strata**

Species	Campo Grande			Region	Pantanal			Region
	Strata				Strata			
	1	2	3		1	2	3	
<i>Brachiaria decumbens</i>	56.0	55.5	40.6	<b>49.3</b>	13.3	13.8	6.3	<b>9.5</b>
<i>Brachiaria humidicola</i>	10.0	5.7	10.5	<b>8.8</b>	24.8	16.9	77.8	<b>52.5</b>
<i>Andropogon gayanus</i>	0.4	0.1	2.6	<b>1.3</b>	0.0	0.0	0.0	<b>0.0</b>
<i>Panicum maximum</i> (cv Colonião)	0.0	10.3	3.8	<b>5.2</b>	39.7	43.8	6.4	<b>22.0</b>
* <i>Brachiaria brizantha</i> (cv Marandu)	31.3	18.6	38.2	<b>29.9</b>	22.2	21.8	9.5	<b>14.9</b>
* <i>Panicum maximum</i> (cv Tanzania)	1.1	7.9	3.1	<b>4.3</b>	0.0	2.3	0.0	<b>0.7</b>
* <i>Panicum maximum</i> (cv Vencedor)	0.0	0.2	0.8	<b>0.4</b>	0.0	0.0	0.0	<b>0.0</b>
* <i>Panicum maximum</i> (cv Mombaça)	0.1	0.3	0.1	<b>0.2</b>	0.0	0.0	0.0	<b>0.0</b>
Others	0.1	0.4	0.3	<b>0.3</b>	0.0	1.4	0.0	<b>0.5</b>
<b>Total</b>	100.0	100.0	100.0	<b>99.7</b>	100.0	100.0	100.0	<b>100.1</b>

\* Species selected by EMBRAPA

*Brachiaria brizantha* was tested by EMBRAPA and transferred to the market in 1984 (EMBRAPA, 1984). This species has had a great deal of acceptance for soils of medium to good fertility. In addition, its great advantage is resistance to attack of “spittle bugs”. *Panicum maximum* (cv Tanzania) was transferred by EMBRAPA to farmers in 1990 (EMBRAPA, 1990). Although, this grass is best for soils of good fertility, it has been accepted quickly. Most of farmers in Campo Grande establish

Tanzania on soils with improved fertility following soya bean grown for more than three years. On the other hand, the cv Vencedor which was made available in 1990 (Barcelos et al, 1990) but was not widely adopted. More recently (EMBRAPA, 1993a), the cv Mombaça was selected also for soils of good fertility and this already shows indication of acceptance among farmers. The cv Mineirão is a legume selected to be used as mixture or single pasture in order to improve soil fertility and animal diet (EMBRAPA, 1993b).

Table 6.3 indicates that the farmers of Campo Grande seem to be better informed on the grasses selected by EMBRAPA than those of Pantanal. However, it was not statistic significant that there are likely differences between the regions, except in relation to Mineirão ( $\chi^2_{.05} = 4.61, p < 0.05$ ). Vencedor does not seem to have been a success but it was not well promoted among farmers, while Mombaça and Mineirão are still in the process of transferring and adoption. The farmer's opinion about the importance of the selected forage materials by EMBRAPA is in the Table 6.4. This question was asked only to farmers that already knew the materials. It is realised that cv Marandu has been considered as the most important but this did not mean that the others were not considered important in Campo Grande. Variation of opinions was small as indicated by the standard deviations.

### **6.3 Land ownership**

In the region of Campo Grande, 70 per cent of the land was obtained through purchasing, while in the Pantanal this way of land access is reduced to 40 per cent. The opposite characteristic is found in relation to land obtained from inheritance, being 30 per cent in Campo Grande and 60 per cent in Pantanal. This is indicative that in the Pantanal region farm tradition is stronger than in Campo Grande passing ownership from generation to generation. Farms in strata 3 were registered as having the lowest percentage of purchased land (58 per cent at Campo Grande and 30 per cent at Pantanal). Rented land was not significant in the sample as a means of access to land.

**Table 6.3: Percentage of farmers that know the selected forages by EMBRAPA**

Forages	Campo Grande				Pantanal			
	Strata			Region	Strata			Region
	1	2	3		1	2	3	
Marandu	96.8	94.7	100.0	96.7 <sup>a</sup>	90.9	88.9	85.7	88.2 <sup>a</sup>
Tanzania	64.5	78.9	80.0	71.7 <sup>a</sup>	72.7	44.4	64.3	61.8 <sup>a</sup>
Mombaça	19.4	31.6	50.0	28.3 <sup>a</sup>	18.2	44.4	14.3	23.5 <sup>a</sup>
Vencedor	3.2	15.8	50.0	15.0 <sup>a</sup>	9.1	0.0	7.1	5.9 <sup>a</sup>
Mineirão	12.9	21.1	30.0	18.3 <sup>a</sup>	0.0	11.1	0.0	2.9 <sup>b</sup>

Figures with same letters in the same row are not significantly different,  $p > 0.05$ , while with different letters are,  $p < 0.05$

**Table 6.4: Farmer's opinion on importance of selected materials by EMBRAPA**

Forages	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Marandu	4.4	0.77	4.3	0.76
Tanzania	3.7	1.09	4.1	0.67
Mombaça	3.8	1.09	3.6	1.18
Vencedor	3.1	1.27	2.0	0.00
Mineirão	3.2	0.87	1.0	0.00

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

#### 6.4 Sources of income

Beef cattle are the most significant source of agricultural income (92 per cent in Campo Grande and 100 per cent at Pantanal). Cash cropping was identified as a secondary source in Campo Grande. It assumes much more significance among farmers of strata 3 (60 per cent). On the other hand, in strata 1 and 2 only 13 per cent and 10 per cent of farmers respectively are involved with cash cropping. Income from dairy cattle was identified only in the strata 1 and 2 of Campo Grande representing 16 per cent and 11 per cent of the total respectively. Tables 6.5a and 6.5b display frequencies of presence or absence of other sources of income. Independent of region or strata, the proportion of cases in which other income sources are parts of family income is expressive. Even though, in the Campo Grande region the presence of other sources of income is greater than the absence there is not statistic evidence to be likely different ( $\chi^2_{.05} = 1.06$ ,  $p > 0.05$ ).

From selected cases for presence of other income sources, *entrepreneur* income was indicated as the highest contribution among the farmers in both regions (Table 6.6a and Table 6.6b). In the region of Pantanal *professional* income appeared in second place followed by earnings as an employee and return from *rented buildings*. In Campo Grande, income from *rented buildings* is the second, *employee* income the third and *professional* earnings the fourth. However, large variation was found in all strata. Other sources of income represent approximately 55 per cent in Campo Grande and 50 per cent in Pantanal in the total income of farm families.

**Table 6.5a: Presence or absence of other sources of farm family income - number of farmers (per cent of farmers shown in brackets); Campo Grande**

Other sources of income?	Strata 1	Strata 2	Strata 3	Total
Yes	19 (61.3%)	11 (57.9%)	4 (40.0%)	34 <sup>a</sup> (56.7%)
No	12 (38.7%)	8 (42.1%)	6 (60.0%)	26 <sup>a</sup> (43.3%)
<b>Total</b>	<b>31</b> <b>(100%)</b>	<b>19</b> <b>(100%)</b>	<b>10</b> <b>(100%)</b>	<b>60</b> <b>(100%)</b>

For the column Total, figures with same letters are not significantly different,  $p > 0.05$

**Table 6.5b: Presence or absence of other sources of farm family income - number of farmers (per cent of farmers shown in brackets); Pantanal**

Other sources of income?	Strata 1	Strata 2	Strata 3	Total
Yes	5 (45.5%)	6 66.7%	6 (42.9%)	17 (50.0%)
No	6 (54.5%)	3 (33.3%)	8 (57.1%)	17 (50.0%)
<b>Total</b>	<b>11</b> <b>(100%)</b>	<b>9</b> <b>(100%)</b>	<b>14</b> <b>(100%)</b>	<b>34</b> <b>(100%)</b>



**Table 6.6a: Mean percentage of contribution from other sources of income: Campo Grande**

Sources	Region	Strata 1	Strata 2	Strata 3
As entrepreneur	28.4	26.6	30.9	30.0
Rented buildings	10.7	8.9	11.4	17.5
As employee	6.5	7.4	2.7	0.0
As professional	4.9	4.2	7.7	0.0
Other sources	4.4	7.5	0.0	0.0
Spouse work	0.0	0.0	0.0	0.0
<b>Total</b>	<b>54.9</b>	<b>54.6</b>	<b>52.7</b>	<b>47.5</b>

**Table 6.6b: Mean percentage of contribution from other sources of income: Pantanal**

Sources	Region	Strata 1	Strata 2	Strata 3
As entrepreneur	25.3	24.0	43.3	8.3
As professional	12.9	28.0	0.0	13.3
As employee	9.1	20.0	8.3	1.7
Rented buildings	2.4	0.0	6.7	0.2
Spouse work	0.0	0.0	0.0	0.0
Other sources	0.0	0.0	0.0	0.0
<b>Total</b>	<b>49.7</b>	<b>72.0</b>	<b>51.6</b>	<b>23.5</b>

### 6.5 Beef cattle activities

A large proportion of farmers in Campo Grande is involved with breeding, rearing and fattening males (61.7 per cent) followed by breeding cows (23.3 per cent), (Table 6.7). For instance, while these two activities aggregate to include 85 per cent of cases, 100 per cent of farmers in strata 3 are involved with the former activity. Strata 1 presented more diversity of cattle activities than strata 2 and 3 in Campo Grande. Breeding cows is the most important activity in Pantanal appearing in 32.4 per cent of the cases. However, breeding and rearing of males and breeding, rearing and fattening of males are activities responsible for 20.6 and 29.4 per cent of the cases respectively. Similarly to Campo Grande, more diversification was found in strata 1 than in the strata 2 and 3. There is statistical evidences that the likely

proportions of farmers involved with breeding cows plus rearing of males in Pantanal is greater than the farmers in Campo Grande ( $\chi^2_{.05} = 7.46$ ,  $p < 0.05$ ). However, the proportion of farmers in the activity of breeding cows plus rearing and fattening of males is likely to be greater in Campo Grande than in Pantanal ( $\chi^2_{.05} = 9.03$ ,  $p < 0.05$ ). Statistical evidences were not found that the proportions of other activities are likely to be different between regions.

**Table 6.7: Percentage of farmers involved with different beef cattle activities**

Activities	Campo Grande			Region	Pantanal			Region
	Strata		3		Strata		3	
	1	2			1	2		
Breeding cows	32.3	21.1	0.0	<b>23.3<sup>a</sup></b>	27.2	44.4	28.6	<b>32.4<sup>a</sup></b>
Breed. cows + rear. males	6.5	0.0	0.0	<b>3.3<sup>a</sup></b>	18.2	11.2	28.6	<b>20.6<sup>b</sup></b>
Breed. cows + rear. + fatten.	48.5	63.1	100.0	<b>61.7<sup>a</sup></b>	18.2	44.4	28.6	<b>29.4<sup>b</sup></b>
Rearing males	3.1	0.0	0.0	<b>1.7<sup>a</sup></b>	9.1	0.0	0.0	<b>2.9<sup>a</sup></b>
Rearing + fattening males	6.5	10.5	0.0	<b>6.7<sup>a</sup></b>	18.2	0.0	14.2	<b>11.8<sup>a</sup></b>
Fattening	3.1	5.3	0.0	<b>3.3<sup>a</sup></b>	9.1	0.0	0.0	<b>2.9<sup>a</sup></b>
<b>Total</b>	100.0	100.0	100.0	<b>100.0</b>	100.0	100.0	100.0	<b>100.0</b>
	n=31	n=19	n=10	<b>n=60</b>	n=11	n=9	n=14	<b>n=34</b>

For the column Region, figures in same row with different letters are significantly different,  $p < 0.05$  while with same letters are not,  $p > 0.05$

## 6.6 Demographic information

89.4 per cent of the population responsible for farm decision making were male: figures for female were 11.7 and 8.8 per cent in Campo Grande and Pantanal, respectively. The presence of women as the main decision-maker is directly related with marital status usually by the absence of their husbands, 30 per cent being divorced and 60 per cent being widows. The average age of the main decision-maker is 54 years old. This mean is the same in both regions and not so different between strata. However, 13.8 per cent of the farmers are between 26 to 39 years old, 51 per cent from 40 to 59 followed by 35 per cent older than 59. The level of experience was found to be quite high: 25 years in the farm business was identified as average.

Education is an important variable for social studies of this nature. It was surprising to find that approximately 45 per cent of entire population had concluded university

level and 34 per cent reached secondary school. These figures are an indicative that formal education is not as low as it was thought. The survey identified in both regions that around 22 per cent of the farmers, who concluded university level, are professionals of Agricultural and Animal Sciences. Farmers in Pantanal region shown had slightly higher formal education than those from Campo Grande. Farmers from strata 3 in both regions had higher education levels than strata 1 and 2.

In average, 81.9 per cent of the farmers are married, 7.4 per cent divorced, 7.4 per cent widowed and 3.2 per cent single. In Campo Grande was found that in 52 per cent of the couple, the spouse came from farm families while in Pantanal is 64 per cent. Number of children is very similar in both regions (Table 6.8).

**Table 6.8 Family size (percentage of cases in relation to number of children)**

<b>Number of children</b>	<b>Campo Grande</b>		<b>Pantanal</b>	
0 - 2	21	(35.0%)	10	(29.4%)
3 - 5	38	(63.3%)	21	(61.8%)
6 - 8	1	(1.7%)	3	(8.8%)
<b>Total</b>	<b>60</b>	<b>100.0</b>	<b>34</b>	<b>100.0</b>

Motivation factors that led farmers to the farm business are presented in Table 6.9. It seems important to notice that farmers of Pantanal tend to give more importance to family tradition, inheritance from parents, acquired knowledge and style of living than farmers of the Campo Grande. In Pantanal, the frequencies of farmers who classified those variables between important and very important are 76.5, 61.3, 70.6 and 79.4 per cent respectively while in Campo Grande the figures are 58.3, 28.3, 46.7 and 61.7 per cent.

In fact, inheritance from parents and style of living are likely to be more important in Pantanal than in Campo Grande while for alternative business there is evidence to be more important in the latter (Mann-Whitney Test U,  $p < 0.05$ ). However, there were not statistic differences in relation to other factors. Variation of answer, for majority of the factors, was considered high, as indicated by standard deviation.

**Table 6.9: Importance of factors to become farmer on a five point scale**

Factors	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Safe business	4.0 (1st)	0.98	4.0 (2nd)	1.64
Style of living	3.8 <sup>a</sup> (2nd)	1.22	4.4 <sup>b</sup> (1st)	0.98
Family tradition	3.5 (3rd)	1.65	4.0 (2nd)	1.64
Acquired knowledge	3.4 (4th)	1.20	3.8 (3rd)	1.29
Profitable business	3.2 (5th)	1.22	3.0 (5th)	1.30
As alternative business	2.6 <sup>a</sup> (6th)	1.68	1.8 <sup>b</sup> (6th)	1.38
Parents inheritance	2.4 <sup>a</sup> (7th)	1.71	3.1 <sup>b</sup> (4th)	1.84
Spouse inheritance	1.7 (8th)	1.31	1.6 (7th)	1.37

Figures in same row with different letters are significantly different,  $p < 0.05$

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

## 6.7 Objectives

Ranking of farmer's multiple objectives are shown in Table 6.10. The results indicate that the first seven objectives, which farmers considered important, make common group for both regions. The farmers of both regions ranked the objectives, *be recognised for nature conservation* and *have a herd of high quality* at second and third place respectively. *Leave the farm for next generation* appeared in first place for farmers of Campo Grande. This latter result could be an attitudinal response to intensive social pressure for agrarian reform in the region in recent years. Such pressure is less intensive in Pantanal region. *Increase income and profit* is considered also as an important objective among all farmers.

It is important to notice that the farmers tend to consider the majority of the objectives as important. However, *be recognised as advanced farmer* tends to be an objective of low importance. There are strong evidences that likely the farmers of Pantanal consider more important *be recognised for nature conservation*, *have a herd of high quality*, *increase profit*, *improve family's standard of living*, *expand farm business*, *transfer knowledge to children*, *create work opportunity for children* and *be recognised as advanced farmer* than the farmers of Campo Grande (Mann-Whitney Test U,  $p < 0.05$ ). Although there is low variation of the answers, Pantanal region presented also lower standard deviations than in Campo Grande (Table 6.10).

**Table 6.10: Importance of farmer's multiple objectives on five point scale**

Objectives	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Leave the farm to next generation	4.2	1.16	4.5	0.59
Be recognised for nature conservation	4.1 <sup>a</sup>	1.11	4.6 <sup>b</sup>	0.65
Have a herd of high quality	4.1 <sup>a</sup>	1.04	4.6 <sup>b</sup>	0.82
Increase income and profit	4.0 <sup>a</sup>	1.04	4.6 <sup>b</sup>	0.74
Keep ownership of the land	4.0	1.16	4.3	0.96
Keep the pastures clean	4.0	1.09	4.3	1.00
Improve family's standard of living	4.0 <sup>a</sup>	1.08	4.5 <sup>b</sup>	1.02
Expand farm business	3.8 <sup>a</sup>	1.27	4.2 <sup>b</sup>	1.28
Work without financial risk	3.7	1.18	4.0	1.03
Transfer knowledge to children	3.6 <sup>a</sup>	1.44	4.2 <sup>b</sup>	1.28
Work without loan	3.6	1.43	4.1	1.28
Dedicate more time to family	3.5	1.20	3.8	1.33
Create work opportunity for children	3.4 <sup>a</sup>	1.47	4.1 <sup>b</sup>	1.00
Belong to rural community	3.1	1.34	3.3	1.22
Spend more time in the farm	3.1	1.46	3.8	1.39
Be recognised as advanced farmer	2.6 <sup>a</sup>	1.43	3.1 <sup>b</sup>	1.37

Figures in same row with different letters are significantly different,  $p < 0.05$

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

## 6.8 Behaviour and attitudes in relation to decision-making

Many of the farmers of Pantanal seem to have the attitude of being “followers” instead of first experimenters with new technology or product (Table 6.11). In both regions the frequency of the desire to be leaders with new technology is low, the majority take some time to analyse the impact before serious consideration. Intuition by itself is not recognised by many farmers as the basis on which to make decisions. Table 6.12 indicates that the group is more or less equally divided into two behaviours where analysis and its combination with intuition are the main characteristics of farmers' decision-making behaviour.

**Table 6.11: Frequency (%) of attitudes to new product or technology**

Attitudes	Campo Grande				Pantanal			
	Strata		Region		Strata		Region	
	1	2	3		1	2	3	
Use immediately	12.9	5.2	10.0	10.0	0.0	11.2	14.3	8.8
Analyse before using	38.7	47.4	90.0	40.0	45.5	44.4	21.4	35.3
Wait to others to use first	48.4	47.4	0.0	50.0	54.5	44.4	64.3	55.9
<b>Total</b>	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

**Table 6.12: Frequencies (%) of behaviour in relation to decision making**

Attitudes	Campo Grande				Pantanal			
	Strata		Region		Strata		Region	
	1	2	3		1	2	3	
Intuition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Analysis	54.8	52.6	30.0	50.0	27.3	44.4	50.0	41.2
Intuition + Analysis	45.2	47.4	70.0	50.0	72.7	55.6	50.0	58.8
<b>Total</b>	100.0	100.0	00.0	00.0	100.0	100.0	100.0	100.0

## 6.9 Strategic decisions

### 6.9.1 Partners of decision making

The results indicate that the farmers of Pantanal seem to involve the family more in their decisions than the farmers of Campo Grande (Table 6.13). Statistical evidence was found (Mann-Whitney Test U,  $p < 0.05$ ) that the farmers in Pantanal consider more important the participation of the spouse and parents in decisions than in Campo Grande. Other farmers were considered moderately important in the decision process, but other key individuals were also of moderate importance as well.

**Table 6.13: Importance of partners in farmer's strategic decisions**

Partners	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Farmer	4.7	0.66	4.7	0.61
Spouse	2.6 <sup>a</sup>	1.45	3.1 <sup>b</sup>	1.25
Children	2.5	1.55	2.9	1.60
Parents	1.7 <sup>a</sup>	1.30	2.4 <sup>b</sup>	1.67
Technical assistant	2.7	1.43	2.7	1.35
Other farmers	2.8	1.17	3.2	1.14
Friend	2.8	1.21	2.5	1.35

Figures in same row with different letters are significantly different,  $p < 0.05$

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

## 6.9.2 Investments inside and outside farm

Almost all farmers (Table 6.14) have taken forward decisions of investing money in the farms, in the last five years. Although the frequency of investments outside farm presents similar figures between regions, it is only about 30 per cent of the cases (Table 6.15).

**Table 6.14: Frequencies of presence and absence of investment in the last five years in the farm - number of cases**

Answer	Campo Grande			Region	Pantanal			Region
	Strata		3		Strata		3	
	1	2			1	2		
YES	31 (100%)	16 (84.2%)	10 (100%)	57 95.0%	10 (90.9%)	9 (100%)	13 (92.9%)	32 94.1%
NO		3 (15.8%)		3 5.0%	1 (9.1%)		1 (7.1%)	2 5.9%
<b>Total</b>	31 (100%)	19 (100%)	10 (100%)	60 (100%)	11 (100%)	9 (100%)	14 (100%)	34 (100%)

The results presented in Table 6.16a and Table 6.16b reveal that *increase profit* is the most important motive for investment on the farm, which is compatible with the objectives. In Pantanal tends to be more important than the farmers of Campo Grande. *Agrarian reform* and *availability of credit* are not important motives.

**Table 6.15: Frequencies of presence and absence of investment in the last five years outside farm - number of cases**

Answer	Campo Grande			Region	Pantanal			Region
	Strata		3		Strata		3	
	1	2			1	2		
YES	12 (38.7%)	5 (26.3%)	1 (10.0%)	18 30.0%	3 (27.3%)	3 (33.3%)	4 (28.6%)	10 29.4%
NO	19 61.3%	14 (73.7%)	9 (90.0%)	42 70.0%	8 (72.7%)	6 (66.7%)	10 (71.4%)	24 70.6
<b>Total</b>	31 (100%)	19 (100%)	10 (100%)	60 (100%)	11 (100%)	9 (100%)	14 (100%)	34 (100%)

**Table 6.16a: Importance of motives to invest on the farm - Campo Grande**

Motives	Region		Mean		
	Mean	Std Dev	Strata 1	Strata 2	Strata 3
Increase profit	4.0	1.05	3.8	3.9	4.4
Profitable business	3.2	1.92	3.0	3.1	3.7
Available money	2.9	1.35	2.9	2.8	2.9
Work for children	2.8	1.56	2.7	2.8	2.9
Agrarian reform	1.6	0.99	1.5	1.6	2.0
Available credit	1.4	0.74	1.3	1.8	2.0

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

**Table 6.16b: Importance of motives to invest on the farms - Pantanal**

Motives	Region		Mean		
	Mean	Std Dev	Strata 1	Strata 2	Strata 3
Increase profit	4.4	0.65	4.5	4.3	4.3
Profitable business	3.2	1.42	3.7	3.2	2.7
Work for children	2.9	1.41	3.0	3.6	2.5
Available money	2.5	1.39	3.1	2.2	2.3
Available credit	1.5	1.20	2.1	1.3	1.2
Agrarian reform	1.5	0.94	1.4	1.2	1.7

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

The frequency of alternative investments on farms is shown in Table 6.17. The majority of farmers have invested more to recover the existing pastures than to establish new areas in the region of Campo Grande. Proportionally, the frequency of investments in pastures in Pantanal is lower than Campo Grande. There is statistical evidence ( $\chi^2_{.05} = 13.71$ ,  $p < 0.05$ ) that the proportion of investments on pasture recovery is likely to be greater in Campo Grande than in Pantanal. However, evidence of difference was not found in relation to establishment of new areas of pasture ( $\chi^2_{.05} = 0.57$ ,  $p > 0.05$ ) or even to other investments. In the Pantanal the frequency of establishing new areas of pasture is slightly higher than pasture recovery. These findings make sense, since in Campo Grande available areas to establish new pasture is reduced while this is not true in Pantanal. Improving the genetic potential of the herds was demonstrated to be a common area of farmers' interest. Erecting new building seems to be also usual motive for investment among the farmers.



**Table 6.17: Frequencies of alternatives in which farmers invested money**

Alternatives		Campo Grande		Pantanal	
		%	cases	%	cases
New pastures	YES	33.3	20	41.2	14
	NO	66.7	40	58.8	20
Pasture recovery	YES	76.7 <sup>a</sup>	46	38.2 <sup>b</sup>	13
	NO	23.3 <sup>a</sup>	14	61.8 <sup>b</sup>	21
Buildings	YES	98.2	56	93.9	31
	NO	1.8	1	6.1	2
Animal genetic improvement*	YES	94.1	48	100	27
	NO	5.9	3		

Figures in same row with different letters are significantly different,  $p < 0.05$

\*Investment in animal genetic improvement was considered only among farmers involved with production systems where breeding cows was present.

It was identified that farmers in Campo Grande have used cash cropping on 33 per cent of the area as an intermediary phase before pasture establishment. This practice is not so wide spread in Pantanal where 96 per cent of new pastures have been established directly. Pasture recovery has been the most important issue and maybe the biggest challenge of beef industry as whole in the last years. This reality is well portrayed in this research by declaration of 93 per cent of farmers in Campo Grande that there were areas of pastures to be reformed in their farms. According to the farmers, these areas were estimated approximately to be 40 per cent of the total improved pasture. The farmers almost strongly agree with EMBRAPA's recommendation for pasture recovery, (Table 6.18). Improving soil fertility with lime and fertiliser, deep ploughing and erosion control have been suggested.

**Table 6.18: Farmers' opinion on EMBRAPA's technology of pasture recovery**

Specification	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
<b>Region</b>	<b>4.4</b>	<b>0.92</b>	<b>4.6</b>	<b>1.00</b>
Strata 1	4.5	0.72	4.5	1.08
Strata 2	4.2	1.21	4.9	0.37
Strata 3	4.6	0.84	4.5	1.19

(1 = strongly disagree; 2 = disagree; 3 = moderately agree; 4 = agree; 5 = strongly agree)

EMBRAPA also has advised farmers to use cash cropping as the entry to recover degraded pasture. The main benefits are to repay costs and to improve soil fertility by

residual effects of cropping fertiliser. The survey identified that 10 per cent of the recovered area was managed through cropping, and 17 per cent was recovered directly. The farmers declared that the most important motives for cropping were increase soil fertility and farm income. Moreover, it was realised that the farmers are trying to reduce the costs of recovering pasture directly by the fact that only 36 per cent and 25 per cent used fertiliser in Campo Grande and Pantanal respectively. Researching and monitoring the results from these experiences seems to be an important point.

Investment in better bulls was confirmed by all farmers involved with breeding cows as a strategic decision to improve genetic potential of their herds. However, only 33.3 per cent of farmers in Campo Grande and 14.8 per cent in the Pantanal carried out investment in artificial insemination. Cross breeding, as recommended technology by EMBRAPA, is more widely adopted than expected: 49 per cent in Campo Grande and 33.3 per cent in Pantanal. Looking at Table 6.19 it is realised that stimulus from experience of other farmers was an important motive for farmers to use cross breeding. There is statistic evidence that in Pantanal motivation based on farmers experiences is likely to be more important than in Campo Grande (Mann-Whitney Test U,  $p < 0.05$ ). Motivation stemming from EMBRAPA in the Pantanal tends to be stronger than in Campo Grande while private technical assistance is higher in the later. High variation is related to motivation stemming from personal experience. The farmers reacted more to practical motives of reducing age of slaughter and increasing carcass weight.

**Table 6.19: Importance of motives to use cross breeding**

Motives	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Reduce age of slaughtering	4.4	0.86	4.1	1.26
Increase carcass weight	4.3	1.02	4.2	0.66
Personal experience	3.2	1.63	2.2	1.85
Private technical assistance	3.2	1.19	1.9	1.35
Experience other farmers	3.2 <sup>a</sup>	1.35	4.4 <sup>b</sup>	0.72
EMBRAPA	2.0	1.52	2.6	1.58
Tax incentives	1.9	1.22	1.3	0.70
Extension service	1.1	0.40	1.2	0.66

Figures in same row with different letters are significantly different,  $p < 0.05$

EMBRAPA has been responsible for a programme of bull ranking of Zebu (*Boos indicus*) breeds. It is expected that the breeders are the primary recipients of this information. Nevertheless, commercial beef cattle farmers also are interested once the information can be orientated to them to buy better bulls from selected sires. In this way, the Table 6.20 indicates the level that commercial farmers know this information. Although, in Campo Grande the proportion of farmers familiar with this information appears to be greater than in Pantanal, there is not statistical evidence indicating that the proportions are different ( $\chi^2_{.05} = 1.33, p > .05$ ). In both regions, the strata 3 farmers tend to have a higher knowledge than those of strata 1 or 2 about this information, but it was not possible to consider statistic analysis once expected number of cases were low to be accepted in the chi-square test. However, when the farmers that already know the information were asked about actual utilisation of the bull ranking, only 33.3 per cent answered positively in Campo Grande and 25.0 per cent in the Pantanal.

**Table 6.20: Percentage of farmers knowing the bull ranking developed by EMBRAPA**

Opinion	Campo Grande				Region	Pantanal			Region
	Strata			Region		Strata			
	1	2	3			1	2	3	
YES	25.7	36.8	60.0	<b>35.0<sup>a</sup></b>	9.1	11.1	42.9	<b>23.5<sup>a</sup></b>	
NO	74.3	63.2	40.0	<b>65.0<sup>a</sup></b>	90.9	88.9	57.1	<b>76.5<sup>a</sup></b>	
<b>Total</b>	100.0	100.0	100.0	<b>100.0</b>	100.0	100.0	100.0	<b>100.0</b>	

In the column Region, figures in same row with same letter are not significantly different,  $p > 0.05$

## 6.10 Tactical decisions

### 6.10.1 Decision partners, buying and selling attitudes

The farmers, by themselves, are the most important in making short-term decisions, while others, have moderate importance (Table 6.21). In both the regions the farmers gave similar importance to the usual partners and there is not statistic evidences of likely differences (Mann-Whitney Test U,  $p > 0.05$ ). However, high variation of answer was found in relation to children in both regions.

**Table 6.21: Importance of partners in farmer's tactical decisions**

Partners	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Farmer	4.6 <sup>a</sup>	0.76	4.8 <sup>a</sup>	0.45
Spouse	1.7 <sup>a</sup>	1.03	1.9 <sup>a</sup>	1.04
Children	2.2 <sup>a</sup>	1.53	2.2 <sup>a</sup>	1.47
Parents	1.5 <sup>a</sup>	1.09	1.8 <sup>a</sup>	1.34
Technical assistant	2.1 <sup>a</sup>	1.42	1.8 <sup>a</sup>	1.19
Other farmers	2.1 <sup>a</sup>	1.16	2.4 <sup>a</sup>	1.07
Friend	2.2 <sup>a</sup>	1.10	2.2 <sup>a</sup>	1.21

Figures in same row with same letter are not significantly different,  $p > 0.05$

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

Price survey is considered the most important attitude in the process of buying inputs to farm (Table 6.22). Moreover, the attitude of consulting traditional suppliers, other farmers, technical assistants or even some friends are also reported as important. Looking for information from advertisements does not seem important in the decision process of farmer's buying. Evidences of likely significant differences between the regions in answering these questions were not found, except in relation to personal experience; the farmers of Pantanal trust more in their experiences..

**Table 6.22: Purchasing attitudes**

Purchasing attitudes	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Price survey	4.6	0.72	4.6	0.78
Trust in personal experience	3.4 <sup>a</sup>	1.23	4.2 <sup>b</sup>	0.80
Consult traditional suppliers	3.4	1.15	3.6	1.28
Consult other farmers	2.7	1.35	3.2	1.36
Consult technical assistant	2.7	1.35	3.2	1.36
Consult some friend	2.7	1.60	2.7	1.47
Look for advertisement	2.5	1.28	2.7	1.38

Figures in same row with different letters are significantly different,  $p < 0.05$

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

Table 6.23 indicates that, although, the farmers use a variety of sources of information in the process to buy cattle, auction enterprises for selling of cattle and other farmers are the most important sources. There is not evidence of likely significant differences between regions in relation to the importance of each source of information (Mann-Whitney Test U,  $p > 0.05$ ). The survey also identified that in

Campo Grande, 76 per cent of cattle that are not slaughtered are sold on farms while in Pantanal this figure decreases to 45 per cent. This means that farmers of Pantanal sell more at auction than in Campo Grande.

**Table 6.23: Importance of different sources of information to buy cattle**

Sources	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Auction enterprises	3.5 <sup>a</sup>	1.45	4.0 <sup>a</sup>	1.03
Farmers	3.4 <sup>a</sup>	1.20	3.7 <sup>a</sup>	1.09
Media (newspaper, TV, etc.)	3.0 <sup>a</sup>	1.38	2.8 <sup>a</sup>	1.48
Bulletins	2.3 <sup>a</sup>	1.34	2.4 <sup>a</sup>	1.32
Specialised service offices	2.2 <sup>a</sup>	1.34	2.5 <sup>a</sup>	1.64

Figures in same row with same letter are not significantly different,  $p > 0.05$

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

### 6.10.2 Animal Husbandry

The frequencies of animal husbandry practices used by the farmers are presented in the Table 6.24. The proportion of farmers using seasonal mating season is likely to be significantly greater in Campo Grande than in Pantanal ( $\chi^2_{.05} = 16.27, p < .05$ ). Significant differences were found also in relation to the proportions of farmers using mineral supplements between the two regions ( $\chi^2_{.05} = 16.27, p < .05$ ). Anti-parasite treatment is a very common practice in both regions while cow pregnancy and bull fertility diagnosis is less practised. However, the results show that the farmers of Campo Grande use more advanced practices than in the Pantanal and, to some extent, the farmers of strata 3 tend to use more advanced technology than the strata 1 and 2.

**Table 6.24: Percentage of farmers using animal husbandry practices**

Activities	Campo Grande			Region	Pantanal			Region
	Strata				Strata			
	1	2	3		1	2	3	
Seasonal mating*	55.6	62.5	90.0	64.2 <sup>a</sup>	28.6	22.2	8.3	17.9 <sup>b</sup>
Pregnancy diagnosis*	33.3	37.5	70.0	41.5	42.9	33.3	66.7	50.0
Bull fertility diagnosis*	25.9	37.5	40.0	32.1	42.9	22.2	41.7	35.7
Anti-parasite treatment	87.1	100.0	100.0	93.3	100.0	100.0	100.0	100.0
Mineral supplements	100.0	89.5	100.0	96.7 <sup>a</sup>	72.7	77.8	85.7	79.4 <sup>b</sup>
Dry season supplements	32.3	52.6	60.0	43.3	9.1	22.2	42.9	26.5

For the column Region, figures in same row with different letters are significantly different,  $p < 0.05$

\* Farms involved with breeding cows

The survey also indicated that only 32 per cent of the farmers in Campo Grande and 44 per cent in Pantanal know about the strategic anti-parasite treatment developed and recommended by EMBRAPA. Additionally only 8 farmers, of entire sample, declared use the treatment in the three months recommended by EMBRAPA. Only 34 per cent of farmers apply anti-parasite treatment three times per year. EMBRAPA has advised the farmers to use the anti-parasite treatment for weaning calves up to two years old, but it was identified that the majority of the farmers have used anti-parasite indiscriminately for the entire herd. Lack of information is not important in the opinion of 78 per cent of the farmers who do not use mineral supplements, while the high cost of supplements was indicated by 55 per cent as being an important disincentive.

EMBRAPA has demonstrated to farmers that energy and protein supplementation for young males during the dry season is a sound economic practice toward decreasing the age at slaughter. Although statistical evidence was not found, the farmers of Campo Grande tend to use more dry season supplementation than in Pantanal (Table 6.24). Weaned males and cattle over two years of age are the categories for which the majority of farmers declared supplementation in both regions. On average, farmers consider this practice as important (Table 6.25)

**Table 6.25: Frequency of farmer’s opinion on importance of protein and energy supplement**

Specification	Campo Grande		Pantanal	
	Frequency	%	Frequency	%
Not important	4	6.7	2	5.9
Little important	8	13.3	3	8.8
Moderate important	7	11.7	8	23.5
Important	20	33.3	8	23.5
Very important	21	35.0	13	38.2
<b>Total</b>	<b>60</b>	<b>100.0</b>	<b>34</b>	<b>100.0</b>

### 6.10.3: Pasture management

The attitude of the farmers in Pantanal, in relation to pasture management, is divided practically into two. One is to base stocking rate on the annual average pasture production and the other to utilise a different stocking rate for each season, but

always looking at the preservation of pasture production in the long term (Table 6.26). In Campo Grande, the dominant attitude of the farmers is to use a single stocking rate based on annual average pasture production but also looking at the long term. Table 6.27 shows that carrying capacity, according to the majority of farmers, has decreased over time in both the regions. This opinion is stronger in Campo Grande than in Pantanal. However, 65 per cent of farmers in the Pantanal confirmed that changes had occurred in natural vegetation. 82 per cent of farmers confirmed that pasture quality had decreased as a consequence of these changes in vegetation.

Recurrent flooding, trampling and selection of fodder species by cattle were indicated as being important factors responsible for the changes while fire, natural evolution, inundation of new areas and behaviour of wild life were indicated as of little importance. 68 per cent of the farmers believe that the changes have happened moderately or very quickly. The opinions about the effects on the beef industry can be divided into two groups: half considered them to be of little or moderate importance and half to be important or very important.

**Table 6.26: Frequencies (%) of farmer's attitude to pasture management**

Attitudes	Campo Grande	Pantanal
<b>Stocking rate:</b>		
based on production of wet season	1.7	0.0
based on production of dry season	3.3	5.9
based on annual average production	70.0	47.0
for each season	25.0	47.1
<b>Total</b>	100.0	100.0
<b>Preference on pasture utilisation over time:</b>		
prefer long term pasture utilisation	86.7	100.0
prefer short term utilisation	13.3	0.0
<b>Total</b>	100.0	100.0

**Table 6.27: Frequency (%) of opinion on decreasing of carrying capacity**

Opinion	Campo Grande				Pantanal			
	Strata			Region	Strata			Region
	1	2	3		1	2	3	
YES	87.1	84.2	90.0	<b>86.7</b>	36.4	77.8	78.6	<b>64.7</b>
NO	12.9	15.8	10.0	<b>13.3</b>	63.6	22.2	21.4	<b>35.3</b>
<b>Total</b>	100.0	100.0	100.0	<b>100.0</b>	100.0	100.0	100.0	<b>100.0</b>

In the region of Pantanal, it was identified that the frequency of farmers using low stocking rate is higher than in Campo Grande (Table 6.28). According to the farmers in both regions, the incidence of cases utilising high stocking rate is low (13.3 per cent in Campo Grande and 11.8 per cent in Pantanal), while medium stocking rate was considered as the more usual adopted practice for pasture management (65 and 56 per cent in Campo Grande and Pantanal respectively). However, 67 per cent of the farmers in Campo Grande agreed that their colleagues use overgrazing, while in the Pantanal the same answer was given for 44 per cent of the farmers.

**Table 6.28: Frequency (%) of farmers in relation to stocking**

Stocking rate	Campo Grande			Region	Pantanal			Region
	Strata				Strata			
	1	2	3		1	2	3	
Low	29.0	15.8	10.0	21.7	63.3	33.3	7.1	32.3
Medium	54.8	73.7	80.0	65.0	18.2	55.6	85.7	55.9
High	16.2	10.5	10.0	13.3	18.2	11.1	7.1	11.8
<b>Total</b>	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

### 6.11: Operational decisions

The Table 6.29 shows that the farmers considered themselves as very important in making operational decisions. Although children appeared in second place, their involvement was considered as little important in the decisions. It is important to point out that even when indicating low importance farmers still bring other persons to their decisions. There are not significant evidences that the farmers in both regions consider the involvement of partners differently (Mann-Whitney Test U,  $p > 0.05$ ).

**Table 6.29: Importance of partners in farmer's operational decisions**

Partners	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Farmer	4.7 <sup>a</sup>	0.81	4.9 <sup>a</sup>	0.37
Spouse	1.8 <sup>a</sup>	1.22	1.4 <sup>a</sup>	0.95
Children	2.3 <sup>a</sup>	1.45	2.1 <sup>a</sup>	1.45
Parents	1.3 <sup>a</sup>	0.72	1.6 <sup>a</sup>	1.35
Technical assistant	1.8 <sup>a</sup>	1.21	1.6 <sup>a</sup>	1.39
Other farmers	1.5 <sup>a</sup>	0.91	1.6 <sup>a</sup>	1.47

Figures in same row with same letter are not significantly different,  $p > 0.05$

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)



## 6.12 Insight on farmer's information systems

The figures in Table 6.30 indicate that reading has been an important way for farmers to obtain information and knowledge about beef cattle. On average, the answers in Table 6.31 show that newspapers and rural magazines are the most usual source of reading, even though they are not considered very important. There is not significant evidences of likely differences between regions in relation to the importance of reading sources (Mann-Whitney Test U,  $p > 0.05$ ). Substantial variation in the answers is present in this case. During the interview, a large proportion of farmers complained that they do not have access to EMBRAPA publications.

**Table 6.30: Importance of reading for farmers in obtaining information**

Specification	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
<b>Region</b>	<b>3.9</b>	<b>1.23</b>	<b>3.9</b>	<b>1.01</b>
Strata 1	3.9	1.31	4.0	0.77
Strata 2	3.6	1.25	3.9	1.36
Strata 3	4.3	0.82	3.9	0.99

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

**Table 6.31: Importance of different sources of reading**

Sources	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Rural magazines	3.7 <sup>a</sup>	1.34	3.8 <sup>a</sup>	1.02
Newspapers	3.5 <sup>a</sup>	1.00	3.4 <sup>a</sup>	1.32
Bulletins from rural association	2.8 <sup>a</sup>	1.48	2.7 <sup>a</sup>	1.35
Publication from EMBRAPA	2.8 <sup>a</sup>	1.52	2.7 <sup>a</sup>	1.36
Technical books	2.5 <sup>a</sup>	1.53	2.3 <sup>a</sup>	1.38
Publication from extension service	2.3 <sup>a</sup>	1.48	1.9 <sup>a</sup>	1.07

Figures in same row with same letter are not significantly different,  $p > 0.05$

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

Talking and listening tend to be very important in the information process among farmers (Table 6.32). Some usual places to talk and listen about beef cattle are presented in Table 6.33. Although there is a large variation, the farmers in both regions tend to value the same places in similar way to obtain information and there is not statistic evidences of differences except in the case of friend's house.

Television and agricultural fairs appeared at first places followed by rural syndicate, cattle auction, friend's house, commercial shops and EMBRAPA. In addition, fax and internet are not considered important mechanisms to obtain information while telephone and personal visits are important in order to inform upon farming products.

**Table 6.32: Importance of talking and listening to obtain information**

Specification	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Region	4.2 <sup>a</sup>	0.92	4.5 <sup>a</sup>	0.74
Strata 1	4.2	1.04	4.5	0.68
Strata 2	4.2	0.83	4.8	0.44
Strata 3	4.5	0.70	4.4	0.93

Figures in same row with same letter are not significantly different,  $p > 0.05$

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

Observation also is considered by farmers as an important means to gain information and knowledge (Table 6.34). Again in the both regions the farmers tend to value similarly the same places of observing and significant differences were not found (Mann-Whitney Test U,  $p > 0.05$ ) (Table 6.35). In this case EMBRAPA has been pointed out as less important. Table 6.36 provides a view on what the farmers think about activities for information transfer. Although, there is a high variation in opinions the farmers did not value the activities very important.

**Table 6.33: Importance of different places for talking and listening**

Places	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
TV	3.4	0.99	3.4	1.12
Agricultural fairs	3.3	1.36	3.3	1.35
Rural Syndicate	2.7	1.52	3.2	1.52
Commercial shops	2.7	1.27	2.6	1.25
Cattle auction	2.7	1.34	3.2	1.41
Friend's house	2.6 <sup>a</sup>	1.02	3.2 <sup>b</sup>	1.28
EMBRAPA	2.3	1.53	2.2	1.43
Radio	1.9	1.22	1.6	1.07
Rope Clubs	1.8	1.34	1.4	0.99
Bar	1.6	1.15	1.6	1.01
Co-operative	1.6	1.10	1.3	0.83
Social Clubs	1.4	0.90	1.6	1.01
Banks	1.3	0.60	1.4	0.92

Figures in same row with different letters are significantly different,  $p < 0.05$

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

**Table 6.34: Importance of observing to obtain information**

Specification	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Region	4.3	0.80	4.4	0.78
Strata 1	4.3	0.75	4.2	0.75
Strata 2	4.2	1.11	4.3	1.11
Strata 3	4.3	0.51	4.6	0.51

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

**Table 6.35: Importance of different places of observing**

Sources	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Farms in the region	4.0 <sup>a</sup>	1.03	4.2 <sup>a</sup>	0.93
Farms in other regions	3.2 <sup>a</sup>	1.40	3.7 <sup>a</sup>	1.23
Cattle fairs	3.1 <sup>a</sup>	1.37	3.4 <sup>a</sup>	1.20
Cattle Auction	2.8 <sup>a</sup>	1.30	3.0 <sup>a</sup>	1.31
EMBRAPA	2.7 <sup>a</sup>	1.61	2.4 <sup>a</sup>	1.45

Figures in same row with same letter are not significantly different,  $p > 0.05$

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

**Table 6.36: Farmer's opinion on the importance of activities in knowledge and information transfer**

Activities	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
Seminars	3.0	1.52	3.0	1.46
Fields days	2.9	1.62	2.6	1.61
Training courses	2.7	1.57	2.4	1.47

(1 = not important; 2 = little important; 3 = moderate important; 4 = important; 5 = very important)

### 6.13: Farmer's satisfaction

According to the results in the Table 6.37, the satisfaction as a farmer was affected by the economic policy recently implemented by Brazilian government. Although the satisfaction of farmers of Pantanal seems to be more affected than in Campo Grande there is no statistical evidence that the proportions is likely to be different ( $\chi^2_{.05} = 2.17, p > .05$ ). The Table 6.38 shows clearly that the economic policy had a negative effect on satisfaction once it decreased after the planning. It is important to point out that, before planning, there is strong evidence that the satisfaction of the farmers in

Pantanal is likely to be greater than in Campo Grande (Mann-Whitney Test U,  $p < 0.05$ ). However, there are not such evidences that after planning the satisfactions are to be different (Mann-Whitney Test U,  $p < 0.05$ ).

**Table 6.37: Frequency (%) of farmers' opinion on government economic policy affecting their satisfaction as farmers**

Opinion	Campo Grande				Pantanal			
	Strata			Region	Strata			Region
	1	2	3		1	2	3	
YES	54.8	57.9	70.0	<b>58.3<sup>a</sup></b>	63.6	66.7	85.7	<b>73.5<sup>a</sup></b>
NO	45.2	42.1	30.0	<b>41.7<sup>a</sup></b>	36.4	33.3	14.3	<b>26.5<sup>a</sup></b>
<b>Total</b>	100.0	100.0	100.0	<b>100.0</b>	100.0	100.0	100.0	<b>100.0</b>

For the column Region, figures in same row with same letters are not significantly different,  $p > 0.05$

**Table 6.38: General satisfaction of farmers before and after government economic planning (farmers who answered "yes" from Table 6.37)**

Specification	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
<b>Before economical planning</b>				
<b>Region</b>	<b>3.7<sup>a</sup></b>	<b>0.77</b>	<b>4.2<sup>b</sup></b>	<b>0.76</b>
strata 1	3.2	0.83	4.1	0.89
strata 2	3.2	0.40	4.5	0.54
strata 3	4.0	0.81	4.1	0.79
<b>After economical planning</b>				
<b>Region</b>	<b>2.8<sup>a</sup></b>	<b>1.13</b>	<b>2.4<sup>a</sup></b>	<b>0.82</b>
strata 1	2.9	1.11	2.6	0.78
strata 2	2.5	1.36	2.5	0.83
strata 3	3.0	0.81	2.3	0.88

Figures in the row with different letters are significantly different,  $p < 0.05$  while with same letter are not,  $p > 0.05$ .

(1 = no satisfaction; 2 = little satisfaction; 3 = moderate satisfaction; 4 = satisfied; 5 = very satisfied)

During the interviews, even farmers who demonstrated dissatisfaction agreed with government planning mainly to keep the Brazilian inflation at low level and under control. However, they disagreed with undue impact on price relation for input/products. The prices of agricultural inputs were kept at a high level while the prices of rural products were low. The level of satisfaction of those farmers who were not affected by the recent economic policy is presented in Table 6.39.

**Table 6.39: General satisfaction of those farmers not affected by recent economic policy (farmers who answered “no” from Table 6.37)**

Specification	Campo Grande		Pantanal	
	Mean	Std Dev	Mean	Std Dev
<b>Region</b>	<b>4.2</b>	<b>0.87</b>	<b>4.2</b>	<b>0.97</b>
strata 1	4.6	0.75	4.0	1.15
strata 2	3.5	0.75	4.0	1.00
strata 3	4.7	0.57	5.0	0.00

(1 = no satisfaction; 2 = little satisfaction; 3 = moderate satisfaction; 4 = satisfied; 5 = very satisfied)

The beef cattle business, in the farmers’ opinion, was greatly affected by the recent economic policy (Table 6.40). However, there is evidence that the proportion of dissatisfaction is likely to be greater in Pantanal than in Campo Grande ( $\chi^2_{.05} = 4.28$ ,  $p < .05$ ). This opinion was more marked among the farmers of strata 2 and 3 than those strata 1 in both regions. These farmers think that there has been a negative effect on the beef cattle business (Table 6.41). In spite of this, when the farmers were questioned if they would like to leave the farm business, almost all said no.

**Table 6.40: Frequency (%) of farmers’ opinion if the recent economic policy affected or not the beef cattle business**

Opinion	Campo Grande				Region	Pantanal			Region
	Strata			Region		Strata			
	1	2	3			1	2	3	
YES	67.7	73.3	90.0	<b>73.3<sup>a</sup></b>	81.8	100.0	92.9	<b>91.2<sup>b</sup></b>	
NO	32.3	26.7	10.0	<b>26.7<sup>b</sup></b>	18.2	0.0	7.1	<b>8.8<sup>b</sup></b>	
<b>Total</b>	100.0	100.0	100.0	<b>100.0</b>	100.0	100.0	100.0	<b>100.0</b>	

For the column Region, figures in same row with different letters are significantly different,  $p < 0.05$

It seems to be important to aggregate additional information on issue of farmer dissatisfaction. Basically, the recent economic policy was directed to control the inflation and to improve social welfare of the poor people. Inflation has been a “cancer” in the Brazilian economy for long time and responsible for undesired social and economic effects. The culture of earning money easily through increasing price and returns from financial market were privileges of a small part of Brazilian society. As a result, the rich were becoming richer and the poor becoming poorer; thus increasing the already existent distorted distribution of income.

**Table 6.41: Mean of farmer's opinion on beef cattle business before and after government economic planning**

Specification	Campo Grande		Pantanal	
	Mean	<i>Std Dev</i>	Mean	<i>Std Dev</i>
<b>Before economical planning</b>				
<b>Region</b>	<b>3.4</b>	<b>0.81</b>	<b>3.9</b>	<b>0.76</b>
strata 1	3.2	0.76	3.3	0.86
strata 2	3.4	0.93	4.1	0.60
strata 3	3.9	0.60	4.0	0.64
<b>After economical planning</b>				
<b>Region</b>	<b>2.7</b>	<b>1.04</b>	<b>2.5</b>	<b>0.85</b>
strata 1	2.7	1.01	2.2	0.83
strata 2	2.8	1.12	2.6	1.01
strata 3	2.8	1.09	2.5	0.77

(1 = very bad; 2 = bad; 3 = reasonable; 4 = good; 5 = very good)

In the context of the new policy, a strong new currency was created equivalent to US dollar, supported by the internal exchange reserve. Open market was implemented facilitating entry of imported goods into the internal market as to promote competitiveness. The new policy brought the words “efficient business” as imperative. Place for financial speculation and undue increase of prices were cut down as ways of increasing wealth, opposite of the past situation. Of course, the effects of this policy came soon. Prices and salaries became stable, the purchasing power of workers increased and since earning easy money was not available, and the value of the properties fell over substantially in the market.

All sectors of the economy were shocked and within a short period the lesser efficient businesses have closed the doors. As a consequence in the rural sector, land was also devalued and the farmers felt a psychological effect of becoming “poor”. According to the farmers, at the present time, their “status quo” was affected negatively. During the interviews a strong feeling of pessimism, depression and uncertainty was detected. The future will indicate the extent and the consequences of such feelings, but it is important for this understanding to be clear by those involved in the agricultural sector.

## 6.14 Concluding remarks

The analysis and comments of this Chapter are focused to provide a general description of the sample in a broad sense. From this view, it is important to highlight issues of relevance for the next steps of this research. First of all, it is clear that there is a large variation in the answers inside regions and within strata. But differences between regions do arise from the analysis. Hence, there are plenty of opportunities to be explored in the population in order to identify sources of variation. At the same time, this variation is a strong indication of potential clusters of farmers.

This survey was not designed to provide a complete understanding of the social network of farmers' information systems. However, it is quite clear that the farmers give importance to involvement in the decisions while sharing information with other farmers. Furthermore, there are also strong evidences of gaps between information generated by EMBRAPA and farmers' knowledge for most of the developed technologies. It is intended in the next paragraphs to summarise some of the results aggregating discussion for the next steps.

The majority of farm decision making is represented by male gender, but the presence of female as the main decision-maker is above expected. Two thirds of the farmers are less than 60 years old with a long experience. The high education level found in the sample was not expected, and this result should be taken with reserve. However, there is a strong indication that the level of education of the farmers is higher than thought and this has implication for EMBRAPA's strategies. Motivation to become a farmer and to obtain land in Pantanal is more tied up to farm family tradition than in Campo Grande. Multiple objectives were ranked similarly in both regions, but the farmers of Pantanal tend to give more importance to nature conservation than the farmers of Campo Grande. These results reinforce the opinion of those people who defend farmer's multiple objectives instead of only profit maximisation.

Beef cattle activities are the most important for all farmers. However, cash cropping was important for farmers of strata 3 in Campo Grande. All farmers of the strata 3 in Campo Grande are involved with breeding cows plus rearing and fattening of males while other beef cattle activities are distributed more or less in the farms of strata 1 and 2. This is an interesting point since it seems to be related with the size of the business. In other words, the bigger the herd and the farm in Campo Grande more farmers are involved in the three phases of production (breed, rear and fatten). This observation is not valid for Pantanal, where the farmers are evenly distributed into breeding cows, breeding plus rearing and breeding plus rearing and fattening.

Despite beef cattle being the most important source of income, the figures found for other sources in total family income were very noteworthy. Entrepreneurial income by itself represented almost 50 per cent of the total of other income sources for those farm family that the income is not provided only from farming activities. From the social economic point of view this finding seems to be important for further research. In addition, this reality has implications for EMBRAPA. Gasson (1990) reported that part-time farming has been also has been important in Europe and interesting questions has arisen in relation to effect this in the farming community and in the agriculture context.

It was clear that, to some extent, farmers share with family members farm decision making and consult other persons outside home not only in decisions but also to obtain information. The persons who have been consulted by the farmers must be searched in order to identify the information network. The current questionnaire was not designed to identify this but it gave indication about the importance of different groups which farmers use to obtain information.

Investment in farming has been constant among farmers in the last five years. A large proportion of farmers in Campo Grande has invested money in pasture recovery. Answering questions related to the source of the technical and practical information on pasture recovery can only developed from more detailed case studies. The same approach may be applied about other selected points about which information is



necessary for farm decision making. The farmers of Campo Grande are using more intensive technologies than in Pantanal and seemed also to be better informed on developed technologies by EMBRAPA. The same occurs in relation to the strata in Campo Grande; the farmers of the strata 3 are using more advanced technologies than the strata 1 and 2. This does not mean that, in general, they are able to identify the technology with EMBRAPA. Cross breeding technology is a good example of this. Despite the fact that EMBRAPA had first developed the experience in the region, those farmers who made the decision to using cross breeding considered the importance of the institution low. The experience of other farmers was considered more important than EMBRAPA as source of information. Identifying from where these farmers obtained their motivation and experience can lead to the starting point for technology dissemination. However, more important than this is to understand the mechanism of exchange information.

Another example, such as the strategic anti-parasite treatment, can be mentioned to illustrate that EMBRAPA is not disseminating the information properly. In this case, the farmers are not using the recommendation because they do not have the information. Even when they know about the technology it has not been used as recommended. Most of forages species selected by EMBRAPA are well known and disseminated among the farmers. Why this kind of technology is well disseminated? What are the differences in the mechanisms that make this information run quickly? Are the farmers more interested in this type of information than others? These and other questions arise from this analysis which may be followed through in case studies.

Insight on farmer's information systems has shown that reading, observing other farms, talking and listening are ways that the farmers consider important in obtaining information. Case studies can explore this field better taking into account the provided indications on the usual sources of reading, places of observing, talking and listening outlined in this research.

At the present time, it was a clear-cut point that the farmer satisfaction, as a farmer,

was affected by recent Brazilian economic policy. Furthermore, the level of satisfaction decreased substantially after the policy had been implemented. However, apart from the generalised psychological effect of decreasing the property value and from unfavourable input/product prices it is important to identify what the farmers are thinking in terms of farming to overcome the dissatisfaction. This issue is important because the farmers do not want to leave the business and they will need to take decisions that should be known and understood by EMBRAPA in order to provide technological support to the decisions.

# Chapter 7

## Factor and Cluster Analysis

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### 7.1 Introduction

Chapter 6 was concerned with a descriptive analysis of the sample population according to the data obtained from the survey (questionnaire). Data were analysed about several aspects of farming and farmers such as demography, goals, objectives, attitudes, managerial decisions, appropriate technologies, sources of information, and satisfaction in relation to the new policies. However, a deeper understanding is necessary than was possible from the survey in order to achieve the objectives of this thesis. Because of this, *case studies* of representative farmers comprised a key element of the methodological approach applied to explore in-depth information from farmers. In order to aid the selection of representative farmers Factor and Cluster Analysis were applied, since a large number of variables involved in the survey had made it difficult to differentiate the population into groups.

### 7.2 Factor analysis

As mentioned in Chapter 5, the main aim of applying Factor analysis in this thesis was data reduction. The analysis was carried out with data from the entire sample (94 farmers). Hair, *et al.* (1987) have suggested a ratio between number of variables and sample size of 1:5 as acceptable to carry out factor analysis. They also highlighted that more conservative analysts recommend 1:10, while others are forced to use 1:2. According to them no clear-cut relationship exists in this matter, and when dealing with a low ratio, the analyst should interpret the findings cautiously. The rationale for using a more conservative ratio (higher ratio) is based on sample errors: the smaller the sample the greater is the influence of sampling error (Child, 1990). In this research a ratio approximately of 1:5 was used to carry out the factor analysis taking into account data from the entire sample (Campo Grande and Pantanal).

#### 7.2.1 Selecting variables

Selection of variables was carried out in order to facilitate separation of farmers into groups. The main orientation for selecting variables was to group farmers according to individual *social* traits such as *education, motivation to become a farmer, goals, objectives, openness to external assessment* and mechanisms used to obtain *information* rather than grouping them according quantitative variables such as area of the farm, size of the herd, area of pastures, etc. Having this orientation in mind, thirty-three variables were selected according to their relevance identified in Chapter 6 (see Table 7.1).

**Table 7.1 Selected sets of variables for factor and cluster analysis**

Sets	Components	Variables
Set 1	Social - <i>Education</i>	level of education
Set 2	Social - <i>Motivation to become a farmer</i>	family tradition desire for a profitable business desire for a safe business style of living
Set 3	Social - <i>Goals and objectives</i>	belonging to rural community increasing standard of family living to run the business without risk to transfer knowledge to children to be recognised for nature conservation
Set 4	Social - <i>Openness to external assessment</i>	consult other farmers before taking decision consult technical advisers before taking decision consult other farmers before buying inputs consult technical advisers before buying inputs
Set 5	Information - <i>sources of reading</i>	read EMBRAPA publications read rural magazines read bulletins of farm association read specialised books read rural newspapers
Set 6	Information - <i>localities for talking and listening</i>	through rural syndicate from EMBRAPA at cattle auction at supplier shops at agricultural fairs through television at friend's house
Set 7	Information - <i>localities for observing and learning</i>	from field days at technical seminars at training courses from EMBRAPA at agricultural fairs at farms in the region at farms in other regions

**7.2.2 Criteria for factor analysis**

Factor analysis was carried out using the model of principal component (SPSS, 1993). Factor extraction was based on factor *eigenvalues*, test of *scree plot* and percentage of cumulative explained variance. Following SPSS (1993), Hair *et al.* (1987) and Manly, (1986) only factors that accounted for *eigenvalues* greater than 1 were extracted. This is because factors with variance less than 1 are no better than a single variable (the logic is: a factor associated with eigenvalue less than 1 “explains” less variation in the overall data than one variable, (Manly, 1986)). The *scree plot* was obtained by plotting the eigenvalues against the number of factors in their order of extraction. According to Hair *et al.* (1987), the point at which the curve begins to be straightened is considered to indicate the maximum number of factors to extract. Given the nature of social information, a solution that accounts for approximately sixty per cent per cent of the total variance might be accepted as satisfactory (see Hair *et al.*, 1987). The Varimax method was used for orthogonal rotation of the factors in order to facilitate the interpretation of the factors (see Hair *et al.*, 1987; SPSS, 1993). Variable correlation loadings of less than 0.40 were not displayed, because the factors were interpreted on the basis of variables with moderate to strong relation with the factors (see Hair *et al.*, 1987).

From Table 7.1 it can be seen that the selected set of variables fall into two obvious groups: sets 5, 6 and 7 form a “distinct” group, since all variables are specifically related to mechanisms used for gaining “information”. The remaining selected sets 1, 2, 3 and 4, are concerned with *education, motivation to become a farmer, goals, objectives and, openness to external assessment* form a group of “social” variables. According to Hunter (1999, Pers. comm.) it was advisable to carry out two separate factor analyses, since each group of variables is concerned with a specific meaning. The rationale is that it does not make sense to include, within the same analysis, groups of variables having different meanings. In addition, similar “social” variables have been already analysed as a specific group (Gasson, 1973; Perkin and Rehman, 1994; Willock *et al.*, 1995) and these analyses may be used as a comparison. Therefore, it was decided that factor analysis should be carried out separately for each group of variables (*information* and *social*).

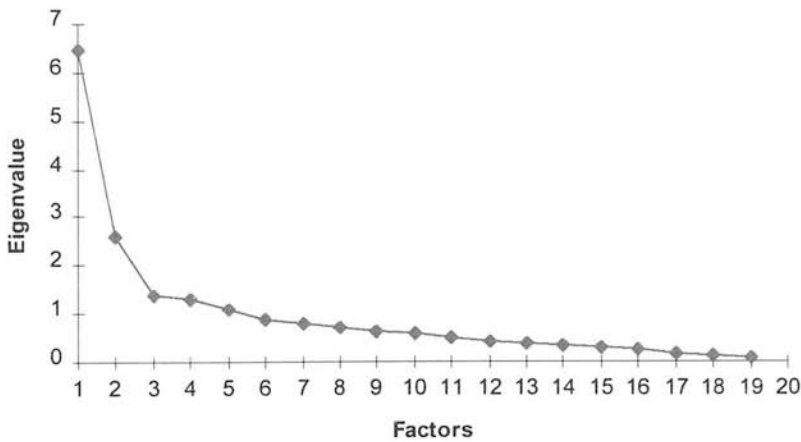
### 7.2.3 Factor analysis 1 – informational variables

Table 7.2 and associated *scree plot* in Figure 7.1 show that the extraction of five factors is an acceptable solution for this factor analysis, since the five first factors account for a variance (*eigenvalue*) greater than 1 and the curve in the *scree plot* begins to flatten after the five factors. Table 7.2 shows also that the largest part of the variation (67.5 per cent) is explained by the first five factors.

**Table 7.2: Initial statistics of factor analysis 1**

Factors	Eigenvalues	% variance	Cumul. %
1	6.45	34.0	34.0
2	2.60	13.7	47.7
3	1.37	7.2	54.9
4	1.30	6.8	61.7
5	1.09	5.8	67.5
6	.90	4.7	72.3
7	.81	4.3	76.6
8	.71	3.8	80.3
9	.62	3.3	83.6
10	.57	3.0	86.6
11	.49	2.6	89.2
12	.43	2.3	91.5
13	.37	2.0	93.5
14	.32	1.7	95.2
15	.29	1.6	96.7
16	.24	1.3	98.0
17	.15	.8	98.8
18	.12	.7	99.5
19	.09	.5	100.0

**Figure 7.1: Scree plot - factor analysis 1**



#### 7.2.3.1 Factors interpretation

The factors were interpreted on the basis of the rotated factor correlation matrix (see Table 7.3), which shows the correlation between the variables and the factors. Firstly, it can be seen that groupings of the variables with a correlation of no less than 0.40 “form” the factors. Secondly, the groupings seem to indicate underlying dimensions (meanings), which are expressed through the combination of the variables. Thirdly, the variables within each grouping present different levels of correlation with their respective factors. Variables with higher correlation with the factor are considered more important in interpreting the factor (Hair *et al.*, 1987).

**Table 7.3: Rotated factor matrix correlation – factor analysis 1**

Variables Name	N <sup>o</sup>	Factors				
		1-1	1-2	1-3	1-4	1-5
field days	344	.85				
training courses	345	.84				
technical seminars	346	.84				
EMBRAPA (observing)	341	.80				
EMBRAPA (talking and listening)	330	.78				
EMBRAPA (publications)	322	.67				
specialised books (reading)	321	.63				
farms in the region (observing)	339		.72			
farms in other regions (observing)	340		.68			
television	337		.65			
friend’s house (talking and listening)	332		.56			
rural newspapers (reading)	317			.75		
rural magazines (reading)	318			.68		
farm association bulletins (reading)	319			.63		
supplier shops (talking and listening)	333				.80	
cattle auction (talking and listening)	335				.74	
agricultural fairs (observing)	342		.43		.54	.45
agriculture fairs (talking and listening)	324					.70
rural syndicate (talking and listening)	317	.55				.61

According to the information obtained from the rotated correlation matrix the following interpretation of the factors are suggested:

**Factor 1-1** – The variables associated with this factor are strongly related with technical information and together they explain 34 per cent of the observed variation. EMBRAPA technical output is represented with variables such as reading publications and attending meetings. In fact, there is evidence that this factor is directed to specific technical subjects.

**Factor 1-2** – The variables associated with this factor are essentially concerned with applied practice. Farmers usually observe other farms and talk at a friend's house, in order to identify what farming practices their colleagues are adopting. In addition, farmers' experience is also presented on rural TV programs.

**Factor 1-3** – General technical information may be an adequate "label" of this factor, since the associated variables provide a large diversity of information on technical subjects about farming.

**Factor 1-4** – The combination of variables in this factor appear to be directed to farm business information, because it is believed that the cattle auction, supply shops and agricultural fairs are the usual places where the farmers exchange information about market, products, land price, cattle breeding, etc.

**Factor 1-5** – The label general information may be applied here because the variables used to describe the factor: attendance at agricultural fairs and rural syndicates, are concerned with a large diversity of information about agricultural subjects such as animal breeding, machinery, equipment, products, class movement, policy, business and farming information.

#### **7.2.4 Factor analysis 2 – social variables**

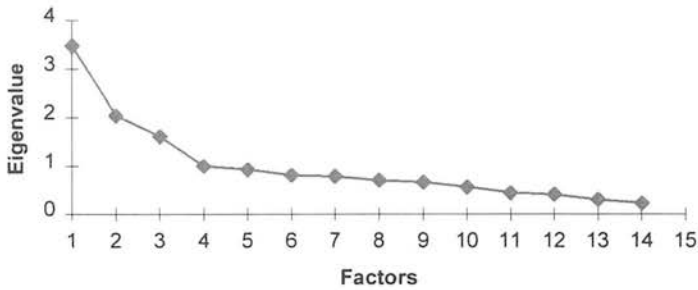
A second analysis was carried out separately with the *social* variables. According to the criterion of *eigenvalues* greater than 1 and the shape of the *scree plot*, Table 7.4 and Figure 7.2 show respectively that four factors are presented as an acceptable solution. Table 7.4 also shows that the four factors account for almost 60 per cent of the total variance, which can be accepted as solution for social research (Hair *et al.*, 1987).



**Table 7.4: Initial statistics of factor analysis 2**

Factors	Eigenvalues	% variance	Cumul. %
1	3.47	24.8	24.8
2	2.04	14.6	39.5
3	1.61	11.6	51.0
4	1.00	7.2	58.2
5	.92	6.6	64.8
6	.81	5.8	70.7
7	.78	5.6	76.2
8	.70	5.0	81.3
9	.66	4.7	86.0
10	.56	4.0	90.0
11	.44	3.2	93.2
12	.41	2.9	96.1
13	.30	2.2	98.3
14	.23	1.7	100.0

**Figure 7.2: Scree plot - factor analysis 2**



#### 7.2.4.1 Factors interpretation

The factors were interpreted on the basis of the rotated factor correlation matrix (see Table 7.5). This means that the underlying dimension and the factor label are defined by those variables with higher correlation with the factor.

**Table 7.5: Rotated factor matrix correlation – factor analysis 2**

Variables Name	N°	Factors			
		2-1	2-2	2-3	2-4
consult technical advisers to buy inputs	181	.79			
consult other farmers to buy inputs	180	.73			
consult technical advisers to take decision	084	.70			
consult farmers to take decisions	085	.55			
education	032	.43			
be recognised by nature conservation	079		.84		
run the business without risk	068		.66		
transfer knowledge for children	074		.62		.42
belong to rural community	063		.58		.44
style of living	047		.48		
profit business	045			.77	
safe business	046			.75	
family tradition	039				.75
increase standard of family living	065			.43	.63

**Factor 2-1** – There is strong evidence that this factor is related to openness to take decisions because variables such dealing with consultation with technical advisers and farmers buying inputs are involved and present a high correlation with the factor. Although education is present in this factor, its correlation is not so accentuated as the other variables.

**Factor 2-2** – This is associated with nature conservation, running the business without risk, transferring knowledge to children and belonging to a rural community. This is strongly indicative of this factor being some kind of commitment to rural life.

**Factor 2-3** – The label farm business expectation may be applied to this factor to express the combination of the variables associated with having a profitable and safe business as well as increasing the standard of family living.

**Factor 2-4** – The association of this factor with variables such as family tradition, increasing standard of family living, transference of knowledge for children and belonging to rural community is a strongly indicative that this factor can be linked to farm family tradition.

## 7.3 Cluster analysis

Cluster analysis was planned in this research to identify groupings of farmers separately within the two Regions. This was partly done because it is hypothesised that the agro-environmental difference between the Regions would create different types of clusters (Chapter 5): a view strengthened by evidence obtained from the survey (see Chapter 6). The cluster analysis was carried out separately for each Region by identifying the individual farmers from each Region and using the factor scores derived from the nine factors (1-1 to 1-5 and 2-1 to 2-4) from the factor analysis 1 and 2.

### 7.3.1 Criteria for cluster analysis

*Squared Euclidean distance* was chosen to measure the similarity between individuals and the agglomerative hierarchical *Ward's method* to identify the clusters (see Chapter 5). A *dendogram* was used as a graphic representation of the distances and clustering process in order to assist location of the cluster-solutions. According to Hair *et al.* (1987) in the procedure of hierarchical clustering (which includes *Ward's method*), individuals or clusters are progressively linked at increased distances from the initial clusterings. The clustering process ends up when all individuals are finally merged into a single cluster (Hair *et al.*, 1987; SPSS, 1993). Clusters-solutions should not be sought at very small distances because the individuals are split into a large number of clusters (see Hair *et al.*, 1987; SPSS, 1993). The cluster-solutions obviously should be accepted only if they can be rationally interpreted.

### 7.3.2 Results, interpretation and description of clusters-solution

According to the dendograms shown in Figures 7.3 and 7.4 three cluster-solutions are possible for both Regions. It can be seen that the three cluster-solutions in both Regions are being formed at an “acceptable” distance. In addition, three clusters are also accepted as an adequate number to the research goals.

Figure 7.3: Dendrogram - C. Grande

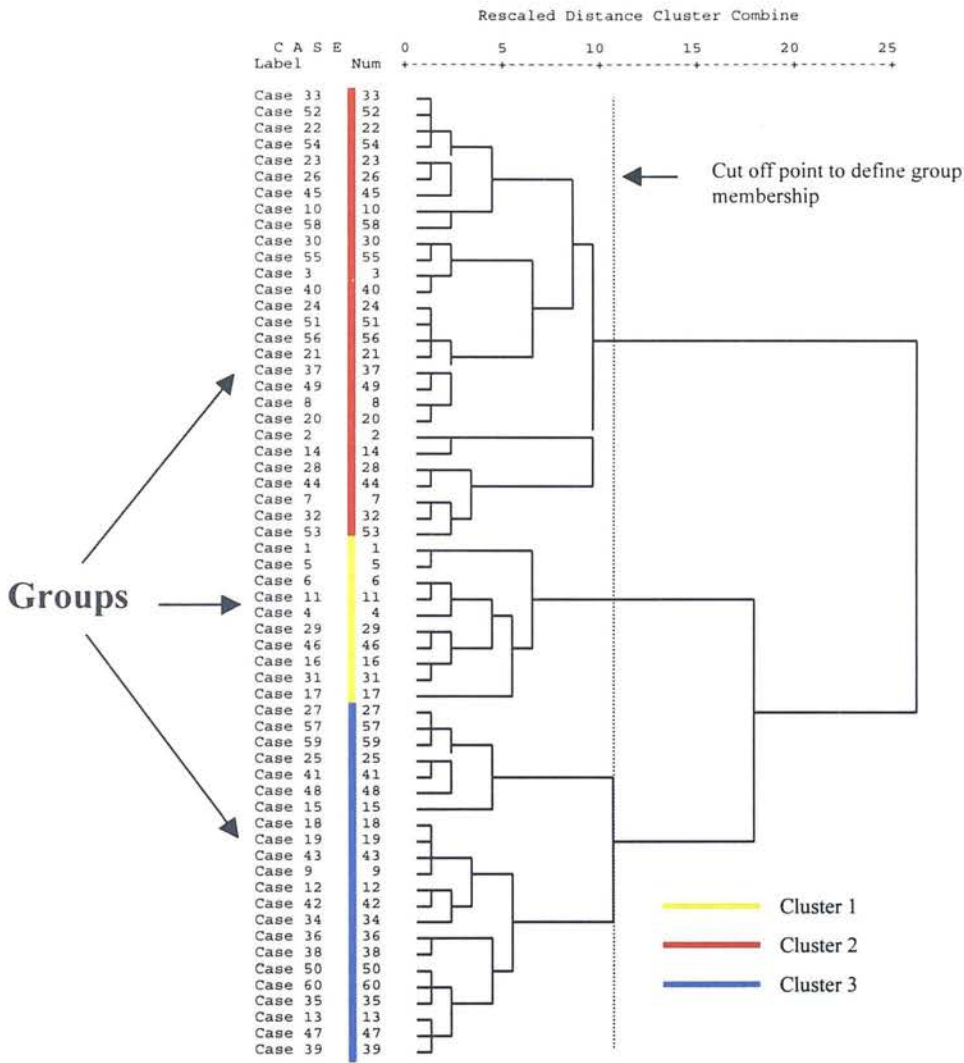
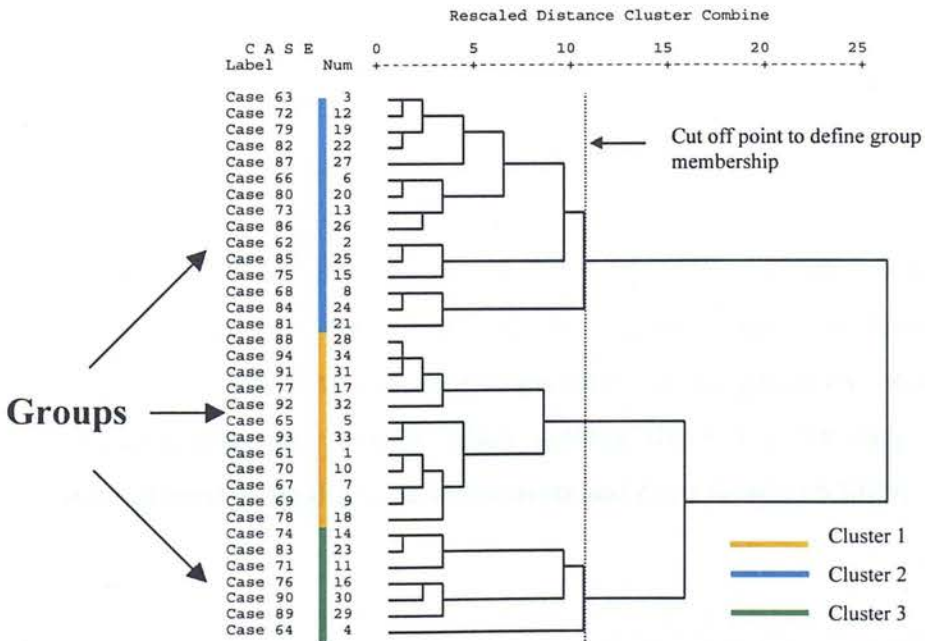


Figure 7.4: Dendrogram – Pantanal



The interpretation of the cluster-solution was facilitated by calculating the means of the factor scores (see Tables 7.6 and 7.7). The averages of the factor scores indicated that the clusters have different characteristics within and between regions.

**Table 7.6: Means factor scores within cluster - Campo Grande**

Factors	cluster 1 (10 cases)		cluster 2 (28 cases)		cluster 3 (22 cases)	
	Mean	Sd	Mean	Sd	Mean	Sd
1.1 – technical information	-.54	.55	.72	1.00	-.53	.65
1.2 – applied practical information	.26	1.15	.34	.66	-.87	.74
1.3 – general technical information	-.56	1.54	.41	.76	-.22	.97
1.4 – farm business information	.79	1.00	-.19	1.10	-.24	.71
1.5 – general information	.38	1.23	.15	.83	-.51	.84
2.1 – openness to take decision	-1.11	.62	.77	.65	-.71	.75
2.2 – commitment with rural life	.82	.55	.16	.82	-.96	1.05
2.3 – farm business expectation	.66	.93	.00	1.10	-.19	.59
2.4 – farm family tradition	.73	.61	-.28	1.10	-.39	1.04

**Table 7.7: Means factor scores within cluster - Pantanal**

Factors	cluster 1 (12 cases)		cluster 2 (15 cases)		cluster 3 (7 cases)	
	Mean	Sd	Mean	Sd	Mean	Sd
1.1 – technical information	.58	.85	-.47	.87	-.44	.81
1.2 – applied practical information	-.61	.67	.71	.90	.52	1.09
1.3 – general technical information	.09	.79	.08	.97	-.49	.93
1.4 – farm business information	.49	.66	-.69	.66	1.02	.83
1.5 – general information	.02	1.08	.34	1.10	-.30	.99
2.1 – openness to take decision	.80	.65	-.07	.72	-.46	.92
2.2 – commitment with rural life	.20	.51	.50	.61	-.18	1.18
2.3 – farm business expectation	-.25	.78	.69	.67	-1.39	.99
2.4 – farm family tradition	.29	.47	.40	.88	-.03	1.06

### Campo Grande

- In cluster 1, the farmers are seen as being averse to selected and general technical information but very interested in applied, farm business and general information. The data indicate that members of this group also seems to be averse to consulting other people when making decisions, but they have a strong commitment to rural life, farm business and farm family tradition.

- Cluster 2 seems to be opposite to cluster 1. It demonstrates evidence of members being open to involving people in decisions and in exploring information. There is evidence that the members of this group use technical information. On the other hand, farmers in this group seem to be only moderately committed to rural life and farm family tradition.
- Farmers members of Cluster 3 seem to have no interest in the sources of practical information, no commitment to rural life and is self sufficient in decisions making.

### **Pantanal**

- Farmers in Cluster 1 are open to advice from other people, have a moderate commitment to rural life and family tradition. This group uses selected technical and farm business information but tends not to be so interested in applying practical information.
- Farmers in Cluster 2 are not so open in involving other people in decision-making. Applied practical and general information appears to be very important to them but technical and farm business information appears to be less relevant. The farmers in this group seem to be strongly related to a commitment to rural life, farm business expectation and farm family tradition.
- Farmers in Cluster 3 consider applied and farm business information to be moderate and very important respectively.

### **7.3.3 Cluster memberships**

On basis of the above clusters-solution, there is little evidence for separating the farmers according to their original sample strata (see Tables 7.8 and 7.9). The exception is that Cluster 1 in the region of Campo Grande is formed by farmers from the strata 1 together with one farmer from strata 2. Thus, farmers belonging to different size groups (size of herds) present other common features which are able to group them within a same cluster.

**Table 7.10: Clusters-solution membership - Campo Grande**

Clusters	Strata 1 case numbers	Strata 2 case numbers	Strata 3 case numbers
1	1, 4, 5, 6, 11, 16, 17, 29, 31	46	
2	2, 3, 7, 8, 10, 14, 20, 21, 22, 23, 24, 26, 28, 30	32, 33, 37, 40, 44, 45, 49	51, 52, 53, 54, 55, 56, 58
3	9, 12, 13, 15, 18, 19, 25, 27	34, 35, 36, 38, 39, 41, 42, 43, 47, 48, 50,	57, 59, 60

**Table 7.11: Clusters-solution membership – Pantanal**

Clusters	Strata 1 case numbers	Strata 2 case numbers	Strata 3 case numbers
1	61, 65, 67, 69, 70	77, 78	88, 91, 92, 93, 94
2	62, 63, 66, 68	72, 73, 75, 79, 80	81, 82, 84, 85, 86, 87
3	64, 71	74, 76	83, 89, 90

#### 7.4 Selecting representative farmers for cases study

A cluster consists of a number of points in proximity to each other but dispersed within n-dimensional space. The problem arises as to how to choose a representative case within the cluster. The individuals are dispersed within group according to their distances from the centre of the cluster. Those individuals close to the centre of the cluster may thus be said to be more representative of the clusters (Ferreira, 1997). An objective approach to this problem is to select the closest individual to the centroid of the cluster in the n-dimensional space spanned by its variables (Morgan, 1997, Pers. comm.). The problem is set in nine dimensions (factors) and whilst nine dimensional space is obviously impossible to visualize, it can follow the same rules of co-ordinate geometry as applying to smaller dimensional systems. The centroid co-ordinate ( $CC_{xi}$ ) of each dimension (factor) was calculated as the average of their points (cases). This is given by the sum of individual factor scores divided by the number of individuals in the cluster. For example, the centroid of the factor 1-1 (dimension) in the cluster 1 of Pantanal is .58 (see Table 7.7). The distances ( $D_{xi}$ ) from each individual to  $CC_{xi}$  are calculated as *Euclidean distance*, (Chapter 5). The distance of

each individual was given by the squared root of the sum of squared distances from the centroids of all factors:

$$(D_{individual}) = \sqrt{D_{xi}^2 + D_{xi}^2 + D_{xi}^2 + \dots + D_{ni}^2}$$

Once all individual distances have been calculated, the individuals with the lowest distances are considered closest to the cluster-centroid and consequently the most representative. The farmer (case) with the lowest distance is preferentially chosen to represent each cluster within region (see Appendix 7.1). In this way, Table 7.10 presents a preferential order of the cases for each Cluster and Region.

**Table 7.10: Preferential order of cases according to their *Euclidean distance***

Region	Cluster 1		Cluster 2		Cluster 3	
	Case	Distance	Case	Distance	Case	Distance
Campo Grande	6	1.551	24	1.173	19	1.233
	11	1.664	33	1.571	50	1.701
	16	2.134	21	1.595	25	1.710
	31	2.352	26	1.700	47	1.816
Pantanal	94	1.165	82	1.458	74	1.869
	61	1.196	85	1.762	83	2.021
	88	1.706	72	1.776	90	2.165
	67	1.946	63	1.807	89	2.528

### 7.5 Concluding remarks

The aim of Factor analysis in this thesis was to reduce the data into factors, in order to use them in the cluster analysis. This objective was achieved, since the thirty-three selected variables were reduced into nine factors (five from *informational* and four from *social* variables). Cluster analysis was carried out successfully using the scores from factor analysis. Squared *Euclidean distance* and *Ward's method* as procedures of analysis provided interpretable clustering. Complete separation of groups was possible leading to representative farmers being chosen through an objective approach. The tasks of Factor and Cluster analysis were performed through available computational facilities. Therefore, there is evidence to support the conclusion that the application of multivariate techniques in this thesis achieved the desired purposes for selecting farmers for *case studies*.



# Chapter 8

## Case Studies

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### 8.1 Introduction

The main aims of this Chapter are to present and discuss the content findings of in-depth interviews from the six representative cases of the farmer groups and from four persons who were nominated as “trusted” people by the case studies. The six distinct groups of farmers were identified and described in Chapter 7, being three in Campo Grande and three in Pantanal. The procedure to select the representative cases was described in Chapter 7. As mentioned in Chapter 5, the aim of the in-depth interviews was to obtain deeper insights in the social construction of the farmers’ information network, and to access additional data which permits a more comprehensive testing of the hypotheses. A semi-structured interview was chosen as the methodological approach to carry out the interviews, as described in Chapter 5.

### 8.2 Presentation and discussion of case studies

The data (transcripts) are presented according to groups of hypotheses which are in turn related to sub-sections of assigned codes and sequences of questions (see Table 8.1). The data are presented following a sequence, starting with cases from Campo Grande. A brief identification of the cases, including demographic and business information, is presented in the Table 8.2. Only the main findings directly linked to the hypotheses, from the point of view of the author, will be brought to discussion. Otherwise, the full transcription of the interviews would extend the presentation of the data without adding significant contribution to hypothesis issues. Given the nature of the interview (open question), it is common that the respondents strayed from the focus of the main questions. The main findings are displayed in Boxes according to the code names. The content analysis and discussion are presented after the transcripts in each sub-section. Additional transcripts are also brought into the discussion, where appropriate.

Group of hypotheses	Main questions	Assigned codes
<p><b>Group 1: Knowledge and information</b></p> <p><u>Hypothesis 1:</u> The existing knowledge information systems of beef cattle farmers are complex networks of diverse sources and communication channels in which the participation of EMBRAPA has been peripheral.</p> <p><u>Sub-hypothesis 1.1:</u> A priori understanding of the format of farmers' knowledge information system can facilitate the process of knowledge acquisition from the farmers.</p>	<p>.How did you start learning about farming?</p> <p>.What sources of knowledge and information about farming have you used and why?</p> <p>.Do you trust some sources more than others, and why?</p> <p>.What have been the good experiences that you have introduced into your farming system and from where did you get them?</p> <p>.What have been the bad experiences that you have introduced into your farming system and from where did you get them?</p>	<p>. Initial learning . Knowledge evolution . Sources of knowledge . Trusted information . Good experiences . Bad experiences</p>
<p><b>Group 2: Problems and technology development</b></p> <p><u>Hypothesis 2:</u> Technology development by EMBRAPA has not fully met the needs of the majority of beef farmers in the selected regions. This is because farmers have not participated effectively in the decisions of EMBRAPA due to inadequacy of adopted institutional participatory approaches, and top-down decisions.</p> <p><u>Sub-hypothesis 2.1:</u> Farmers adjust technologies and research findings to their specific situation and conveniences better than formal researchers.</p>	<p>.What have been the main problems of beef cattle farming in the last five years from your point of view?</p> <p>.What have you done to solve the problems and from where did you get the information?</p> <p>.If it is relevant, how and why are EMBRAPA technologies being adjusted by you?</p> <p>.Are you interested in participating in EMBRAPA decisions? Why?</p>	<p>. Problems . Problem solutions . EMBRAPA technologies . EMBRAPA decisions . EMBRAPA decisions</p>
<p><b>Group 3: Environment concerns</b></p> <p><u>Hypothesis 3:</u> Farmers running beef cattle systems dependent on native pasture are more concerned about environmental conservation than farmers running systems on cultivated pastures.</p> <p><u>Sub-hypothesis 3.1:</u> The eco-system has a strong effect on farmers' behaviour, style of living, goals and objectives, as well as in the structure of their knowledge information systems.</p>	<p>.How do you think your farming practices affect the environment here? Why?</p> <p>.How did you get information for these explanations?</p> <p>.What do you understand by nature conservation? Why?</p> <p>.How did you get information on nature conservation?</p>	<p>. Environment effect . Effect explanation . Conservation understanding . Environment information</p>

**Table 8.1: Grouping of hypotheses, main questions and assigned codes**

**Table 8.2: Identification of the cases**

Cluster/case	Text Code	Sex	Age (years)	Education	Marital status	Area (hectare)	Activity out side farm
<b>C. Grande</b>							
Cluster 1: case 6	C1	male	62	secondary	married	986	Yes
Cluster 2: case 24	C2	male	30	university	single	830	No
Cluster 3: case 19	C3	male	73	primary	married	1,594	No
<b>Pantanal</b>							
Cluster 1: case 88	P1	female	35	university	widow	5,200	No
Cluster 2: case 82	P2	male	44	university	married	15,000	No
Cluster 3: case 90	P3	male	63	secondary	married	7,600	No

### 8.2.1 Group 1 of Hypotheses - Knowledge and Information

The main focus here is to identify individually the farmer's knowledge information system in the context of farming. It is expected to identify how the systems are socially developed within the farmers' community and what sources of information are used in the process of farm decision making. In this way, it is important to identify the ways to access information, the trusted individuals, and trusted information sources and institutions as the components of information flows. As a final result, it is expected to have an idea of the network of the knowledge information systems and the associated level of participation of EMBRAPA.

#### 8.2.1.1 Initial learning

##### **Main question: How did you start learning about farming?**

The main findings are presented in Box 8.1.

##### **Box 8.1: Initial learning**

**C1:** *"The apprenticeship came from a long time ago because I grew up with farmers, my father worked with farmers... then I got old knowledge from them."*

**C2:** *"Well, I started to learn within the family because my family always has been linked to rural life. My grandparents from both sides lived by working in the field. For a long time my father had a farm and I started to like rural life. I used to go to my grandparent's and my father's farm ... I liked to go in the field to know the nature, the animals and the countryside. I used to observe the cowboys as my heroes"*

### *Continuation of Box 8.1: Initial learning*

*... I wanted to be a cowboy... In this way I grew up with the aim of working in the field.... The beginning was like that until I entered in the University.”*

**C3:** *“My father was illiterate but a practical man... and the children were almost all illiterates. However, my father gave good examples. He taught the children how to work. We all know how to do all field operations. My father used to deliver the farm management to the son when he reached sixteen years of age. Then my father and the oldest son stayed a side observing and teaching that young son in charge of the farm management. Thus I learnt... until I grew up and got married. I started on my own with 250 heads of cattle and an area of 7,730 hectares.”*

**P1:** *“I am a daughter of farmers, my mother is “pantaneira” she was born in the Pantanal, and she always worked there with my father... Then I grew up learning about life on the farm. During school holidays I used to go there and we worked together. However there was almost a certain distance... that thing of teenagers... we did not want to work in the farm: we wanted to stay in the city. I face today a little of this with my children. However, I am teaching my children to give importance to farm life and how to learn about farming.”*

**P2:** *“This came from cradle. My father was born in the Pantanal, he grew up here and their children as well. We all grew up in the middle of Pantanal... we went out to study later. Then this came from origin, my father, the father of my father... and we have followed this tradition... from there... we started to like the life and I like farming now.”*

**P3:** *“I grew up in this environment of farming. My father worked for a long time with a farmer helping him to sell farm products. I learnt quite a lot from older people: my father and my grand father. My apprenticeship has the tradition of the farm family.”*

Independent of region and cluster characteristics, all cases had their initial apprenticeship within farm family. However, initial learning in the cases **C1**, **C3**, and **P3** seemed to be more marked by old and family knowledge than in **C2**, **P1** and **P2**. The reason for this could be explained by education level and age, since the former are older farmers with a low level of education while the latter are younger, having a University degree. To some extent, these initial findings match with the characteristics of cluster 1 in Campo Grande and cluster 3 in Pantanal as determined in Chapter 7, where practical and applied information about farming appeared as important characteristics in both groups.

Despite the above comments, there were evidences of the transference of knowledge between generations, because without exception all cases reported on their family tradition of farming. In addition, the majority of the cases also reported that the initial learning of farming originated from parents and grandparents. This seemed much more evident within families where the education level is low. For example, in the case C3, a family of “illiterate people”, a strategy was used to transfer knowledge to the children early in their lives by delegating responsibility of the farm management. In this strategy, the father and the oldest son used to teach the younger. This seemed to be a wise way to prepare children to continue in rural life where formal education to pursue other life opportunities was not part of that farm family.

Perhaps, teaching children early in farming could also be seen as a way to preserve the land ownership within a successor process of the life cycle. This interpretation is in agreement with Errington (1985a, 1985b) who pointed out that a reason for delegating responsibility within the farm family is “coaching for success” of the family members. Another hypotheses could be: the incorporation of family labour into farming activities is in order to decrease operational costs or even to expand the farm family business. In this case, the strategy seemed to work well, since C3, still young, started his own business with a big farm.

#### 8.2.1.2 Knowledge evolution

##### **Main question: How did you start learning about farming?**

The main findings are presented in Box 8.2.

##### **Box 8.2: Knowledge evolution**

**C1:** “... with that knowledge that I had, I got talking again with others that understand... getting new knowledge from experienced farmers and improving the knowledge with assistance of a veterinarian... exchanging ideas and watching television. A motive to improve is because I like farming... I have tried to improve my knowledge... I have always had the desire to improve. I am not a lazy man but there is lack of capital... we are doing the minimum. After improving the pastures with new varieties such as *Brachiaria*, we felt the necessity to improve the rest with techniques. We must put everything to work in order not to fall behind.”

*Continuation of Box 8.2: Knowledge evolution*

**C2:** *"I studied Agronomy in the Federal University of Viçosa and I concluded the degree in 1985. I started to study again and more recently I got the degree of Medical Veterinary last June. I felt the necessity for studying and learning more. This was a way to go back to the academic environment."*

**C3:** *"...then I was expanding, I always worked hard with that practical knowledge that my father transferred to me. It was going on until I achieved the point where I am now."*

**P1:** *"...I went to University to study Veterinary Science, I got married to a veterinarian and started to deal with farming."*

**P2:** *"I got the degree of Veterinary Science, I worked a short time away from the farm; after that I came back home to help my father and I have continued up till now."*

**P3:** *"I used to travel very much to farms as a pilot...wherever I went I was observing, talking and learning."*

It is important to understand the mechanisms and the motivation to increase knowledge further. Despite the natural processes of knowledge evolution, fifty per cent of the cases benefited from academic learning. It is important to point out that all cases belonging to this fifty per cent are veterinarians, and one case is also agronomist. This is a very high proportion of cases having a University background in Agricultural and Animal Sciences. From the interpretative point of view of the author, this means a motivation generated within farm family, since these professional careers are directly linked to farming. However, the influence of family knowledge seemed to be stronger in the case **C3** than others. Therefore, a hypothesis arises that: knowledge evolution on farming can be interpreted also as a predetermined strategy in the farm family.

The desire to improve and modernise knowledge is well expressed in the statements of **C1**. Again, practical experiences of old farmers were considered within this process, but it was pointed out that the knowledge is improved by technical assistance. In this way, a very important point was noticed when he stated:

*"...after improving the pastures with news varieties such as Brachiaria, we felt the necessity to improve the rest with techniques".*

Although knowledge evolution is known as a dynamic process, this is strong evidence that such evolution in farm decision making is dependent on the level of technology being used. In general, the demand for information is higher among farmers using higher levels of technology. The author of this thesis, who has worked in the region for the last thirty years, has observed this experience. The above quote also expresses an important reference to technological changes in beef production in the region. This finding seems to be in agreement with the report of Frank (1995b), in which beef farmers in north of Australia change practices in an orderly, sequential process over time. In addition, the changes can follow a rational process of choosing desirable means to achieve personal satisfaction (Frank, 1995a)

Brachiaria grass was introduced in the region in late 1960's and 70's and the transformation of natural savannahs into cultivated pasture becomes possible, a thing which was limited before by the absence of a well adapted grass. Having cultivated pasture, the farmers increased the carrying capacity of the farms, promoting an accentuated increase in the herd size, as already shown in Chapter 2. In this way, it is accepted that the Brachiaria "event" has opened the door to introduce other techniques and also to induce farmers to look for more information within the beef industry, which leads to the local expression, "before" and "after" Brachiaria grass.

### 8.2.1.3 Sources of knowledge

**Main question: *What sources of knowledge and information about farming have you used and why?***

The main findings are presented in Box 8.3.

#### **Box 8.3: Sources of knowledge**

**C1:** *"I use to get knowledge from our own older friends who have a better knowledge. I talk with them and I ask for information... Then I began to improve my knowledge through veterinarians and watching television... I don't like to read. The older farmers have practical knowledge... which is deeper. Nowadays there are weekend farmers. They are doctors and executives... they don't know how to ride a horse, they don't know how to do anything. You know, I deal with transport of cattle*

... yesterday I had a long talk with **TP1** (trusted person) I consider him as an elder farmer... he knows much... I knew his father, his grand parent, I know his family. In fact, he knows everything and why to do this or that and I have learnt a lot.”

**C2:** “The major part of my information are articles in magazines mainly those produced by an association linked to rural activities, books, bulletins, journals of associations, contacts in congresses, seminars... some publications from EMBRAPA. This is the first time I am having a talk with a researcher of EMBRAPA. I don’t think that the researcher should transfer research results individually to farmers, but I believe if EMBRAPA had a narrow interaction with farmer’s associations we would have a better opportunity to work with field demonstrations, seminars, and informal meetings as we are talking now. I would like to get information like that. I went to EMBRAPA, but I had difficulty to meet the researchers. I was worried also that the researchers had their work to do and they couldn’t receive me.”

**C3:** “I used to talk with my brothers. We used to exchange information among some friends and ourselves. This is the information we have. When there is doubt about some business we used to exchange an idea with each other... We also got information from magazines, newspapers and the television helps very much. Globo Rural (TV program) is important and speaks about our struggle. The same practical knowledge that I have, my brothers have... and some person with experience... a trusted person. The **TP2** (trusted person) for example, has a lot of practice on farming and cattle trading, we have negotiated for a long time, and he is a trusted person...(he always has the preference to buy my steers)”

**P1:** “When I have some doubt... and I can’t solve it by myself... I ask people I know that, in my mind, have experience and practice. The people are my mother, my father, and some colleagues or some neighbouring farmer. We used to go to the cattle auction to exchange ideas. Then there is talking and exchanging of ideas. I have worked very hard and I don’t have time... to participate in meetings as much as I would like. I have been every month in the auction of Corichão with several farmers... field days I would like to go to but unfortunately I can’t. Then, the talking in the street with someone you meet it is excellent. We should save time to meet people, to participate in seminars and in meetings of the Rural Syndicate and field days... I don’t have time. From my point of view, the auction of Corichão, where the farmers are all together is the best. EMBRAPA could go there, at least, and say what it is doing. I am veterinarian and I don’t know what EMBRAPA is doing. We should have access and they should have to divulge what they are doing... not for everyone... but through some leadership... some key persons. Dr **TP3** (trusted person) is one of these persons who has been in the Pantanal for more than thirty years and everybody is seeing his success.”

**P2:** “... colleagues that obtained the degree together with me and teachers of the University. Any difficulty I have I ask them. I stayed much more linked to the farm and I am not up date. We learn with experience... my father’s family is from Pantanal and I am always exchanging ideas with my cousins... it is a traditional family.”



### *Continuation of Box 8.3: Sources of knowledge*

*Then we exchange idea about what they are doing, what is happening in their farm. When I am in the city I watch television and seminars at Rural Syndicate. If we go to the cattle auction we meet farmers... there we talk with each other and we are always trying to bring ourselves up to date about what is happening around... On the farm, we learn with the employees... they are people who were born there; they know, they have a life there... they know the day to day... this practical knowledge is very important.”*

**P3:** *“... the major information comes from friends... we have a friend group... the television has, nowadays, much information including that from EMBRAPA. However, in terms of cattle management the majority observing is the best way of working... then you observe the experiences of friends, those that you believe are more intelligent. I like reading... I read the newspaper and when I have an interest in some subject I look in magazines... I used to observe my father-in-law who had long experience... if you innovate too much you get “iron” (local expression meaning problems). I use to say to my children... they must observe everything when they are travelling or visiting a farm they must observe even the housekeeper... if you do not take notice of illiterate people, maybe you are losing the opportunity of learning something practical. Do you know **TP4** (trusted person)? For me he is one of the most intelligent guys I know and I used to talk with him almost every day in the bar.”*

A common characteristic is that farmers talk and exchange ideas with other persons in order to obtain information and knowledge. The sources of information were diverse but television has been used by all cases. However, independent of cluster and region, each case develops its own information network, and consulting a “trusted person” when a decision had to be made was always present. Ferreira (1997) emphasised the role of trusted people in the process of farm decision making, in agreement with the concepts from Gasson (1971) and Skerratt (1995) who considered the process of decision making, within a social context. Ferreira (1997) has expanded the discussion to the function of trusted people in the different “layers” or “stages” of the decision making process. This means that for each stage of a decision, different trusted people can be involved. In the present research, knowledge of the experience and success of others is an indispensable characteristic of consulting.

The case **C1** emphasised knowledge and practical experiences of older farmers and stated “*I don’t like to read*”. This case represents a group of farmers averse to selected and general technical information, but interested in applied, farm business

and general information. In the survey (questionnaire), C1 pointed out commercial shops, cattle auctions, agricultural fairs and farms in the region as important places for information of a specific and general type. When he was asked “why those places were considered important”, he answered the following:

commercial shops *“I use this opportunity to talk with the elderly... because there is a place where they are buying salt, medicines... then I ask them... why are you buying this?”;*

auction *“Because the auction is a meeting of beef cattle farmers only... and the talking is about cattle”;*

agricultural fairs *“... it is an interesting place to meet people that understand and know about cattle”;*

farms in the region *“the farms are important because you can observe... if it is more or less functional than yours... not to criticise but to get what is interesting...”*

On the other hand, EMBRAPA and field days that are concerned with selected technical information were not considered important by case C1. The explanation being:

*“No because EMBRAPA is not important. Maybe I have doubt to go because the time is short during office hours... and EMBRAPA is open only in that period... and I don't have time available during the day. Ninety per cent of the farmers have doubt to go there because they are not sure if they would be well attended because people there don't have time... during the week I don't have time and during the weekend I run to my farm”*

A similar answer was given to justify why seminars and courses are not important sources of information in this case. However, the farmer pointed out an important aspect when he stated:

*“I think that the courses should be interesting to employees... because they are difficult to accept new ideas. For example, if you buy a new product for cattle the employees are resistant to apply it. They need explanation but from someone who knows how to transfer information and knows how to motivate them to change their mind. I can attend ten courses, but I do not know how to explain to them what I learnt.”*

It is obvious that this farmer, being also an entrepreneur, develops his information system according to available time and preference. In this case, rural events cannot be attended because his business, outside the farm, depends on his presence. In this way, he tries to fill this gap talking with other farmers or even at night in the cattle auctions. He faces a similar constraint of time as the majority of farmers who have another economic activity. They go to the farm only during the weekend, depending

mainly on employees to run the farm. Then, the necessity of trained labour is accentuated.

This case comprises an example where the farmer has to delegate to the employees a high degree of responsibility, because the opportunity cost of farmer's time is high in the activity outside the farm (Errington, 1985a, 1985b). According to Errington (1984) training courses for employees is one way to incorporate new information and knowledge into the process of decision making, since every member of the farm workforce will take decisions in their every day work. In addition, the farmer would expect that the training courses could also be a means to motivate the farm workforce to accept new technologies. Errington (1985a, 1985b) has also outlined the beneficial effects of increasing the staff motivation in managerial activities.

The transcript interpretation from C2 suggests that in this case technical information is very important. He explores different sources of technical reading and also attends meetings. These findings match with the characteristics of cluster 2 of the Campo Grande region described in Chapter 7, where selected technical information also appeared as important for this farmer group. However in this individual case, rural magazines were the major source of such information. The reason for this was explained in the following statement:

*"At some way it is not a total preference... maybe because I frequently receive magazines from rural association".*

In the survey he also considered his rural syndicate as an important source of information and he explained this as follows:

*"I see the rural syndicate as a political institution of the class, and having the influence of a union it organises events to transfer technology".*

Although EMBRAPA was cited as a source of information, it is realised that C2 has not established a relationship with EMBRAPA. The reason can be explained in the statement:

*"I went to EMBRAPA, but I had difficulty to meet the researchers, I was also worried that the researchers had their work to do and they couldn't receive me".*

A similar observation was pointed out by **C1**. In addition **C2** recognised that the researchers of EMBRAPA should not attend farmers individually, but it was suggested that there should be interactions with farmer associations in order to create better opportunities to explore mechanisms, where large number of farmers can be involved in events for transferring of technology. Informal talking was also appreciated by this case as a mechanism to improve interaction between EMBRAPA and farmers. This can be interpreted as indicative to promote discussion and to exchange experiences in two ways between farmer and researcher.

Case **C3** represents a group of farmers (cluster 3 of Campo Grande) averse to the mechanisms of transferring technical, practical and general information included in the survey. The transcripts match this interpretation and indicate that the major source of information flow is limited to family and friends. Magazines and newspaper seem to be less important in his information system, while television was indicated as usual source of information. However, it was evident that a specific person (trusted person-TP2) is important in his system. **C3** has complete confidence in this person for practical and business knowledge.

Case **P1** is a widow lady who has had to assume administration of all farms belonging to her family. In the recent past, she was responsible only for office tasks, and her husband managed the fieldwork. It is realised that given the actual circumstances of her life, she does not have time available to explore other sources of information as she used to do in the past. These findings are evidencing that circumstantial events of human life affect personal information systems.

However, **P1** established her own circle of information, where close friends, relatives, colleagues and neighbours are the main components of the system. The cattle auction was emphasised as being frequently visited and an adequate place to exchange information. Furthermore, it was suggested that EMBRAPA should use these places to inform farmers about developing research. In this way, strong criticism was made of EMBRAPA. Leadership was indicated to be worked with, in order to divulge information. In fact, the named leader is well known in that

community and coincidentally he has a close and friendship relationship with EMBRAPA.

Although case P2 included professional colleagues and teachers as sources of information, it is within the family that the “discussion forum” of decisions is established. Eventually, information is obtained through television and meetings at the rural syndicate. The cattle auction was also indicated as a usual place to exchange information and to know what is happening around the business. Employees were also indicated as an important source of information in the context of practical knowledge and operational decisions.

Talking with groups of friends was emphasised by P3 as a mechanism to access information. This is also evidence that individually the farmer builds up his own circle of information in which “friends” are always involved. Television appeared as a mechanism recently introduced into his system. In addition, rural magazines are used for specific subjects. However, observing the experience of other farmers was considered almost a routine of his information system. Finally, even though sources of experience and practical knowledge are the main components, a respected veterinarian was included as an adviser.

#### 8.2.1.4 Trusted information

**Main question: Do you trust some sources more than others and *why*?**

The main findings are presented in Box 8.4.

#### **Box 8.4: Trusted information**

**C1:** *“... we get information from older people and from talking with veterinarian.”*

**C2:** *“Firstly, I trust in articles which have the researcher’s name... scientific papers... that brings something to be thought about and analysed.”*

**C3:** *“All sources are equal, what we see in the television, in the newspaper... I have the habit of reading the newspaper every day. Then if we see something there of*

### *Continuation of Box 8.4: Trusted information*

*interest, then I follow it up... I use to comment with others about what I read, in order to exchange ideas."*

**P1:** *"... I receive calls from sellers... I don't buy... firstly, I ask them to indicate who made the research... to send me all the data... then I will go to read, analyse and talk... I will go and exchange ideas... then I will think if I will buy or not... This is because I trust very much in the products with which I am currently working. For example, I have used the same mineral supplements for the last five years... I trust in the quality of the product. EMBRAPA has suggested that I shouldn't use some practices, and I haven't yet made up my mind."*

**P2:** *"I used to ask help of teachers and professional colleagues... In relation to selling of cattle I used to go in auction, the slaughter industry and talk with farmers... then I would ask about price... about the financial health of the slaughter industry. We always have to look for this information. In relation to business, I always exchange ideas with my brother-in-law... He has an open view. For day to day decisions I exchange ideas with my farm manager."*

**P3:** *"I don't know... in my mind the case of mineral supplements is almost the same as the slaughter industry... you trust them... it is the same for a pilot, dentist, and doctor you trust... In the case of sellers you can't trust in everything they are saying because they are earning money... then you must have a clear mind to see what is good for your business."*

In general, the transcripts indicated that the farmers had difficulty to specify trusted sources of information. Despite their own information circle, they use some sort of procedure to protect them against possible non-trusted information. However, in relation to new products, it was also evident that they are resistant to change even when a trusted supplier is met. In addition, the majority of cases nominated trusted people as sources of information.

#### **8.2.1.5 Good experiences**

**Main question:** *What have been the good experiences that you have introduced into your farming system and from where did you get them?*

The most important findings are presented in Box 8.5.

### Box 8.5: Good experiences

**C1:** *“For example, the subdivision of paddocks... orientation of the mating season and more recently creep feeding. Most of these involved exchanging ideas... creep feeding was introduced to me by a seller of mineral supplements who taught me.”*

**C2:** *“The first good practice I learnt... it was with my grandparents and my father “do not leave for tomorrow what you can do today”. In the technical field, I would say it was about pasture fertilisers and electric fences.”*

**C3:** *“This practice I learnt with a farmer (Mr TP2) who has a farm in Ribas do Rio Pardo (region)... at on one occasion he was at my farm and told me to recuperate the pastures... but he told me to recuperate properly... Then I did soil conservation to avoid erosion. The other practice was pasture rotation... I learnt this watching the Globo Rural (TV program)... also I went to visit a farm where I saw a farmer doing rotation in his farm and I talked very much with him... it was a great experience from that man.”*

**P1:** *“EMBRAPA monitored my farm... this opened the doors for us. I am also using feed supplements for males during the dry season on another farm outside Pantanal. I was trying to do this and I exchanged ideas not with a researcher but with technicians from EMPAER (State Extension Service), veterinarians and other farmers... I have prepared the ration by myself in a very simple way and at low cost.”*

**P2:** *“Good practices were to test male fertility... pregnancy test... and mineral supplementation, which have proved to be very important.”*

**P3:** *“The best experience was the introduction of cultivated pasture, after the grass *Brachiaria humidicola* was introduced in the region. Sowing grass seed by plane was also a good experience... I observed this in several farms... I was a pilot. Another good experience was subdivision of paddocks.”*

The sub-division of paddocks was indicated by three cases in the Campo Grande region as a good experience introduced into farm systems. Sub-division of paddocks is a practice of public domain. However, there is an overriding technological component in the statement, which is pasture rotation. The television program (Globo Rural) was identified by C3 as his first source of this information, but the experience of other farmers was also taken into account before the decision was made to use the information. The adoption of this practice has increased in recent years and the electric fence has been used to decrease costs of pasture sub-division. Pasture rotation is being adopted similarly to dairy farmers in Wisconsin, USA and interpreted by Hassanein and Kloppenburg (1995) as a wave of “social movement”.

This movement in Brazil was strong in the early 70's and declined in 80's. However, the movement has returned stronger from early 90's among farmers as an alternative to improve the beef farms carrying capacity. It is important to point out that such practice has been supported on the basis of assistance of agricultural professionals.

Creep feeding is the most recent technology made available to beef cattle farmers in the region. To some extent, it was a surprise that C1 was using it, since other priority practices had not been yet adopted, such as the pregnancy test and the bull fertility test. A seller was indicated as the source of information of creep feeding. In fact, there was a trusted relationship with the seller, which facilitated the introduction of this new technology. EMBRAPA has promoted creep feeding to increase the weight at weaning in systems of breeding cows, plus with rearing and fattening males. However, in this case, the technology is being used to obtain a better price for weaned calves.

Although pasture recovering (fertiliser) and rotation (electric fence) were indicated by C2 as successful technical experiences, the family's attitudinal experience of managing seemed to be the most important. In this case, managerial concern seems to be a primary condition to guarantee business success. The experience of another farmer was accepted to convince the introduction of pasture recovering in the case C3. When it was asked about "what in farming has forced you to look for information?" He stated:

*"It was pasture recovering... the pastures were established twenty five years ago ... then it started to be degraded, and the number of cattle was decreasing. Then I went to exchange ideas with an experienced farmer to start".*

The monitoring presence of EMBRAPA was cited by P1 as a very successful experience in the Pantanal. However, outside Pantanal, feed supply during the dry season was advised by other technicians and farmers' experience. Reproduction husbandry and mineral supplementation were recognised by P2 as successfully introduced practices. As mentioned before, veterinarian colleagues and teachers have been sources of information in this case.



The introduction of cultivated pasture was a successful practice pointed out by P3. The dissemination of this practice into Pantanal was made possible after *Brachiaria humidicola* was introduced in the region approximately twenty years ago. In this case, the practice was adopted by observing other farms.

### 8.2.1.6 Bad experiences

**Main question:** *What have been the bad experiences that you have introduced into your farming system and from where did you get them?*

The main findings are presented in Box 8.6.

#### Box 8.6: Bad experiences

**C1:** *“An experience that I didn’t find interesting was castrating the steers very early. Castration must be done with a knife, I am against “burdizzo” (tool to castrate), this for me was a bad experience.”*

**C2:** *“What can I say... the cost of being “stupid” or maybe we have to pay for our mistakes. Then we should take care... in the University I learnt to go slow... and I believe that farming should be like that. By making mistakes we can adjust to find our proper model.”*

**P1:** *“Interesting, I don’t know how to speak about this. I don’t make things without analysing, talking or exchanging ideas. I believe that all practices that I introduced on the farm have been very good because they can be used as experience to learn how to select what you are going to do; with the financial cost that we have today, we can’t afford to commit mistakes.”*

In general, the farmers did not identify bad experiences. In those cases C1, C2 and P1, where bad experience and mistakes were experienced, the farmers did not consider them relevant in affecting their production system. Otherwise, they are considered as valuable experiences. It is realised that the decision to introduce a new practice is made only after they are convinced about its positive results. In this way, the farmers try to minimise risks of committing mistakes.

## 8.2.2 Group 2 of hypotheses - Problems and Technology Development

The main focus of questions in this section is to identify farming problems, and to compare them with available technologies and research programmes of EMBRAPA. Another issue to be addressed is that if there are available technologies for the problems, *why* are farmers not using them? In this way, it is expected to find possible motives such as: lack of information, inadequacy of the technologies, lack of financial resources, personal constraints, etc. On the other hand, the questions attempt to identify, if it is the case, *why* the farmers are adjusting the technologies to their specific situations. Finally, it is also focused on identifying if the farmers are interested in participating in the EMBRAPA decision-making processes.

### 8.2.2.1 Problems

**Main question:** *What have been the main problems of beef cattle farming in the last five years from your point of view?*

The main findings are presented in Box 8.7 (technical problems) and Box 8.8 (socio-economic problems).

#### Box 8.7: Technical problems

**C1:** *"I didn't have many, but there were abortion problems."*

**C2:** *"...it was the "syndrome of the dropped cow"... Others doubts are: have I selected the right activity levels? Will the farm output be satisfactory? Is the application of my resources correct? What level of output should I look for? Can EMBRAPA and other institutions help me to answer these questions? What is the way that we can adapt to manage this process of increasing productivity? If I have soil that for a long time has a certain production capacity, why should I try to get higher capacity by spending money on fertilisers... what is the best?"*

**C3:** *"I don't have such problems. These things happen always when somebody decides to do things in a hurry without thinking and without consultation..."*

**P1:** *"... death of cows, the "syndrome of the dropped cows". The diagnostic was botulism... and there was also a rabies outbreak."*

**P2:** *"The "syndrome of the dropped cow". Some years ago nobody knew that... this is a new thing that appeared. The loss was big because we had to follow my father."*

### *Continuation of Box 8.7: Technical problems*

*To satisfy him, we didn't use mineral supplements properly. We have problems of calf mortality and rabies, there is large amount of bats."*

**P3:** *"The serious problem that I have not faced... is in terms of birth rate I harvested 1500 calves. However, it is a necessity to examine bull fertility, but I didn't do it yet."*

#### ***Technical problems***

The farmers seemed to have some difficulty in identifying or reporting technical problems, which are "bottlenecks", affecting the efficiency of beef production. They tended to emphasise socio-economic problems which are more related to some kind of threat for the farm business, such as prices and policies (see Box 8.8). It was realised from this experience that "technical problem" for the farmer has some different meaning from a technical point of view when analysing the overall system performance.

In general, the farmers perceive as technical problem only those "events", which are more related to death of the animals, or responsible by significant losses (large impact) in the herd, and consequently on farm output, excepting C2 that reported a broader problem picture. Technical problem, from biological point of view, is usually concerned on indicators of efficiency (e.g.: kg of carcass/ha/year; kg of weaned calves/cow/year; number of weaned calves/cow/year; kg of carcass/\$ spent; etc., Cezar and Euclides Filho, 1996), where the focus is on factors and their relationships affecting the efficiency of the system as a whole. Rhoades and Booth (1982) have pointed out similar "conflicts" and problem diagnosis should be based on constructive debate and consensus between biologist, sociologist and the farmer.

This conclusion is interesting because comparing data from an earlier section we can see that the success of several practices and technologies that were introduced into their farms was reported. Obviously, these decisions were made in order to solve technical problems such as pasture degradation, low stock-carrying capacity, low calving rate and low weight gain. In fact, this is an apparent contradiction when compared against to the above answers. This finding becomes very important in

order to understand the farmer's thinking and to bring contribution in the way to identify technical farming problems from farmer's discourse. This means that the analyst should be aware of this farmer's characteristic when asking farmers about their farming problems.

Although it is realised among farmers that production efficiency must be pursued, answering the questions outlined by case C2 is crucial for agricultural sector. The questions match with EMBRAPA's mission or even with any institution committed to agricultural development, not only in Brazil but also in any parts of the world. Answering all the questions is a complex and difficult task, but they support the worldwide view of agricultural sustainability.

However, the "the syndrome of dropped cow" was identified as a common problem in several cases. An alarming number of cows were noted in the media in 1988 as being killed by the disease. Under EMBRAPA leadership, a pool of institutions and specialists, at national and international level, were involved in the problem solution. Despite controversies, botulism (*Clostridium botulinicum*) was the dominant and consensus diagnostic (Rosa 1991). It is well known that the outbreak of this disease in cattle herds can be associated with nutritional imbalance. Nutritional deficiency induces animals to consume contaminated carcasses exposed in the field, and once the disease starts its control takes time. However, EMBRAPA disseminated ways to control the problem, and nowadays there are no new outbreaks. Other identified problems such as abortion, calf mortality and rabies were solved using the already available technology such as vaccines and husbandry practices, which will be presented in the next section as the solutions being used by farmers.

### **Box 8.8: Socio-economic problems**

**C1: Economic** - *"The problem rather is financial. Nobody has money to renovate the pastures. We have spent all our money only to keep the farm running. Sometimes we have to sell cows that shouldn't be sold because they are the factories to produce calves. In the past it was different. Why would I go to EMBRAPA to get information? I don't have money to invest."*

## *Continuation of Box: Socio-economic problems*

**C2: Socio-economic** - *“We don’t have the same conditions of American farmers. They have conditions to invest. They pay the interest rates and they know exactly how much they will earn. Here in Brazil it is extremely difficult, change in labour laws, tax, currency and interest rates, which don’t allow you to plan... we have little information if this stage is giving results. The State “charges“ us. The State says that the land has a social goal. In fact, we don’t know what is it. Should it be to exploit the soil without leaving reserve? ... This is a big confusion.”*

**C3: Economic** - *“The money disappeared, everything we need to produce is expensive and our product is cheap. I liked National Economic Planning, but in some respects it is badly carried out. Land needs to be fed...we need to treat it in order to produce... but few people can do this... everyone has become weak under the economic plan... the majority had high debts.”*

**P1: Socio-economic** - *“Nowadays in the Pantanal we no longer have those old employees who had consideration with the farmer. Actually, it is our fault because, for a long time we have not contracted employees with many children... then these children are running away from their environment and going to the city... We are worried with technological questions... but how can I use technology without good labour? I use to say to my farm manager... EMBRAPA will come... you and the cowboys are getting the data... you are more important than EMBRAPA... if you don’t work, EMBRAPA doesn’t have the data.”*

**P2: Social conflict** - *“Nowadays the movement of land invasion, and the government doesn’t do anything... this is a fever. This is a headache for everybody... we can’t sleep relaxed... we are sleeping and the farm is being invaded. The Pantanal is decadent... everybody is tied up, the cattle performance is very low. Surviving in the Pantanal is very difficult.”*

**Economic** - *“Our product is devalued with economic planning. Years ago I had to sell two trucks of cattle to maintain the farm running, nowadays I have to sell three to cover the same expenses... then there is a price distortion in relation to our product. Because of this, there are several abandoned farm and farms being sold... Who is making money?... those dealing with tourism. Never have we had a time so lacking in money*

### ***Socio-economic problems***

The majority of cases pointed out money scarcity as a common problem. The economic planning recently introduced by the government was indicated as the main factor of actual financial unbalance in farming. A brief discussion on this matter has already been presented in the Chapter 6. However, this reality must be understood in order to guide the solution of technical problems.

C1 pointed out that, at this point in time, against his own will, sometimes the cows have to be sold to keep the farm running as indicative of the unfavourable effects of recent policies. In addition, an important finding from C1 statements is related to EMBRAPA when he said: “*Why should I go to EMBRAPA to get information? I don’t have money to invest*”. This means, for this case, that the technologies developed by EMBRAPA are associated with farm investments (spend money). However, if this is an overall image of the EMBRAPA among farmers, the institution should work in order to clear this misunderstanding.

Case C2 blamed the unstable economy of the past, and recent policies, as the limitation for farm planning, placing Brazilian farmers at a disadvantage in relation to farmers of stable economies. This is an important point considering the actual trends and steady negotiation in the direction of globalisation of the economy. The “nightmare” of land invasion under the flag of people “without land”, pointed out by case P2, associated with target land productivity as instrument for tax payment and agrarian reform, are the new socio-economic components in the field. This is well expressed in the statement of case C2:

*“The State “charges“ us, this is a very serious problem because the State says that the land has a social goal. In fact, we don’t know what is it... Is it to exploit the soil without leaving reserve? ... This is a big confusion”.*

Without bringing to discussion the merit of government policies and the social movement of the “without land”, the Brazilian farmers are faced with new stressful components. The farmers complained that the policies have been made from the top down, without proper negotiation. Case P1 emphasised the social problem related with labour deficiency in Pantanal. The origin of the problem was well identified and to some extent, this social problem affects the technical performance of farming systems.

#### **8.2.2.2 Problem solution**

**Main question: *What you have done to solve the problems and from where did you get the information?***

The main findings are presented in Box 8.9.

## Box 8.9: Problem solutions

**C1: technical** - *"I did some brucellosis tests. I separated those cows and I sold them... I talked with four veterinarians... the problem started with heifers that I had bought."*

**C2: technical** - *"I have used the vaccine against botulism... but I am convinced that the control is due to improvement in the animal nutrition."*

**P1: technical** - *"I used the vaccine against botulism and against rabies... but the people from Animal Health Laboratory came and they found a positive diagnostic for rabies."*

**social** (education of children of the employee families) - *"I think that in the Pantanal there should be regional centres for children to stay and to learn how to read and to write... but learning also to deal with rope, vegetable-garden. I have done little or almost nothing. I don't have time for this even though I should spend time with those children today, in order that my children can have qualified labour to work with in the future. I think also that the employee should be like a partner... if the farm is running well, the employee should receive extra benefit as an incentive. Otherwise, no extra benefits are paid."*

**P2: technical** - *"I invited a colleague to go there to study the case of "dropped cow"... I used a new mineral supplement... and the problem finished... the paddocks were very large... then I had to use more points for mineral supplements..."*

**economic** - *"For economic problem it is difficult; we reduced the number of employees and other costs... and we stopped investments."*

Technical problems were solved using already available knowledge and technology. Although EMBRAPA was not mentioned as a source of information, the solution of the most important problem (botulism) had its origin in this institution as was reported in the previous section. In terms of economic problems, no direct solutions were found. There is evidence that farmers are reducing costs and stopping investments as an alternative to keep their business running. There is no doubt that under such a scenario, production efficiency must be pursued.

The question stemming from above scenario is how to increase efficiency while also spending little money, since there is scarcity of capital. This crucial question must be worked out by EMBRAPA in order to rethink, for example, technology for pasture recovering. The available technology, even though it is profitable, has been developed on the basis of investment in machinery and fertiliser inputs. In addition, the government has not provided any sign of financial support.

The solution for labour deficiency in Pantanal was proposed through community commitment. Although this solution is not directly linked to EMBRAPA's mission, the institution can collaborate with other institutions in this way. Perhaps, given the complexity of the social problem of land invasion, no solution was indicated for it. Although the government has a clear position against land invasion, it has not been able to avoid the disastrous conflicts, which have been registered between farmers and invaders. The socio-economic effects of such pressures have not been predicted yet. No doubt remains that this matter by itself is very important for social research. Even though the required answers are not available, understanding the actual social context of farmers' environment is also a focus of this thesis.

### 8.2.2.3 EMBRAPA technology

**Main question:** If it is relevant, *how* and *why* are EMBRAPA technologies being adjusted by you?

The main findings are presented in Box 8.10

#### Box 8.10: Embrapa technology

**C2:** *“EMBRAPA developed a technology for the strategic control of worms, which should be applied in the cattle herd in May, June and September. I think that it is a good technology, but in September the cows are in an advanced stage of pregnancy. In addition, September is the peak of the dry season, a period of low quality of pasture. Therefore, in this period of the year we don't like to bring the cows in the corrals to avoid possible abortion and cattle stress... So I have applied only in May and June but I don't know if the effects were the same... for me the cattle are well and the performance was maintained.”*

**C3:** *“No, I have had little contact with EMBRAPA. We are here with our old practice... We have grown up within this environment. A man in my age that only works in farming... we were born in this, my father my brothers.”*

**P1:** *“My husband developed research together with EMBRAPA... it was related to calf health and I use some of the results. I use knowledge from several sources... and I don't know if it comes from EMBRAPA.”*

**P3:** *“...for a long time... and from outside I have observed your work... It was a good thing that the government set up EMBRAPA... we don't have conditions to do experiments that you do, which in my concept is well done. There are many things that we use but we don't know that they come from EMBRAPA. One thing, with which I disagreed, was the orientation to stop mineral supplements during the dry season... because in Pantanal even then the soil is humid.”*



In general, the farmers did not know how to relate their practices with technologies developed by EMBRAPA. However, without exception, there was evidence that they were using some kind of EMBRAPA technology even though they were not always aware of this. The most common is mineral supplementation. This was a research area for which EMBRAPA developed a large amount of information (Souza *et al.*, 1981; Souza *et al.*, 1982; Souza *et al.*, 1985; Brum and Souza, 1985; Pott *et al.*, 1988; Brum *et al.*, 1987; Rosa *et al.*, 1993a; Rosa *et al.*, 1993b). As a consequence, a substantial change in the formulation of mineral supply has been observed. Other technologies promoted by EMBRAPA, such as pasture recovering, control of botulism, introduction of new grass materials, creep feeding and feed supply for males during dry season also, were used by the case studies.

A close relationship between farmers and EMBRAPA was not evident, except in the case of **P1**, where a monitoring project is being carried out. However, EMBRAPA as an agricultural research institution is well known and respected among farmers (see **P3**). However, the expression, “*we don’t have conditions to do experiments that you do*” highlights the difference between how scientific and farmer knowledge is developed. Bennett (1986) has interpreted this difference as being due to the fact that “the farmer conceives the relevant experimental factors in “folk” ways, and he is limited to vary and control few factors due to risk of negative outcomes, while the researcher is free to “play” with the factors because he has no economic or physical constraint threatening his survival”.

Despite the above comments, two cases pointed out some kind of technology adjustment. **C2** identified that one scheme, recommended by EMBRAPA to control endo-parasites (Bianchin *et al.*, 1995), matches with an unfavourable farming period. According to the farmer, the decision to suppress one month from that scheme did not affect herd performance. **P3** disagrees with the EMBRAPA recommendation of stopping mineral supplementation during the dry season, because pasture condition in Pantanal is different. This observation is right, but it is a typical case where the research information was distorted. The original information from EMBRAPA is to stop mineral supplementation during the dry season only in situations where animals

at rearing and fattening are losing weight (Rosa *et al.*, 1993a; Rosa *et al.*, 1993b). Growing animals do not respond to mineral supplements under conditions of protein and energy deficiency (EMBRAPA, 1995).

#### 8.2.2.4 EMBRAPA decisions

**Main question:** Are you interested in participating in EMBRAPA decisions, *why?*

The main findings are presented in Box 8.11.

#### Box 8.11: EMBRAPA decisions

**C1:** *“This I think would be good since we have access to talk, to show ideas about we are doing good or bad and to say why we are doing. I have my experiences.”*

**C2:** *“I believe that, if this was allowed, and if we could get this, it would be interesting. Maybe we could distil our problems and a person could go to discuss with the researchers... maybe this could point out something that the producer has day to day and can show something to researchers that is not in his experience... and he can start some research. I think this is very good.”*

**C3:** *“I know now that I can always go to EMBRAPA to discuss when I have a problem.”*

**P1:** *“I think that it would be very important. I don’t know if it should be a technical committee or a representative commission of producers... I would like, but at present I don’t have time.”*

**P2:** *“I think that it is interesting that leaders should participate to solve the problems.”*

**P3:** *“I am at very slow phase of my life and I am a little shy... and the personnel of EMBRAPA are well informed and with a certain level of culture... and I would be afraid of saying stupid things”*

Participation in EMBRAPA decisions was welcome among farmers as a way to identify and to solve farming problems. Although the majority of the farmers did not demonstrate an interest to participate by themselves, it was evident that farmer leadership should represent the participation. Of course, the farmers would expect that the leadership could discuss with EMBRAPA common problems and experiences. C2 expressed in a very proper manner the importance of participatory

approach to solve farming problems. The statement of P3 is evidence that the level of culture can create a communication barrier between farmers and researchers. Although the above quotes confirm the necessity of a participatory approach, the crucial question is how to implement this approach at institutional level, and to keep the farmer involved in a program for technology development.

### 8.2.3 Group 3 of hypotheses - Environment Concerns

Considering that the two eco-systems under study are different, the main focus of the questions here is to identify farmers' attitudes in relation to nature conservation, through their local farming practices and conservation understanding. In addition, it is also intended to identify how the farmers obtain information about nature conservation in the two ecosystems.

#### 8.2.3.1 Effects of farming practices

**Main question:** *How do you think your farming practices affect the environment here? Why?*

The main findings are presented in Box 8.12.

#### Box 8.12: Environment effect

**C1:** *"I believe that everything I have done is more or less according to what needs to be done. The farm was almost all deforested before I got it, but there was the legal reserve... forest at the edge of streams and vegetation around watering places... always I am keeping this vegetation to avoid erosion."*

**C2:** *"We have two good examples. One damage practice was exaggerated deforestation near streams and water sources... this caused erosion and prejudices the natural environment of fauna and flora. I think that this was wrong... and happened at a time when I was not in charge of the farm administration... I found this situation, but in fact, I remember that, at that time the farmers were not environmentally conscious and information was not available. The motive was the desire to increase the area of cultivated pastures, and at the beginning, it was exaggerated. On the other hand, a good practice was terracing to control soil erosion, which was implemented recently in all areas of this farm. This practice brought great benefits."*

**C3:** *“Soil conservation and lime... are good things that we need to do... because our soil is degraded. Here in the Mato Grosso do Sul, on almost all farms the land is tired... because Brachiaria grass supports... and farmers have too many cattle... everything finishes in this world.”*

**P1:** *“... environment conservation is part of “pantaneira” life... we don’t use any practice which affects the environment... only one practice caused damage so far ... overgrazing during a determined period. Overgrazing caused weeds... then we had to take out the cattle in order to let the native grasses come out again. Nowadays, I am using an adequate stocking rate on native pasture to ensure the farm is viable. What I want is cow calving on native pastures... I have observed that deforestation is happening too much, and there are no studies about this. I don’t know if EMBRAPA has invested in this. In São Gabriel (region), the farmers deforested all land and now they are reforesting to solve the problems. In fact, the farmers deforested in the past not because they didn’t think; they didn’t know the dimension of future effects... the technicians are full of knowledge but they don’t transfer this. My idea is to introduce cultivated pasture in the clean field.”*

**P2:** *“I think in relation to burning... for one hundred years my family lived here burning the fields... but I am against fire every year... I think that the field could be burnt every two years. The other thing is fire on very dry soil. The fire can damage the plants. Overgrazing was another mistake... in the past my father used to sell fat cows... but nowadays the stocking rate increased too much...then came weeds.”*

**P3** *“... last year I had to pay a penalty because fire came from neighbours... it was an accident. Once, I started accidentally a fire with a cigarette... I use to order my employees not to use fire when the soil is very dry... however, the government is unjust... in the Pantanal there are some kinds of grasses that if they are not burnt, the cattle die of starvation... then they must go here to see. Burning must be used with caution... We must be there to provide orientation to protect the fences... to avoid jumping to another paddocks and neighbours, but in the past the people used to put fire everywhere... and this is not right... each farmer has his correct time to burn. Always I wait for rainfall before burning... if the fire has a favourable wind direction it is quick and the damage is small.”*

Case C2 accepted clearly that deforestation practices are responsible for environmental damage. Lack of information associated with an “exaggerated” desire to increase the area of improved pasture were pointed out as likely motives leading farmers to commit environmental mistakes in the past. In fact, the majority of environmental damage was created because the Brazilian laws were not respected at all. For example, twenty per cent of the total area must be kept as reserve as well as landscape with sharp inclination and protection areas at the edges of water resources.

Therefore, ignorance about the laws can be questioned as a motive of past mistakes. Lack of technical information on risk, effects and control of erosion can be accepted, although such practices have been known for a long time in the region. However, cost was also a strong motive that did not encourage farmers to implement erosion control in the past. The author of this thesis, as an extension officer, also observed this in late 1960's and 70's.

Although the two other cases in Campo Grande region have not pointed out the same mistake of deforestation, case C3 recognised that the soils are in a process of degradation due to overgrazing. This process of pasture degradation is known in the region as being caused by overgrazing, followed by erosion and nutrient depletion (Barcellos, 1996; Kichel *et al.*, 1997; Macedo, 1997). The primary consequence in terms of beef farming is a drastic reduction of carrying capacity that is followed by decreasing animal performance. On the other hand, pasture recovering and terracing to control soil erosion were identified as beneficial practices for environment conservation.

Moreover, understanding the nature of the factors and its interactions affecting adoption of sustainable agricultural practices appears as a key researchable field, in order to facilitate technological innovation and policies. Salteiel *et al.* (1991) reported that perceived profitability presented the highest correlation with adoption of low input and intensive management sustainable practices in the state of Montana, USA, but the nature of farm activity and farm structure differentiated the adoption of one or another.

In Pantanal, where rangelands are dominant, overgrazing and fire were recognised as management practices that have negatively affected the environment there. Similar to the Campo Grande region, the farmers have realised these negative effects only because the carrying capacity of the land has decreased as a consequence. Experience and observation have provided local knowledge to change the management of rangelands in order to reduce the effects of past mistakes. Reduction of fire frequency, burning on windy days and limiting the practice to humid soils comprises

local knowledge on how to reduce fire damage on native pasture. However, they do not take into account other damage on biodiversity such as birds, small animals, native plants and micro-organisms.

Deforestation in Pantanal has not been a usual practice for pasture establishment, and the natural vegetation still remains almost untouched. The introduction of cultivated pasture into Pantanal, under deforestation practice, was questioned since ecological impacts were not evaluated properly. In fact, the region has suffered negative effects from deforestation and erosion at uplands located outside Pantanal. The effects occur because erosion sediments are discharged into rivers of the upper Paraguay river basin running into Pantanal. This has been the most disastrous macro-environmental damage. As consequence, areas of the river basin, which were dry in the past, have changed to flooding areas. Great mobilisations of local farmers and society opinion have forced the government to take decisions in relation to this issue.

In this way, the Upper Paraguay River Basin Conservation Plan - Pantanal (PCBAP) was created under the co-ordination of the Ministry of Environment, Water Resources and Legal Amazon (Brazil, 1997). The studies of the PCBAP encompassed physical, biotic, socio-economic and legal-institutional aspects. EMBRAPA, through Pantanal and Cerrado Agricultural Research Centres and National Soils Research Centre, was involved directly in the plan linked to other institutions such as Universities, Research Institutes, NGOs and GOs. A large amount of information has been compiled and organised as subsidies to orient decision and actions of government and society as whole. Therefore, despite national and international pressures on conservation of Pantanal, the PCBAP constitutes a serious and responsible referential to manage this resource on a scientific basis.

### **8.2.3.2 Effect explanation**

**Main question: *How did you get information for these explanations?***

The main findings are presented in Box 8.13.

### Box 8.13: Effect explanation

**C1:** *“By always talking with people that had already carried out deforestation and pasture establishment.”*

**C2:** *“Observing, talking and reading.”*

**C3:** *“With friends.”*

**P1:** *“Observing and talking.”*

**P2:** *“It was observing the pastures.”*

**P3:** *“I learnt with my father and grandparents.”*

Observation, experience and informal communication were the sources of information to explain the effects of farming practices on the environment. While the short answers seem to make sense to the question, a hypothesis can arise that the farmers use short answers in order to avoid the subject, or this attitude could be interpreted as being due to a lack of more information to explain the effects of their practices. However, the farmers do not organise the thinking to explain their actions and results in the same way as the researchers do. The researcher try to explain and understand his results based on detailed study of relationships and interaction between the biotic factors (sub-system components) while, in general, the farmer is not interested to search for explanation at this level. Perhaps, he accepts the results as a natural “phenomena” from farming practices, thus building his local knowledge.

The meaning of the short answers should therefore be interpreted as important in the way to understand *“why farmers do what they do, and how they justify it”* (Bennett, 1986). From an ethnographic point of view, the information to explain the effects of farming practices on environment are interpreted as coming from “cultural knowledge” (Scoones and Thompson, 1994b), accumulated from observing and communicating “local experiences” within the community.

#### 8.2.3.3 Conservation understanding

**Main question:** *What do you understand by nature conservation? Why?*

The main findings are presented in Box 8.14.

#### Box 8.14: Conservation understanding

**C1:** *“Environment conservation as I understand it is respecting the legal reserve ...establishing pasture without creating damage to the environment.”*

**C2:** *“I think that is to find an adequate way of producing for a long time, where other animal species have the conditions to survive... not only cattle, but also those animals and plants that lived in the environment before.”*

**C3:** *“This is one thing that I don’t know much about... but environment conservation is very important... the reserves on the farms... soil conservation... people must respect water and native areas because these are parts of our own business.”*

**P1:** *“It is keeping the environment at equilibrium. We have to have the snake, capybara, alligator, jaguar, piranha... but if a jaguar starts to eat the calves, that jaguar has to be killed because something is wrong in the system. If the wild pig is becoming scarce... let’s stop hunting. The legislation says it is prohibited to kill. The “pantaneiro” doesn’t have desire for killing... there is capybara, armadillo. If the armadillos are increasing too much creating conditions in the field which promote accidents to cowboys let’s go to kill. This is what I call equilibrium... but environment decisions are made by people at the top that have never been travelling through Pantanal as we do... they don’t know these things. They make the laws... if you kill an armadillo they put you in jail... but they are not there to look after armadillo and wild pig. If there is Pantanal, it is because my mother, my father and my grandparents looked after it. The Pantanal exists still because the “pantaneiro” is there. Then it is a whole, it is an interaction between man, environment, animal and economic activity... it is not only the ecological connotation of foreigners which came from abroad to look at our things.”*

**P2:** *“Everything... deforestation, soil conservation and fire... if each farm preserves the legal reserve, deforestation would not affect so much. I am against overgrazing which caused a big damage... we should increase productivity without damaging the environment. These laws prohibiting deforestation, fire... will led to a situation which will limit our activities too much... then we will go to the government to provide food for us! Whether the Pantanal depend on the “pantaneiro”, the fauna will not finish, but if in the future we have to be substituted by outsiders, I believe that the damage will be great. If we don’t preserve our patrimony who will do it? I am conscious about that I am doing. Another thing that farmers don’t take into account is the number lost caused by the jaguar. In my farm they used to eat one calf per week. It is hard work to put calf at the cow’s foot and at the end seeing the calves being eaten. This animal is becoming a pest in Pantanal. Wild pig is another problem... the humid land, where they eat, looks like ploughed land... they are also becoming a pest because we are prohibited to kill them...”*

**P3:** *“To be honest I am afraid to give my opinion, because after introducing cultivated pastures wild life has increased. For example, it was difficult to see tapir and nowadays we can find them easily. Wild animals increased in numbers.”*



*Continuation of Box 8.14: Conservation understanding*

*In my understanding everything increased because feed supply was increased. The worst thing that I think is the rubbish from tourism which is left here such as cans and plastics... for me this damage is greater than fire."*

Whether satisfaction of living in contact with nature is a characteristic of the farming family, it was expected that these people have developed some sense of nature conservation. Independent of cluster and region, basic concepts of nature conservation such as preservation of forests, water and fauna are implicit in the above statements. However, the data show that farmers' understanding of nature conservation is not disassociated from farming. This also seems to be crucial in the farmers' understanding in developed countries and intensive farming (Bruin and Roex, 1994). This means that from their point of view, nature can be conserved, but also as it interacts with farming activities. The following statement from C2 highlights this interpretation:

*"I think that it is to find an adequate way of producing for a long time, where other animal species have the conditions to survive... not only cattle, but also those animals and plants that lived in the environment before."*

No doubt remains that farmer understanding of nature conservation in Pantanal is strongly marked by a close relationship with wildlife, where the preservation feeling has passed through generations of "pantaneiros". This community has lived in this environment more than 200 years (Ribeiro, 1984; Rodrigues, 1985; Barros, 1998) and the fauna is still preserved as testimony of conservation attitudes. Barros (1998), a respected "pantaneiro" from a traditional family, wrote:

*"At the present time, we see with our heads up that the Pantanal has been shown by international institutions as WWF (World Wildlife Foundation) as an example of economical activity combined with environment preservation"*

Predatory hunting is basically motivated by hunger, but this is not the case in the Pantanal. According to Ribeiro (1984) and Barros (1998), providing beef meat, three times per day, is local tradition. Therefore, the man of Pantanal hunts only sporadically and without the survival necessity. This explains why wildlife seems to be preserved, in combination with beef cattle activity. Local pride of being

“pantaneiro” is interpreted as a common characteristic of P1 and P2. In addition, they believe that Pantanal, as a natural resource, is only threatened if “outsiders” are allowed to go into it. This means that the Pantanal would be at risk if, for some reason, the “pantaneiro” has to be substituted by others who are not familiar with this natural environment.

However, if a wild animal is becoming a predator of a cattle herd or showing evidence that the species is increasing, the farmers believe that control should be carried out. In this way, there is a clear dissatisfaction among farmers in disagreement with Brazilian laws. The merit of these farmers’ opinion can be questioned under a restrictive environmental point of view, but as part of the society and directly involved with the nature, they would like to bring their knowledge and experiences to create laws on environment conservation.

The farmers in the Pantanal did not know that Brazilian Laws on Environment Conservation were being reviewed by National Congress, and on 13 February 1998 Law 9605 of Environment Control was published. The Law remains severe, transforming environment damage into crime, but according to Article 37 it is acceptable to kill wild predators of the herd, when legally authorised by a competent authority. The article contemplates those farmers affected by predators. The implementation of the law has been the agenda of discussions involving government and society (Garcia, 1998) but without communicating this amply, farmers can be severely punished by involuntary damaging practices.

#### **8.2.3.4 Environment information**

##### **Main question: *How did you get information on nature conservation?***

The Box 8.15 presents the main findings.

##### **Box 8.15: Environment information**

**C1:** *“Always talking with friends.”*

**C2:** *“I have not be able to find so much. What I have, I have obtained through contacts with other farmers, discussing and listening to what is going on, and more*

*recently, the inquiry from IBAMA in relation to environment conservation and the declaration of the legal reserve. The influence of television, newspapers and magazines in our mind is very strong. I think that we are being influenced too much by developed countries of the first world... They say that we should do this or that... they destroyed almost all, and now they are suggesting things, some are interesting and we should consider them but we should have freedom to decide exactly how to use and to solve our critical and social problems. We must protect and dominate our resources... and not allowing the biodiversity that we have in the Amazon to be destroyed or even explored by developed countries... If they explore, maybe we have to pay a high price in the future for the products which can be developed from such biodiversity."*

**C3:** *"Only through television."*

**P1:** *"It is television, newspaper, and talking day to day... information is arriving, and as I am working in the farm, I used to create my own concepts... I don't know what is right and what is wrong... but it is some experience of living because I am very close to seeing and observing the environment which is happening in the Pantanal."*

**P2:** *"Reading sometimes, television, listening... but it is not something that I receive regularly."*

**P3:** *"I follow through television... Television provides much information... I am an old man and I have time to watch... I read a little... and I have found coherence in many things because man is the big destroyer... the Pantanal is a place where we should have caution to touch it."*

Informal mechanisms are the dominant characteristic of the farmers' information system on nature conservation also, where talking and listening associated with television are the usual communication channels. However, the behavioural modes of learning by doing, and empirical observation of nature to obtain information and understanding (see Bennett, 1986), is well expressed in the statement of **P1**:

*"... as I am working in the farm I used to create my own concepts... but it is some experience of living because I am very close to seeing and observing the environment which is happening in the Pantanal."*

This finding can be considered as an example of the main concern of ethnoscience discussed by Bennett (1986), that independent of economic development, farmers develop their "local" knowledge by accumulating information and understanding

from their social routines. This is also in agreement with the definition of Roling (1988) about agricultural knowledge system, outlined in Chapter 4.

Although information on nature conservation arrives to rural people, it is realised that the information is not systematically directed to them. The majority of television programs have been directed to call to the attention of society as a whole about environment issues, and to provide environmental education for children. Farming information on how to deal with existing environmental problems of farming would be more useful for farmers.

More recently, IBAMA (Brazilian Institute of Environment and Renewable Natural Resources) has asked farmers to make an official declaration of permanent and legal reserves for environmental decisions. Permanent reserves are lakes, protection areas on steeply sloping landscapes, edges of water resources, rivers, streams and lakes. Legal reserve corresponds to twenty per cent of the total farm area, which must be kept untouched. This requirement has also become a source of information as pointed out in C2.

C2 blamed the media for bringing an excess of external influences from developed countries on environment issues. The opinion was that home solutions should be pursued which take into account internal problems without considering external interest. Although environment conservation has been considered as a global problem, the opinion of C2 is a very important issue for developing countries, which still have plenty of natural resources such as in Brazil, and are also faced with complex social problems.

The in-depth interviews provided a rich insight on the hypothesis issues. However a common characteristic in the majority of the above cases is that they each have a trusted person from whom information and consultation are obtained. Considering the objectives of this research, it was decided to interview those nominated people in order to aggregate a complementary understanding, and to trace back the social characteristics of the information networks.

### 8.3 Complementary search into the information networks: “trusted” people

Tracing back the information network in this research can be considered as an analogy to the model “social construction of technology” reported by Almas and Nygard (1994), where the starting point is to analyse technical change as a social process. According to the authors, the approach of this model is to identify the relevant social groups and follow them backward toward the starting point of a new technology. In so doing, the social constructionism may indicate how networks are created to promote specific technologies, and also how these networks work (Almas and Nygard, 1994). This approach is in agreement with “grounded theory” (Strauss, 1987; Strauss and Corbin, 1990; Patton, 1983). Table 8.3 presents the identification of the “trusted” people and their links with the farmer case studies.

**Table 8.3: Identification of the “trusted” people**

Trusted persons/description				Case who mentioned this trusted person	Code for trusted person	Text code: trusted person
Age years	Education level	Experience	Relationship with the case			
60	. High - Technical (Animal Sciences)	. farm family . farmer . farmer association . relationship with EMBRAPA	. long time family relationship . friendship	C1	COC1CG6	TP1
45	. Low - (Primary School)	. farm family . farmer . cattle trading . entrepreneurs relationship	. cattle trading . friendship	C3	COC3CG19	TP2
70	. High - University (Law)	. farm family . farmer . farmer association . leadership . close relation with EMBRAPA	. cultural values . community tradition . similar technical goals . friendship	P1	COC1PA88	TP3
60	. High - University (Animal Sciences)	. farm family . technical . research . teaching . farmer . close relation with EMBRAPA	. friendship	P3	COC3PA90	TP4

The four nominated trusted were interviewed according to the same procedures applied to the farmer case studies. However, since the interview is complementary, only the first five questions related to knowledge and information (sections 8.2.1.1 to 8.2.1.5) were asked. The aim of this section, therefore, is to bring the interpretation of the main findings concerning the information networks. The complete transcripts from these interviews are presented in Appendix 8.1.

Without exception, the trusted people are also farmers who had *initial learning* about farming within the family. Although these people have followed different ways to build up their *knowledge* and have explored differently the sources of information, they still have a lot in common as shown in the following descriptions.

### 8.3.1 Trusted person TP1

**TP1** is a sixty-year-old beef cattle farmer, and is a descendant of a traditional farm family, having had his initial learning from formal education in Animal Sciences, and gained practical knowledge from older farmers. Although attending formal education, his learning process was developed mostly on basis of personal communication:

*“I used to meet the distinguished teachers and technicians from whom I learnt much more by informal talking than in the class room... I had difficulties to learn by the books,... I preferred personal communication, which facilitates to sharing of experiences and to learn a lot from other farmers... my sources of information are much more by means of personal communication.”*

He started farming thirty years ago as an innovative farmer by experimenting with new farm practices in the region, such as artificial insemination and mineral supplements. At the beginning, the personal experiences were considered very important in the learning process, when he said:

*“I learnt with older farmers, but I think that I learnt as much by doing it myself.”*

His close participation in the farmer association (ACRISUL) had a key role in his information network where he initiated a relationship with the researchers from EMBRAPA.

*“It was in ACRISUL that I obtained much information from the researchers of EMBRAPA. We used to have meetings with the researchers twice a month. I learnt very much with the researchers. During three or four years that I stayed as president director of ACRISUL, I had also the opportunity to visit many places and farms in different regions, from where I learnt other experiences.”*

The technical meetings were very important in order to make stronger the relationship between EMBRAPA and the farmers' association. This mechanism was decisive for EMBRAPA to establish a trusted participation in the farm community. Despite the quality of technical presentation, it is always at the meeting intervals, by informal talking, that rapport is established between researchers and farmers.

From those first contacts, farmers have been motivated to visit EMBRAPA, to develop on farm experiments, and to some extent, to create opportunities for exchanging knowledge and information on the basis of a personal relationship. However, TP1, as an experienced farmer, has realised that most of the farmers prefer to obtain information from other farmers instead of going directly to EMBRAPA by themselves, when he said:

*“We are lucky to have EMBRAPA here in the State. Many farmers, like Dr X, are successfully using the technologies from EMBRAPA. However, few farmers go directly to EMBRAPA because they prefer to speak with other farmers. A farmer told me that some farmers asked him to go to EMBRAPA to obtain information instead of going there by themselves.”*

TP1 said that mineral supplement, reducing the age of weaning, and pasture rotation had been introduced in his farm as good experiences. However, past experiences of overgrazing were shown to be the wrong way for pasture management and environment conservation.

### **8.3.2 Trusted person TP2**

TP2 is a forty-five-year-old farmer who did not have a high level of formal education. However, nowadays he is well known in the local community of beef cattle farmers as being a very active and progressive farmer. The initial learning was strongly rooted in the traditional knowledge from the family. However, pasture

degradation and socio-economic changes have pushed him towards learning new farming practices. In this way, new components were added into his information network, such as agronomists and advanced entrepreneurs on how to face new challenges. This is well expressed in the statement:

*“Things have changed a lot... new people have entered into beef farming. These people are coming with new technologies... The pastures were degraded before they came. We did not know what to do, because we did not have the new knowledge to solve this problem. We had to learn with agronomists and new people mainly entrepreneurs (big farmers from industrial sector).”*

It is important to point out that pasture degradation appears as a driven “event” to look for new knowledge and to move away from the traditional system. This is evidence that the dynamics of the farming environment lead new partners into the information network, as a consequence. EMBRAPA was also mentioned as a new component of his information network. TP2 stated that the new practices, such as cross breeding, pasture rotation, and pasture recovering were acquired from agronomist and farmers, who learnt from EMBRAPA. The institution is again recognised as a trusted agency involved in the right direction of change. However, in this case, informal mechanisms to obtain information still prevails, as expressed in the following quote:

*“I do not like to read, I like to listen, to talk, to exchange ideas and to visit farms. I travel frequently because I am also a steer buyer. Travelling, I have seen advanced techniques... I like very much to watch the rural programs shown on TV.”*

### **8.3.3 Trusted person TP3**

This trusted person is a successful old farmer who has been recognised as a legitimate rural leader in the community. His high level of formal education, culture, good common sense and his constructive actions at farm and philanthropic associations have also made him a respected citizen in the region. His initial learning also started within the farm family. Observing and talking with neighbouring farmers were usual means to obtain information, more than through a technical consultant:

*“My uncle also used to observe what the neighbouring farmers were doing... I learnt very much. Traditionally, the farmer trusts more in his neighbour’s experience than in the information from a technician. In the past, this was more accentuated than now. The information runs fast from farmer to farmer in order to be adopted.”*



However, since he was pursuing his goal of becoming “the best farmer”, this encouraged him to look for information. At the beginning, technical books and rural magazines were reported as the main sources of information:

*“I did change my life completely to dedicate myself to farming. I gave up a professional career as an University teacher in Rio de Janeiro. However, when I took that decision I also made a promise with myself to be the best farmer. From that point in time, I started to read books and rural magazines. I read about animal nutrition and pastures.”*

It is important to point out that **TP3** is evidence that individual goal and objectives strongly affect the information network for decision making. In the process of *knowledge evolution*, other components were added to his information system, such as EMBRAPA, the farmer association (ACRISUL) and the rural syndicate. EMBRAPA was strongly emphasised as a trusted source of information, and a close relationship was established since EMBRAPA has initiated research activities in the region, as stated:

*“I have followed the development of EMBRAPA’s research from the beginning... EMBRAPA is a very important source of information. I used to attend every field day promoted by EMBRAPA and I read all the publications as well. For the majority of farm problems that I have, I go personally to EMBRAPA to ask for a solution.”*

Again, visiting other farms is also considered an effective means to obtain information, mainly at the present time, where many farmers have tried different alternatives. Although his intellectual background has supported reading as an important means to obtain information, **TP3** realises from his experience that, in general, farmers do not have the habit of reading. They prefer to see the experiences in the field.

The introduction of cultivated pasture, mineral supplements, feed supply for young cattle and cross breeding were reported as successful adopted practices. In this way, farmers, technical articles, technicians and research centres were used as sources of information. As an experimenting beef farmer, **P3** suggested that EMBRAPA should develop experiments in the farms in order to facilitate the dissemination of research results to farmers.

### 8.3.4 Trusted person TP4

TP4 is a farmer, but also an experienced veterinarian retired from the Faculty of Veterinary. Past experience as a researcher of EMBRAPA, before deciding to be a teacher, is part of his knowledge evolution. As a teacher, he used to obtain information in the library and exchange experiences with other professional colleagues. Experience was obtained as an observer, farmer, and consultant. EMBRAPA is also considered as a trusted source of information when a solution has to be found, and rural magazines were indicated as the most usual source of reading. However, this case also brought evidence that the majority of the farmers prefer to visit and to observe other farms, in order to obtain information, instead of reading. Demonstration fields, strategically located in leaders' farms, were also suggested to EMBRAPA as a means to disseminate new technologies to farmers:

*“This occurs in relation to my neighbors. They used to go to my farm to see what I was doing. Later, I realized that the neighboring farmers were using the same practices that I used in my farm. The farmers prefer to see in the field instead of reading. I believe that EMBRAPA should have demonstration fields located strategically in the leaders' farms. I am saying leaders' farm in order to guarantee more credibility to EMBRAPA results.”*

Although the interview of the “trusted persons” was not initially planned, it was an adequate methodological decision in this research, since it was possible to aggregate complementary information about the social construction of the information networks and to bring contribution to understanding better part of the thesis issues.

## 8.4 Concluding remarks

This section presents a résumé of the main findings from the case studies associated with the results from the survey. In fact, it is intended in this section to point out the main conclusions as an intermediary phase to introduce the reader to the final Chapters, which are concerned with the synthesis of results (Chapter 9), hypotheses discussion (Chapter 10), and recommendation and implications (Chapter 11). Before moving to other conclusions, it is important to assess how the case studies reflect the farmer clusters. As has been stated, the clusters were formed taking into account the

factor scores from nine selected factors. Five factors were directly related to information (*selected technical, applied technical, general technical, farm business and general information*), and four linked to behaviour, attitudes, and goals (*openness to take decision, commitment with rural life, farm business expectation, and farm family tradition*).

The resultant factors are vectors that expressed the combination (correlation) of selected variables (answers from the survey). The interpretation of the clusters was made on basis of the means of the factor scores loaded in all farmers within cluster. Therefore, it was necessary to turn back to the individual answer (variables) of the case study in association with the findings from the in-depth interviews, in order to verify how much each case study reflect its own cluster.

In this way, the questionnaire data and the findings from the in-depth interviews, provided evidence that the cases reflect the majority of the clusters' characteristics, also giving evidence that the methodological approaches, applied to this research, work satisfactorily. In this regard, a more detailed explanation is presented in Appendix 8.2. The small "distortions" (unfitness) were related to some sort of variation within cluster, and not in relation to the whole cluster. The distortions were predominantly concerned with characteristics related to the factors representing farmer's behaviour, attitudes and goals. For example, *openness to take decisions, commitment with rural life, and farm family tradition*. The conclusion is that such distortions were likely due to the dominance of some variables in the factor<sup>1</sup>. Another explanation is related to the variance of the variables, and consequently with the variance of the correspondent means of the factor scores within cluster (see Appendix 8.2, section 8.2.2).

A general conclusion is that the in-depth interview was valuable in giving a greater understanding of the hypotheses<sup>2</sup> of this thesis; such an understanding would not be obtained exclusively on basis of the data from the survey. The in-depth interviews

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<sup>1</sup> Variables with the highest loading (correlation) indicate strong relation with the factor and should be used in order to interpret the factor (Hair, *et al.*, 1987)

<sup>2</sup> The discussions of the hypotheses are presented in Chapter 10.

also opened a field to formulate new hypotheses for future research. This was an important result from the combination of survey with case study. In addition, it is important to point out here that the complexities stemming from the social construction of the farmers' knowledge information network became more understandable, for example, by identifying the systems' components (sources of information), as well as to explain their social relationships in each case. Firstly, it was confirmed that there are different information systems; each farmer group (cluster) develops its own system. Secondly, although the social construction of the farmers' information system present some kind of common characteristics, each case builds the social relationships on basis of his/her own values, beliefs, education, time preferences, and intensity of using the available sources of information. However, the systems are marked by always consulting a trusted person to take decisions. On the other hand, it was evident that although EMBRAPA is very respected among the farmers, a direct and continuous relationship has not yet been established between the institution and the majority of the farmers. A synthesis and the flow diagrams of these information networks are presented in Chapter 9.

A common characteristic between the farmers' information systems is that, independent of the cluster and region, all cases are marked by their initial farming apprenticeship within the farm family. This knowledge seemed to be more marked in the older farmers with a lower level of education than in the younger farmers having high education. However, independent of age and education, there was evidence of transference of farming knowledge between farm family generations. In the process of knowledge evolution, fifty percent of the cases benefited from academic learning in Agricultural and Animal Science. This indicated that the motivation, for this advance in the knowledge evolution, was probably generated within the farm family. Although knowledge evolution is also a dynamic process, there was strong evidence that such evolution in farm decision making is dependent on the level of technology being used. The demand and sources of information increase among farmers using higher levels of technology. In fact, this is a continuous interdependent process, where the use of one technology "opens" the door to introduce other technologies, consequently expanding the information network. Unusual biotic and socio-

economic “problem events”, affecting the performance of the production systems, also force the farmer to look for information or even to introduce new components in their information network.

Informal communication by talking and exchanging ideas with other persons is a dominant mechanism and a common characteristic among farmers, independent of cluster and region. Knowledge of the experience and success of others is an indispensable characteristic of consulting, where the practical experience of elders plays an important role. In addition, there was evidence that, in general, the farmers do not like reading. However there are accentuated differences between groups in relation to the different mechanisms to obtain information. In this regard, time preference and event of human life were also identified as important factors affecting the use of the existing mechanisms. A farmer having another activity (entrepreneur) outside the farm builds his information network according to his available time preference. In the same way, reduced time availability due to pressure of farming work induces the decision-maker to adjust his/her information system to the current situation. Then, in both cases, part of the available mechanisms to obtain information cannot be properly or even totally explored, as desired.

The farm family as the unit of decision-making was confirmed in this research, since there is strong evidence from some cases, that the “discussion forum” of decisions is established within the farm family. This finding is in agreement with the orientation of this thesis and the conceptual approach pointed out by Gasson (1973), Dent (1991), Gasson and Errington (1993), Dent *et al.* (1994), Ferreira (1997), Skerratt (1998) that is: farm decisions are influenced beyond the individual farmer as decision maker, where family members are also important part of the decision process. The Farm Family Decision-Making Unit (FD-MU) has been studied and emphasised by Ferreira (1997), and also accepted as the research orientation of Skerratt (1998). Ferreira (1997) has stated that “decision-making is not a process developed by each FD-MU in isolation, because the interaction and communication with other FD-MUs appears to be relevant” (cited in Skerratt, 1998).

In general, where there is a bad experience, the farmers did not accept them as being relevant as a mistake, rather such experiences are considered as valuable in the learning process. The majority of the decisions, to introduce a new farming practice, are made after the farmer is entirely convinced about its positive results, as a way to minimise risks. The farmers seemed to have difficulty in reporting technical problems; they tend to emphasise exogenous socio-economic threats, such as an unfavourable relation of price input/product, policies, and land invasion. The farmers perceived as technical problems only those “events” responsible for significant herd losses. However, this seemed a contradiction, since it was evident the adoption of technologies solved other problems such as: pasture degradation, low calving rate, low weight gain and unbalance in mineral nutrition. This was an indicative that the analyst should be aware of farmer’s thinking in order to identify farming problems from farmer’s discourse. Moreover, no doubt remains that pasture degradation was detected as the most important technical problem currently upsetting the farmers.

However, the technical problems outlined by the farmers were solved on the basis of available technology, and in the past the most important, “syndrome of dropped cow”, was solved under leadership of EMBRAPA. In this way, it was detected that the farmers are using some kind of the technologies developed by EMBRAPA, but in general, the farmers do not know how to relate their practices with the institution. Only two cases were able to identify this relationship and to report on technology adjustments.

No direct solutions were indicated for the socio-economic problems, but there is evidence that the farmers are reducing maintenance costs and investments as an alternative, in order to keep their business running. However, there was also evidence of the adoption of technologies to improve the overall efficiency of beef production, such as pasture rotation and feed supply as alternatives for facing their unfavourable situation. Scarcity of capital was cited throughout the sample, which has serious implications for the technology development, by EMBRAPA. Participation in EMBRAPA decisions was welcome among the farmers in order to identify and solve

farming problems, but there was strong indication that such participation should occur through a farmer leadership.

Independent of cluster and region, basic concepts of nature conservation such as preservation of forests, water and fauna are well known among the farmers. In addition, the farmers' understanding of nature conservation is not disassociated from their farming activities. The perception of nature conservation in Pantanal is strongly marked by a close relationship between the farmer and wildlife, where a preservation feeling has passed through farmer generations. In this way, the farmers of Pantanal demonstrated a higher sense of nature conservation and regional pride than the farmers of Campo Grande. To some extent the farmers of Pantanal believe that the environment in the Pantanal is under threat if for any reason the "pantaneiro" has to be substituted by other people unfamiliar with this environment.

Lack of information and an "exaggerated " desire for expanding the area of cultivated pasture, associated with excessive use of fire and overgrazing, were pointed out as likely motives leading farmers to commit environmental mistakes in the past. These past mistakes were hard "lessons" leading farmers to develop "local knowledge" and a new sense of farming. These findings are in agreement with Amanor (1993b), Long and Villareal (1994), Bebbington (1994) and Chambers (1984b) in the way that rural people develop "local knowledge". Local knowledge and conservation practices against soil erosion are being implemented in order to minimise undesired macro-effects in the environment.

It is evident that the farmers are concerned by the internal and external pressures associated with the environmental issues and farming. This, in addition to, with land invasion and unfavourable policies, constitute new stressful factors in the field, which have affected farming stability and farmers' decision-making. However, as part of the society, and having a direct involvement with nature, farmers would also like to participate with their knowledge and experiences, to create the laws on environment conservation. The research was not designed to detect the social magnitude of this impact, but there was strong evidence of dissatisfaction among the

farmers, which was expressed through feelings of pessimism, devaluation of the patrimony, and loss of social status.

A first conclusion stemming from the complementary interviews is that the trusted people have a broader information network than their respective farmer case studies, in the sense of looking for, and in the intensity of using, sources of information. As a result, the trusted people are better informed and more advanced farmers than those case farmers who are trusting them. The trusted people also recognise the importance of informal communication between farmers, rather than reading, to obtain and to exchange information. In addition, the “trusted people” have a closer relationship with EMBRAPA than the farmer cases, in order to solve their technical farming problems, or even to obtain new knowledge.

In this study, there was evidence of a “close social link” as a characteristic of establishing relationships between the farmer cases and their respective trusted people. This finding is in agreement with Gasson (1971) in the way that such relationships do not happen without common grounds. Bennett (1986) pointed out that the reasons for a functioning agricultural network have not been explained. In addition, Skerratt (1998) presented a comprehensive review on informational networks and stated that “*there are few references which are concerned with farmers’ influence upon one another and also of farmers’ susceptibility to being influenced by others*”. A discussion of this topic, on the basis of this research, is extended in Chapter 9 as a contribution to understanding better these relationships.



# Chapter 9

## Synthesis of Results

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### 9.1 Introduction

According to the applied *systems approach*, which was outlined earlier in Chapter 5, the main objective of this Chapter is the *synthesis phase*. Firstly, a framework of the information network of each representative case (case study) is presented highlighting the differences between the cases, the implications of the differences, and the participation of EMBRAPA. Secondly, a synthesis of the social links between the cases and their respective “trusted persons” is presented. In fact, the main focus here is to bring the evidences that the farmers build their information on basis of a strong social relationship and that knowledge “acquisition” from rural people can be facilitated by the reconstruction of such networks.

### 9.2 Representation of the farmers’ information network flow

This research has demonstrated evidences that farmers’ knowledge evolves within a complex social network of information under the influence of diverse factors. Such a complexity could be expanded if the information networks were examined in terms of the different levels of decision, as was pointed out by Ferreira (1997). However, in bringing together the data from the survey (questionnaire) and the in-depth interviews, it was possible to construct a general graphic representation of the main components of the information networks of the six representative case studies. The components classified by the farmers as being of little or moderate importance were not incorporated into the diagrams. The representations incorporate only those components that the farmers considered important and very important, or even expressed evidences from in-depth interview that really are parts effective of the information networks. This decision was taken in order to maintain approximately the same relation of importance within and between the network’s components.

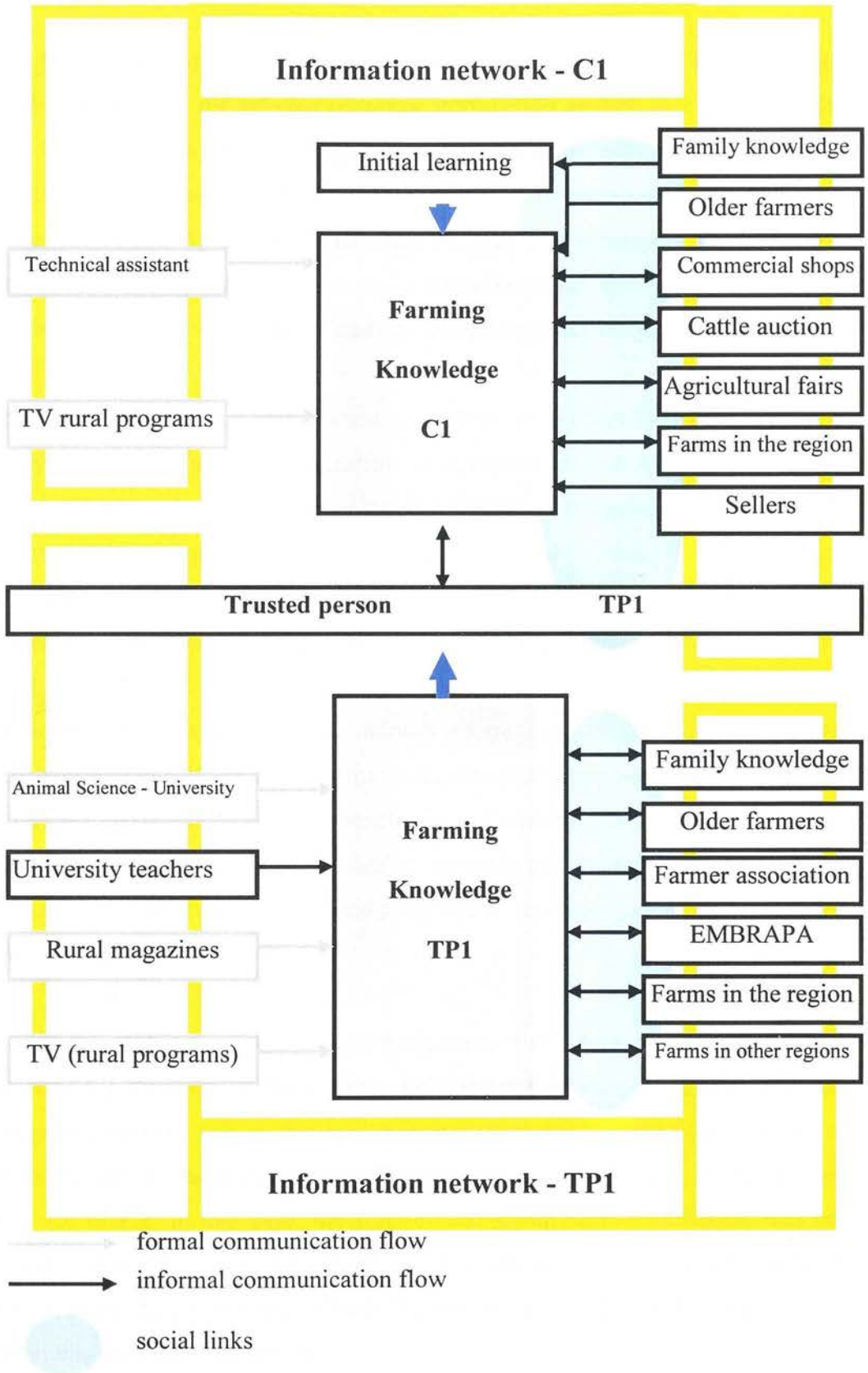
### 9.2.1 Case C1 – Campo Grande

Looking at Figure 9.1, it can be seen that the structure of the knowledge information network of **C1** is based mainly on the components for *applied technical*, *business* and *general* information, since only one component (technical assistant) for *selected technical* information is present in this structure. It is important to point out that the information flow is primarily based on informal communication. The initial learning of farming was developed on basis of family knowledge and experience of older farmers. Older farmers, sellers, technical assistants and farms in the region comprise the sources of knowledge flow of the *applied* information, and commercial shops, cattle auction, agricultural fairs and rural program of television are the sources of *farm business* and *general* information.

However, the information network of **C1** is supported by the participation of a “trusted person” (**TP1**). We can see that the information network of the **TP1** presents a more broadly based balance of sources of information than **C1**, with an additional presence of components for *selected technical* information. For example, the initial learning of **TP1** was developed on basis of practical family knowledge and older farmers, but also included technical learning through formal education in Animal Science University and informal learning from University teachers. The development of the network of **TP1** is also marked with *selected technical* information expressed by the presence of components such as EMBRAPA, farmer association and rural magazines. Although in this case the “trusted person” has enlarged the information network, informal communication still prevails.

The relationship between **TP1** and EMBRAPA was described in Chapter 8; however, it is important to emphasise that EMBRAPA, as an external agent of technical information, has played an important role in the farming knowledge of this “trusted person”. In addition, there was evidence of a continued relationship, where the institution is seen as an important place to exchange and obtain information. Considering the important role of **TP1** in the information network of **C1**, peripheral knowledge from EMBRAPA has passed indirectly through this information flow.

Figure 9.1: Components of the information network flow - C1



### 9.2.2 Case C2 – Campo Grande

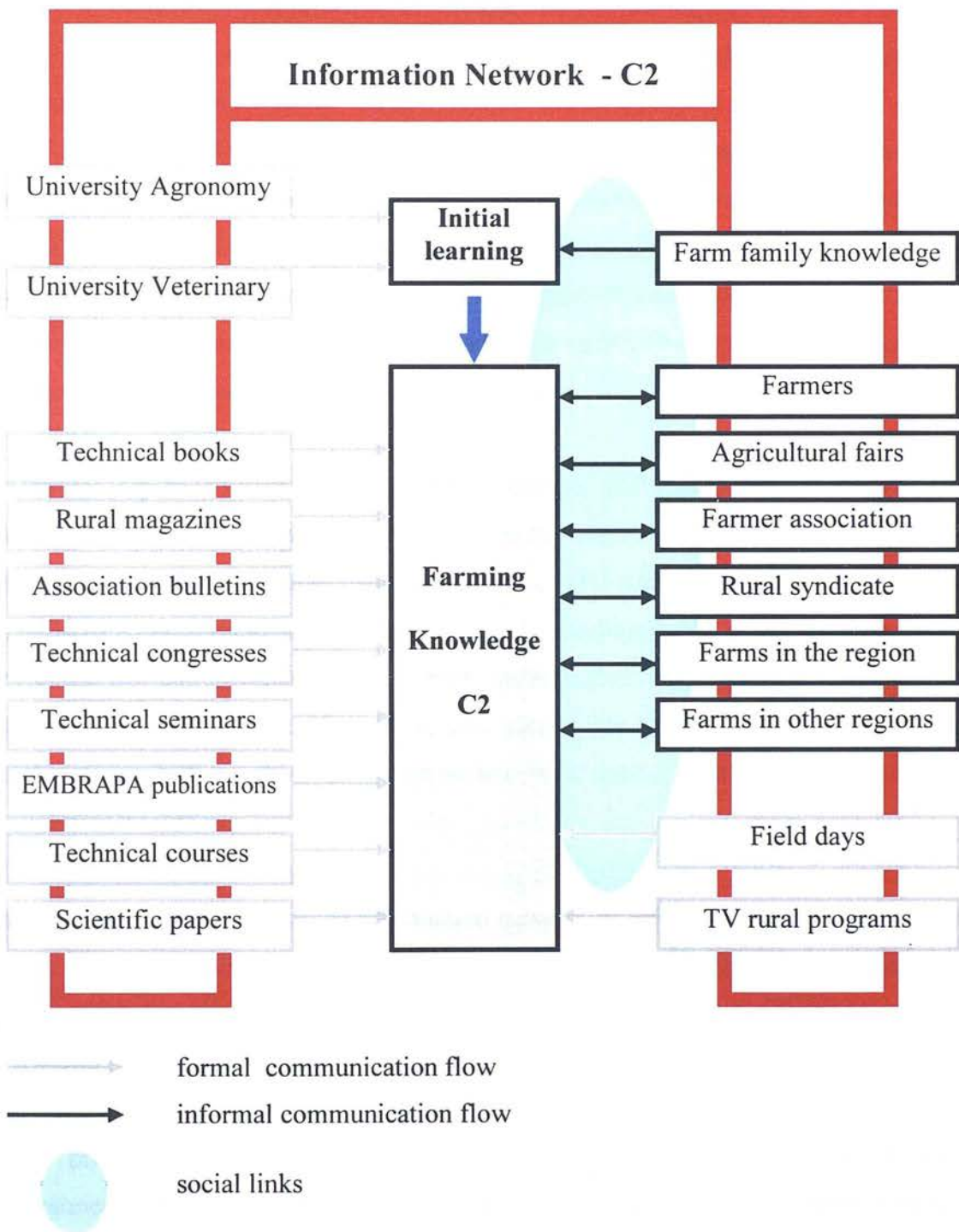
Figure 9.2 shows that the structure of the information network of C2 is strongly supported by sources for *selected technical* information as well as on a diversified source for *applied* and *general* information. On the other hand, the diagram also shows that *farm business* information is not expressed in the network of C2. In fact, this is evidence of a typical case where the biological performance of the production systems seems to be the driver factor in the information network. Probably this occurs as a result of a strong influence from the technical background of C2.

In this way, although the initial learning was based on family knowledge, it is strongly marked by a formal education in Agricultural and Animal Science. In addition, the network for *selected technical* information comprises a large diversity of formal sources of information such as technical books, rural magazines, association bulletins, technical congress, technical seminars, EMBRAPA publications, field days, technical courses and scientific papers.

Other sources for *selected technical*, through informal communication, are also part of this information network such as rural syndicate and farmer association. However, this does not mean that the sources for *selected technical* information are exclusive in the information network of C2, since other farmers, agricultural fairs, farms in the region, farms in other regions and rural programs of television constitute sources for *applied* and *general information*.

Although the publications of EMBRAPA appear as a component of the information network of C2, there was evidence from the in-depth interview that EMBRAPA has not played a decisive role in this information system. In fact, the other sources of information seemed have been more effective than the EMBRAPA in the farming knowledge of C2. In this case, the fragile relationship with EMBRAPA was not expected, since C2 is very concerned about technical information. The in-depth interview indicated that a proper relationship was not established in the first contacts between this case and the institution.

Figure 9.2: Components of the information network flow - C2



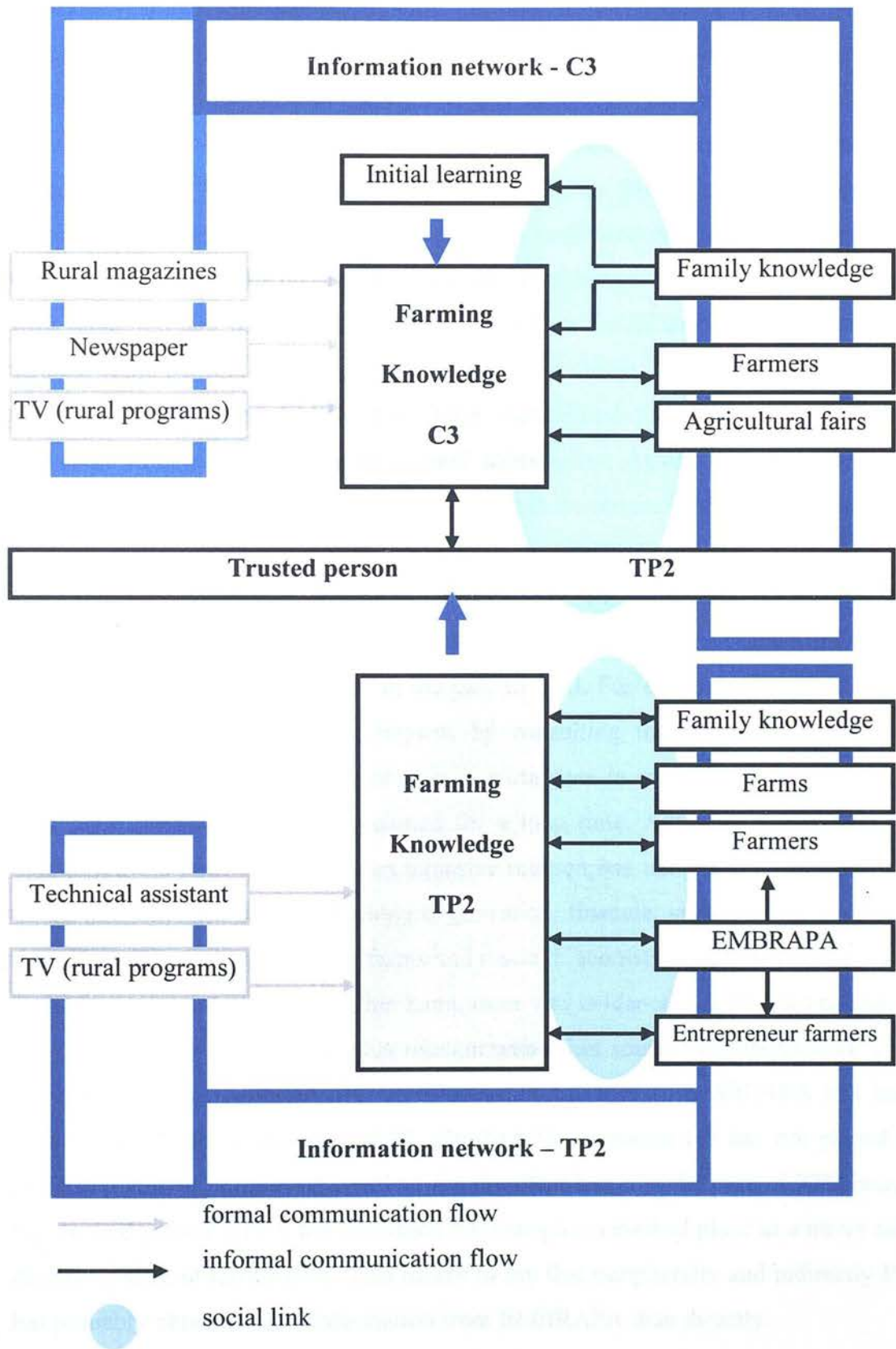
### 9.2.3 Case C3 – Campo Grande

Figure 9.3 shows that the information network of **C3** is developed on the basis of few sources of information, which are mainly related with *applied* and *general* information. This is a case in which the initial learning process was very tied up in the family knowledge, and where the circle of decisions is restricted on the basis of exchanging information with family members and advice from a “trusted person” (**TP2**). Additional *applied* information in this case is obtained with other farmers while agricultural fair, newspaper and rural program of television are the sources of *general* information on farming. Rural magazines appear in this network as a unique source of *selected technical* information.

Although Figure 9.3 shows that the “trusted person” (**TP2**) also incorporates family knowledge and other farmers as sources of *applied* information, it is realised that the network of **TP2** is broader than **C3**. In fact, **TP2** adds technical assistant and EMBRAPA as sources of *selected technical* information. In addition, there was evidence that entrepreneur farmers were incorporated in the network by **TP2** as a very important source of information, also responsible by implementing the recent technical innovations. Rural programs on television appear again as a component of *general* information.

EMBRAPA is presented in the information network of **TP2** as playing an important role not only to provide and exchange information directly for this farmer, but as a component for disseminating information to others members of his network. However, there was evidence that **TP2** belongs to a group of well established farmers who have developed social links on the basis of pursuing deep changes in their production systems, and where there is evidence of available capital for investments. From a synthesis point of view, this is the expected role of EMBRAPA, which should be extended in the majority of individual information networks, but there was evidence that such an extension has not been yet achieved.

Figure 9.3: Components of the information network flow - C3



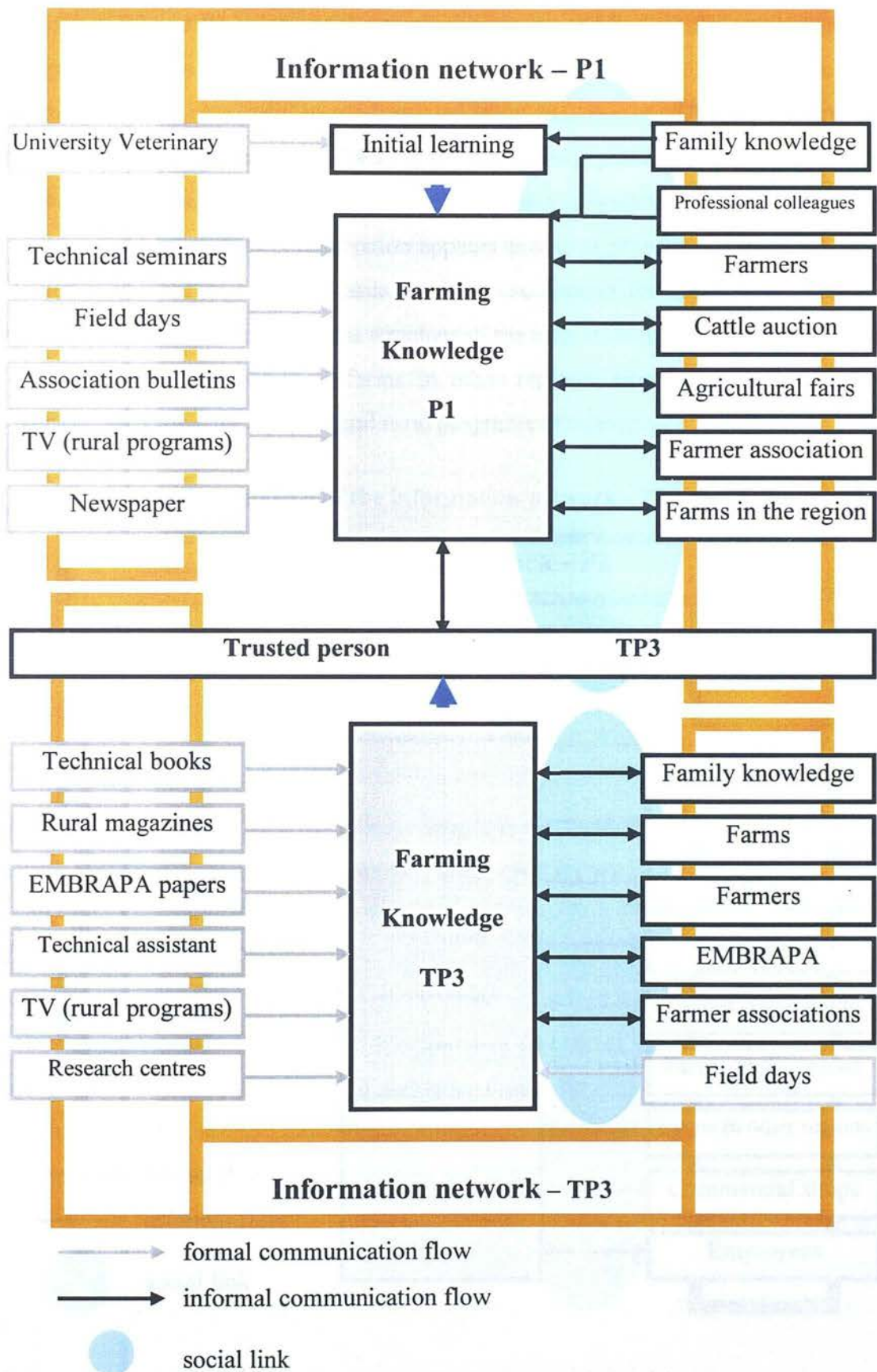
### 9.2.4 Case P1 – Pantanal

Figure 9.4 shows that the information network of **P1** presents a structure that balances components on *applied*, *selected technical*, *business* and *general* information. The initial learning of **P1** was developed on the basis of family knowledge, but was also complemented with a formal background in Animal Science. Family knowledge, other farmers and farms in the region provide the sources for *applied* knowledge. Although, the cattle auction is a typical place for *business* information, **P1** emphasised it as also being proper to exchange information with other farmers on overall farming. *Selected technical* information is present through technical seminar, field days, association bulletins, professional colleagues, farmer association and EMBRAPA, while agricultural fairs, rural programs on television and newspaper provide *general information*. Again, a “trusted person” (**TP3**) is also present as an important component in the structure of this network.

Although the information networks of **TP3** and **P1** show similar sources of information, the in-depth interviews provided evidence that the intensity of using these sources is more accentuated in the case of **TP3**. For example, the presence of **TP3** in EMBRAPA has been frequent by consulting the researchers to make decisions, to obtain publications, or even to participate in events such as field days. This close relation has been developed for a long time. Although EMBRAPA is monitoring the farm of **P1**, such an intensive relation has not yet been established. Given his better condition of farming organisation, financial situation and available time, **TP3** frequently visits other farms and research centres, as well as participating in the farm association. On the other hand, there was evidence that **P1** does not have the same conditions to intensify his relation with other sources of information. The above context demonstrated two cases in which the role of EMBRAPA has had different meanings. In the case of **P1**, EMBRAPA is present but has not played a leadership role to provide information. On the other hand, in the case of **TP3** being the “trusted person” of **P1**, the institution has occupied a marked place as a direct and decisive source of information. This means to say that peripherally and indirectly **P1** has probably obtained more information from EMBRAPA than directly.



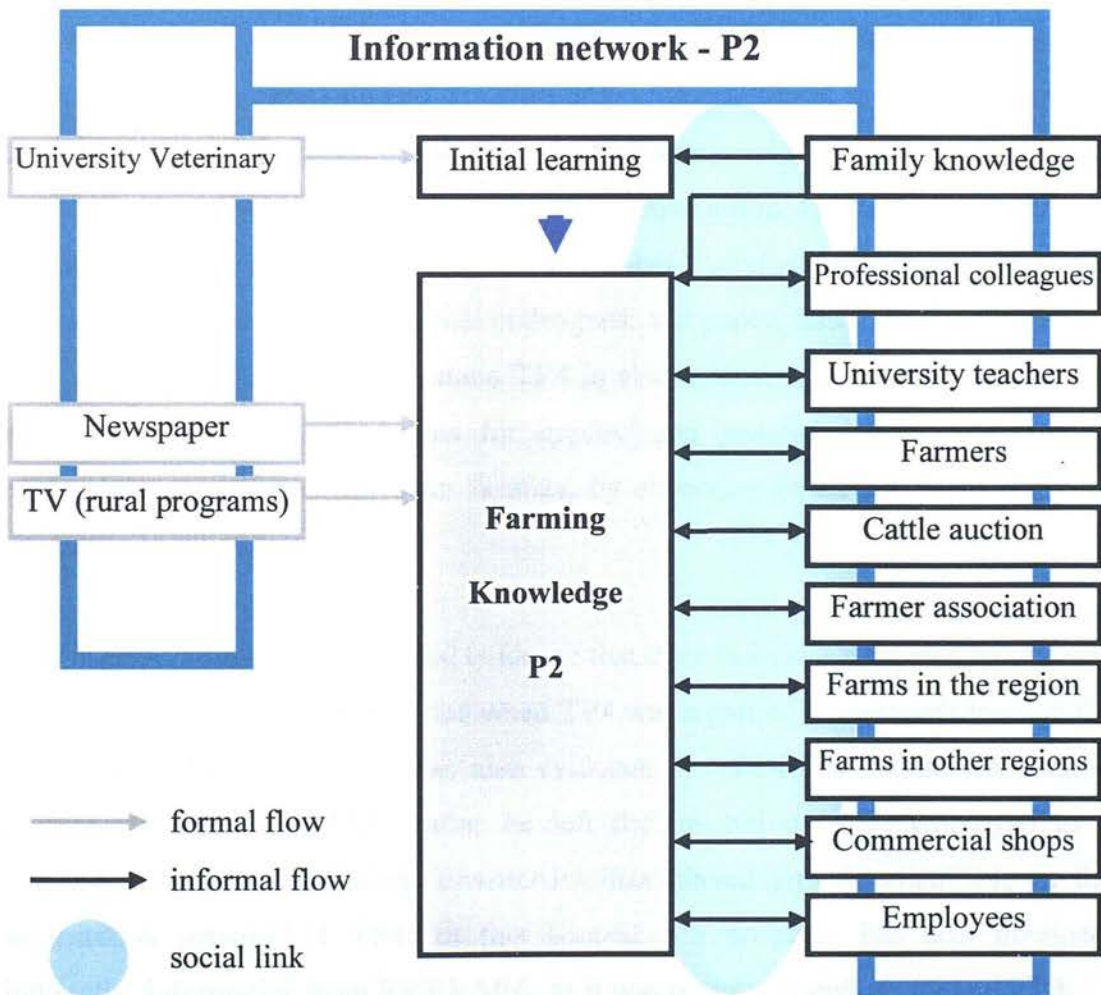
Figure 9.4: Components of the information network flow – P1



### 9.2.5 Case P2 – Pantanal

Although **P2** and **P1** belong to the same community and had similar initial learning, Figure 9.5 shows that the structure of the information network of **P2** is not the same as that of **P1**. The basic difference is related to *selected technical*, where the structure of the information network of **P2** incorporates only professional colleagues and University teachers, who are eventually consulted when occurs a disease break out occurs. In addition, farmer association appears as source of information of **P2**, but it is not frequented on a regular basis. In this case, sources for *applied, business* and *general* information dominate the structure of the information network such as: other farmers, farms in the region, farms in other regions, employees, cattle auction, commercial shops, newspapers and rural programs of television.

**Figure 9.5 Components of the information network - P2**



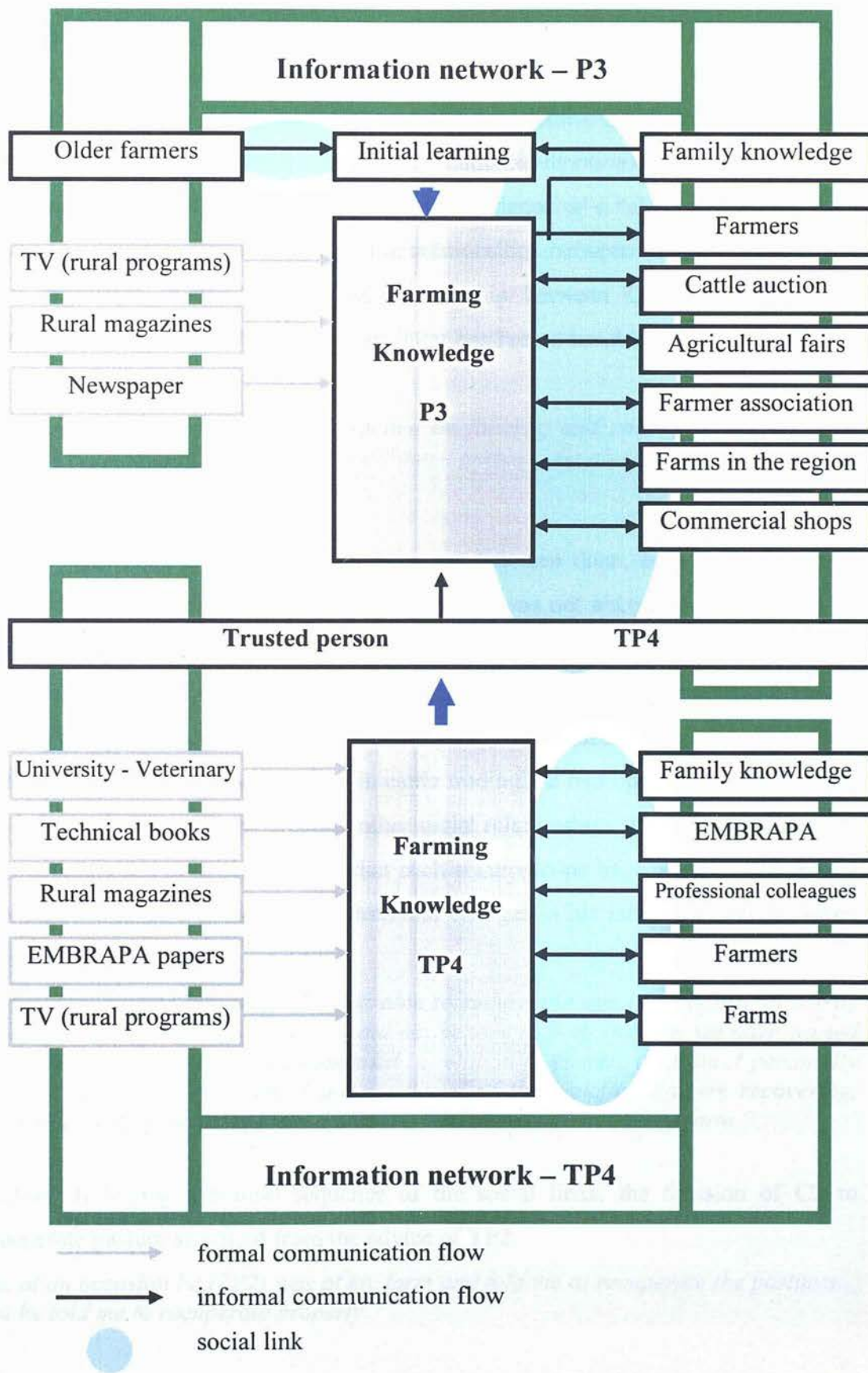
### 9.2.6 Case P3 – Pantanal

Figure 9.6 represents the information network of **P3**. Similarly to the other cases, the initial learning of **P3** was based on family knowledge associated with the experience of the older farmers. As a characteristic of his own cluster, the information network of **P3** does not present evidence of a strong relation with *selected technical* information. The majority of the components are related to *applied*, *business* and *general* information. In this way, other farmers, farms in the region, cattle auction, commercial shops, agricultural fairs, newspapers and rural programs of television are presented as the sources of information and knowledge. However, the structure of the information network of **P3** is supported by the experience and knowledge of a “trusted person” (**TP4**).

Although, on the one hand, **P3** does not incorporate directly the components for selected technical information, on the other hand this is compensated, to some extent, by the technical background and structure of the information of the **TP4**. Looking at the components of the information network of **TP4**, it is evident that in addition to an initial learning developed on basis of a formal education in Animal Science, there is a dominance of components related with *selected technical* information (technical books, rural magazines, professional colleagues, and papers and a direct relationship with EMBRAPA). In addition, since **TP4** is also a farmer, he incorporates in his information network components for *applied* and *general* information through exchanging experience with other farmers, by observing farms and watching rural programs on television.

The in-depth interview highlighted evidence that there is a close relationship between **TP4** and EMBRAPA, which started when **TP4** was a part of the research team of the institution. In addition, there was also evidence that **TP4** has maintained a close relationship with EMBRAPA after he left the institution to be employed as a University lecturer. Therefore, EMBRAPA has played an important role in the information network of **TP4**. In this context, **P3** probably has also obtained, indirectly, information from EMBRAPA, as it was observed between **P1** and **TP3**.

Figure 9.6: Components of the information network flow – P3



### 9.3 The social links between the farmer and “trusted person”

Gasson (1971) pointed out that social interaction happens selectively, not randomly, on the basis of social values. According to Bennett (1986), although social interactions within an agricultural community organise productive efforts and promote contact among farmers, the strictly economic functions of the networks have never been adequately studied. In this study, evidence of a “close social link” was found as a characteristic to establish the relationships between the farmer cases and their respective trusted people. The relationship between C3 with TP2 started through trusted cattle trading, where the latter has been a usual buyer from the former for a long time:

*“TP2, for example, has a lot of practice on farming and cattle trading, we have negotiated for a long time, and he is a trusted person... he always has the preference to buy my steers.”*

Even though there is a marked age difference between them, both grew up within two traditional families, where formal education was not encouraged, but, from an early stage, practical farm knowledge was taught in order to prepare the family descendants to cope with life. In this case, similar cultural background and a trusted trading seem to be the common ground to promote the close social link. However, TP2 being younger and very active in cattle trading, he had opportunities to expand his information network by creating other social relationships with advanced farmers (entrepreneurs). No doubt remains that such relationships have strongly influenced the decision of TP2 to introduce substantial changes in his farming practices, when he said:

*“I have seen cross breeding which is able to reduce the age of slaughter to twenty months. This is very new for us, we did not believe at first, but now we have started to use this practice. The same happened in relation to pasture rotation. I personally did not believe it, and today I am convinced of the benefits. Pasture recovering, associated with practices to avoid erosion, was also a success in my farm.”*

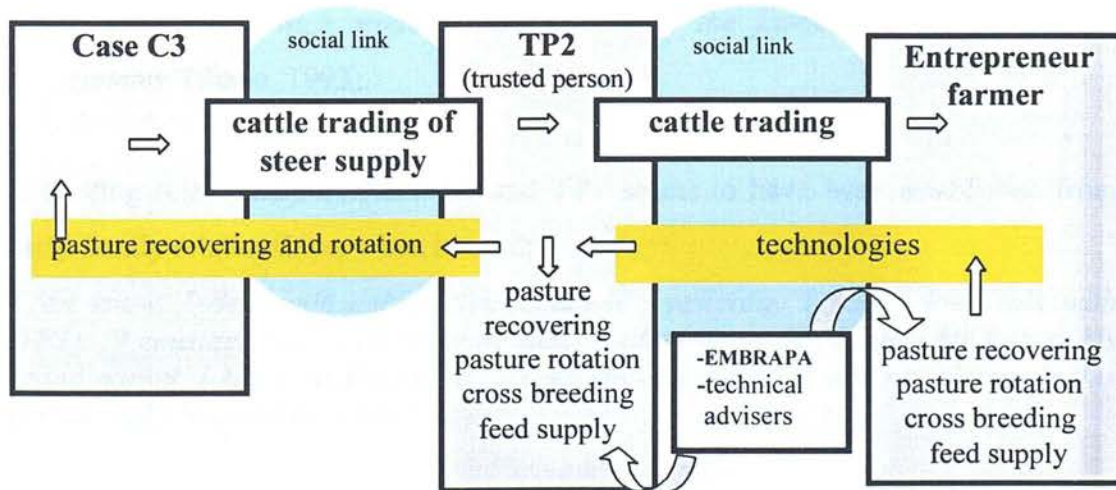
Further, following a natural sequence of the social links, the decision of C3 to recuperate pasture stemmed from the advice of TP2.

*“... at an occasion he (TP2) was at my farm and told me to recuperate the pastures... but he told me to recuperate properly.”*

It is possible that TP2 had persuaded C3 to recuperate pasture expecting a supply of better steers (good pasture produces good cattle). TP2 is an active buyer of young steers to fatten on his own farm and on entrepreneurs' farm as well. It is well known that part of the profit of a purchased steer comes from its capacity to gain weight during the fattening period. Thus, if a young steer is well fed during the rearing period, its chance to achieve earlier the slaughter weight during the fattening stage is better. C3 accepted the suggestion to recuperate pasture because he benefits from increasing the carrying capacity and selling the steers at a better price.

Figure 9.7 is a synthesis framework of the above interaction process, where the transfer of knowledge (pasture recovering) is tied up with a network of social interest by cattle trading of a well defined group: starting with big entrepreneurs, passing through trusted steers buyer, and coming to steer supplier. In this case, the trusted buyer becomes an important "actor" in the social process of knowledge transfer. This does not mean that there was a negotiated plan between the entrepreneurs and the steer buyer in order to stimulate the steer supplier to recuperate pasture; the evidence is that the process of knowledge transfer from entrepreneur to steer buyer happened naturally on the basis of observation and informal relationship. Additional research is necessary to clarify this point, but there was empirical evidence for what Arce and Long (1994) outlined as "intended" and "unintended" results from social interaction.

**Figure 9.7: Social network representation in the transfer of technology**



In the region, cross breeding technology has been transferred from entrepreneur farmers as an intended result by facilitating the selling or renting of crossed bulls to other farmers, under the condition of having the preference to buy the steers. In this way, other modalities are also practised in the region, such as breeding packages under similar conditions, where technical assistance and genetic material are provided.

Close social links are also highlighted between the **P1** and **TP3**. Both are descendants from traditional families of the Pantanal region, and share a pride in being “pantaneiro”. The latter is also well known in the region by participating in the movements in favour of the Pantanal and its people. Recently, he published a book under the title “Gente Pantaneira” (People from Pantanal) (Barros, 1998), where the pride to be “pantaneiro” is well expressed. The former shares similar feeling when she said:

*“If there is Pantanal, it is because my mother my father and my grandparents looked after it. The Pantanal exists still because the “pantaneiro” is there.”*

In addition, the level of education and cultural background, and facing similar challenges to increase farming efficiency by using more advanced technologies, seem to strengthen the social link between them. This interpretation is corroborated by definition of culture:

*“Culture has existed as long as there have been groups of people who live together, trying to find solutions to the challenges of their natural and social environment, which made sense to them in the framework of their value-systems”*(Sizoo, 1993).

A trusting relationship between **C1** and **TP1** seems to have been established from early family relationships, when he said:

*“You know, I deal with cattle transportation... yesterday I had a long talk with (TP1)... I consider him as an elder farmer... he knows much... I knew his father, his grand parent, I know his family. In fact, he knows everything and on why to do this or that and I have learnt a lot.”*

TP4 became a trusted person of P3 from a relationship developed at a usual meeting place of farmers in Campo Grande city. This is expressed in the statement:

*“Do you know (TP4)..., for me he is one of the most intelligent guys I know and I used to talk with him almost every day in the bar.”*

Several factors and attributes lead to people being considered as trustworthy. Further, in a large community the probability of different people being considered trustworthy by different individuals increases. However, “why” a farmer chooses a specific person to be a trusted source of information and knowledge is an important point to be answered, in order to understand better the social mechanisms of the farmers’ information network. This section tried to answer this question through interpretation of empirical available data, however, additional research in this field is required in order to clarify this point. Gasson (1971) reported several socio-economic structural and psychological factors for association among farmers, such as socio-economic status of family origin, aspirations, achievement-motivation of the farmer, family and community norms, and significant others’ influence. Perhaps, a better understanding of the mechanisms underlying the farmer’s decision and changes in farming can be obtained as Gasson (1971) stated:

*“Using the concepts like “significant other”, style of life, community structure and value orientation, the sociologist can give a greater insight into the role of leadership in the diffusion of innovations, the influence of community structure on farmers’ receptiveness to ideas and so on.”*

#### **9.4 Implications of synthesis results (case networks) for hypotheses discussion**

Perceptions and dimensions were only possible to be aggregated into the synthesis of the networks through in-depth interviews, which are also a “theoretical” background to discuss the thesis hypotheses. Such implications are concerned with the social construction of the knowledge networks, mechanisms for information flows, relationship with EMBRAPA and environmental concern. In fact, the synthesis of results (case networks) comprises an important link between the micro (case studies) and macro (hypotheses discussion) in the next Chapter.



# Chapter 10

## Discussion of the Hypotheses

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### 10.1 Introduction

This research was designed from a focus upon a particular research problem, which was outlined in Chapter 1 with the hypotheses being outlined in Chapter 4. The methodological approaches adopted within the research elicited data and brought together evidence related to the issues of the research hypotheses. The aim of this Chapter is to discuss the initial research hypotheses in the light of the data analysis obtained from the survey (questionnaire) and from the in-depth interviews. Considering the qualitative nature of the data from the in-depth interview, part of the discussion was supported on the basis of qualitative evidences rather than statistical tests.

### 10.2 Group 1 of hypotheses - Knowledge and information

#### 10.2.1 Hypothesis 1

*The existing knowledge information systems of beef cattle farmers are complex networks of diverse sources and communication channels in which the participation of CNPGC-EMBRAPA has been peripheral.*

Engel (1990, 1996) pointed out that the study of knowledge networks is concerned with how knowledge and information are generated, shared and used between network members. However, Engel (1996) has argued that the rules that govern knowledge sharing and information exchange in agriculture have not been studied satisfactorily. Only a few papers have been pioneers in this line of research, among them Box (1986, 1990) and Ramirez (1997). Skerratt (1998) highlighted a similar

conclusion from a recent literature review concluding that the issues of social and informational networks have been addressed indirectly rather than directly.

In analysing and interpreting the data there was strong evidence to accept the above hypothesis. Firstly, different knowledge information networks in the beef farmer communities of Campo Grande and Pantanal were noted. The data from the survey, the clustering of farmers through factor and cluster analysis, and the findings from case studies supported this finding, indicating six representative information networks (see section 8.4 in Chapter 8, Appendix 8.2, and Chapter 9). Although common sources of knowledge and information were present among the networks, aspects such as level of education, cultural values, preference, available time, life cycle, biophysical and socio-economic events, were all identified as affecting the individual information systems and, were also responsible for the network complexities.

Reading, observing, talking and listening were the channels of communication indicated by the interviewees. However, the “reconstruction” of the knowledge information networks (see Chapter 9), showed that the networks are built and work fundamentally on the basis of informal mechanisms strongly linked with social connections. Social connections appeared to be the driving characteristic in the information networks, which were marked by the presence of “trusted persons”.

These findings are in agreement with the concepts that the process of decision making is developed in a social context (Gasson, 1971; Röling, 1994; Skerratt, 1995). Moreover, the complexity of the information networks stems from how the social connections are established. In this way, the data illustrated that informal relationships were constructed on the basis of personal values, such as observing the success of others, friendship, cultural values and education. These informal relationships had a stronger influence in establishing the components of the information systems than the formal relationships usually developed in association with the research institutions.

Formal communication, such as technical seminars, congresses, and books, rural magazines and scientific papers, when present were not exclusive; rather they were always combined with informal mechanisms. Formal communication appears mainly in the information networks of those farmers with high levels of education. However, no doubt remains that personal communication is still preferred by the farmers in obtaining information; this, combined with observing “in loco” at farm level, was considered as the best alternatives to enable understanding and gain new farming experiences. Box (1986) reported similar findings in Dominican Republic and Netherlands, as well as Ramirez (1997) in the Philippines, Peru and Ethiopia, where farmers’ primary source of information was other farmers.

There was also evidence to suggest that the participation of CNPGC-EMBRAPA in the farmers’ information network is peripheral. The survey data indicated that on average the farmers did not consider EMBRAPA as an important place for talking, listening and observing, or that reading its publications assisted knowledge and information (see Table 6.31, Table 6.33 and Table 6.35 in Chapter 6). Similar interpretation came from case studies, because even the cases that considered EMBRAPA as a source of information had not yet established a proper flow of information from the institution. The exception was accounted for by some “trusted persons”, who, by means of personal characteristics of leadership, have established a good relationship with EMBRAPA.

However, there was strong evidence from the survey and case studies that the majority of farmers were using some kind of technologies developed by EMBRAPA, but that they did know how to relate them with the institution. This is an indication that, to some extent, the information from EMBRAPA is influencing farmers in a peripheral way. For example, the recommended grass varieties are well known among the farmers (see Table 6.3 in Chapter 6). The grass *Brachiaria brizantha*, by itself, comprises up to 30 per cent of the area of improved pasture in Campo Grande (see Table 6.2 in Chapter 6). There was also evidence that the farmers were using other technologies from EMBRAPA such as crossbreeding in beef herds, feed supply

management during the dry season and the use of mineral supplements. However, it was evident that the information flows better from farmer to farmer, than from EMBRAPA directly to the majority of the farmers. Also, there was evidence that the “trusted persons”, who have established a direct relationship with EMBRAPA, have been important information links with the farmer community.

As far as EMBRAPA-CNPGC is concerned, the institution has made a considerable effort in disseminating information. According to the report of Corrêa *et al.* (1998), in the last four years (94/97) 36 institutional visits and 32 field days involving 818 and 3,239 participants respectively were organised. The researchers provided 449 technical seminars at national level and answered queries from 36,700 persons from several parts of the country through direct personal contacts, telephone, letters, and e-mail. In the same period, EMBRAPA-CNPGC has participated in 47 agricultural fairs and maintained 12 units of observation and 8 units of demonstration at private farms and at its own research base. Technical assistants have also been mechanism for information transfer, where 384 technicians were trained in the same period.

No less effort has been dedicated to printed information. EMBRAPA-CNPGC distributed 56,300 technical publications, 80 percent through selling and 20 percent by donation. 96,000 copies of 28 technical folders were printed and a total of 122,000 copies of a monthly “beef research bulletin” (Gado de Corte Informa) have been also distributed. In addition, three books about beef cattle were also published. Additional to these efforts, EMBRAPA-CNPGC participated in rural programs on television, articles in newspapers as well as in the technical, farmer’s association, rural and scientific magazines.

Although EMBRAPA-CNPGC has not established an effective information flow with the majority of farmers, to some extent, such massive mechanisms of communication, if they are not yet an ideal, they are accepted as being at least important and responsible for the peripheral participation of the institution in the farmers’ information networks. In fact, a great deal of effort has been spent, but the

objective, of disseminating efficiently information for the majority of the farmers, has not been achieved, according to the findings of this research.

### 10.2.2 Sub-hypothesis 1.1

*A priori understanding of the format of farmers' knowledge information systems can facilitate the process of knowledge acquisition from the farmers.*

The key issues associated with neglecting “local farmer knowledge” were discussed in Chapter 3 and 4, comprising an important background of this thesis in order to formulate the research hypotheses. It was clear that the research institutions should move away from a “top down” research and development to an “integrated research action”, where the farmer as main client must be incorporated as a decisive partner to develop new knowledge. In fact, this proposal is based on the perception that the farmers know things that the researcher does not know, and that the farmer has accumulated further knowledge and experiences in their every day life that the researcher has not experienced.

The application of expert systems was also highlighted as a new way to improve the use of simulation models in the process of farmer decision making, where farmer's knowledge and farmer's decisions rules must be also incorporated (Edwards-Jones and McGregor, 1994; Edward-Jones and Hopkins, 1995; Dent, 1994). Expert systems as a means of to integrating local knowledge have been reported (Walker *et al.*, 1995a; Benfer and Furbee, 1990; Walker *et al.*, 1995b). However, knowledge acquisition was pointed out as the most critical component in the development of expert systems (McGraw and Harbison-Briggs, 1989). Given the diversity and complexities of agricultural knowledge systems the difficulty is increased in relation to “acquisition” of farmer's knowledge.

Although this thesis was not focused on the acquisition of farmer's knowledge, the identification and graphical representation of knowledge networks of farmer groups

(see Chapter 9) provided important frameworks for further research planning in order to elicit farmer's knowledge. The approach supporting this, is that the "decision support systems" (DSS) should be flexible to accommodate the different farmer groups, which naturally occur in any farm community (Dent, 1994). This is in contrast with a general pragmatic approach of considering the farm units as similar when in reality they are not (Dent, 1994). In addition, there was evidence in this research that the farmer's knowledge is also developed and obtained through social links and interfaces with other knowledgeable components. Without a proper identification of such links, interfaces and components, the farmer's knowledge flow cannot be traced back in order to have a complete acquisition or characterisation of a specific knowledge.

In the process of "knowledge transfer", the farmer can adapt or even generate new knowledge. In this way, Röling (1990) pointed out several kinds of transformations taking place in this process. Röling (1990) has also reported that the process of knowledge generation appears to be more effective when carried out by groups of farmers rather than individually. A DSS taking into account socio-economic data on decision rules of the farm unit is a new area of research for which methods and approaches are still being researched (Edwards-Jones and McGregor, 1994; Edwards-Jones and Hopkins, 1995, Dent, 1994). In addition, a key basic hypothesis has not been yet tested. This might be: *"farms/farm households can be classified by kinds of socio-economic characteristics and that the essentials of a DSS are the same for all members of the group"* (Dent, 1994).

Therefore, the identification of the knowledge networks in this thesis comprises an important component in developing farmers' knowledge acquisition. For example, the in-depth interviews indicated that C3 used the knowledge from TP2 (trusted person) to regenerate the degraded pasture, and TP2 obtained this knowledge from entrepreneur farmers, and the latter having learnt such knowledge from EMBRAPA (see Chapter 9). In this process of knowledge transfer, it is possible that adaptations have occurred in each specific situation. Further research into understanding the

transformation process has important implications for EMBRAPA. Therefore, a structured framework comprising the sources of information, links and interfaces will facilitate the process of addressing and summarising the construction of knowledge-bases.

### 10.3 Group 2 of hypotheses - Problems and technology development

#### 10.3.1 Hypothesis 2

*Technology development by EMBRAPA has not fully met the needs of the majority of beef farmers in the selected regions. This is because farmers have not participated effectively in the decisions of EMBRAPA due to inadequacy of adopted institutional participatory approaches, and top-down decisions.*

The overall findings did not provide sufficient evidence to reject the hypothesis that the technology development by EMBRAPA has not fully met the need of the majority of the beef farmers. Although the evidence indicated that EMBRAPA is working on the right “bottle necks” to increase the efficiency of beef production, this does not ensure that EMBRAPA has identified adequate solutions to satisfy the needs of the different social groups of farmers. Generalised solutions run the risk of satisfying only partially the farmer community, since they negate the different socio-economic characteristics of the FD-MUs (Dent, 1994). In this way, there was evidence to support the above hypothesis. For example, the degraded pasture, as the most important problem confronting the farmers, has not been solved yet through the available technology. 93 per cent of the farmers in Campo Grande declared that there were areas of pasture to be regenerated on their farms, and that these areas represented up to 40 per cent of the total area of improved pasture. The survey indicated that only 27 per cent of this area has been recuperated, and only 36 per cent of the farmers, who recuperated pasture, have used fertiliser.

The above evidences indicated that the problem was not solved in the region and that the majority of the farmers are not using EMBRAPA recommended technology. It was not possible to explain “why” the problem was not solved, and “why” the farmers were not using fertiliser. However, there was evidence, that the answer is probably related to economics, since there was strong evidence that, in general, there is a scarcity of capital associated with an unfavourable economic environment for beef farmers (see transcripts of **C1**, **C2**, **C3** and **P2**, Box 8.8 in Chapter 8). The common ground was that the farmers are reducing investments and costs in order to keep the farm running. The argument that the solution exists and that the problem relies solely on economic ground negate the case that applied technologies must be developed taking into account the characteristics of the representative FD-MUs.

Therefore, the most important question to be addressed is whether the technology to recuperate the pastures is adequate for the different socio-economic FM-DUs. The evidence from this research suggests that the answer is that it is not. Without answering this question, it is not possible to argue whether the farmers’ decision in looking for alternatives suitable to their specific socio-economic environment are correct, even though there is evidence that some group of farmers, mainly entrepreneurs (see transcripts of **TP2**) were using the recommended technology. In fact, the majority of the farmers are probably using their knowledge and managerial skills adjusting their production systems to the socio-economic environment to overcome dissatisfaction (decline of income) (Frank, 1995a).

Nevertheless, this research also identified that the institution has conquered the respect of farmers. Of course, such approval was achieved on the basis of the contribution and commitment to improve the beef industry, since farmers are very critical and trusted more in another farmers than in the researchers. Evidence of the institutional effort, to improve research planning, was also presented in Chapter 4. Personally, the author of this thesis, as member of the CNPGC-EMBRAPA research team, has participated closely and observed the effort of colleagues to make contributions so as to improve the performance of the beef industry. However, the



second part of the hypothesis, which is related with inadequacy of the participatory approach and “top down” decisions, was also accepted as a consequence from the evidence that the needs of the majority of the beef farmers have not yet been met.

In fact, there was no evidence that EMBRAPA has used a systematic participatory approach to identify, in-depth, the demands of the different farmer groups. In general, there was evidence only that the most advanced and successful farmers are taking advantages from the overall technologies. In this way, Tables 6.2 and 6.3 (Chapter 6) indicate that the big farmers of the Campo Grande region have known about and used the grass cultivars promoted by EMBRAPA. Similar conclusion came from Tables 6.20 and 6.24, where the larger farmers demonstrated better knowledge about bull ranking and they have used more advanced practices such as dry season supplementation. Evidence of this also came from case study C1, a smaller farmer, who stated: “*Why should I go to EMBRAPA to get information? I don't have money to invest*”. This farmer's perception can be interpreted as EMBRAPA is developing technologies for larger farmers, who have financial conditions to invest.

Developing technologies only for more advanced farmers cannot be defended by EMBRAPA as a strategy to push forward deep changes in the beef industry, while at same time expecting that lesser advanced farmers will be “followers” of a natural evolutionary process of technology transfer because:

- no explicit strategy in this way has been internally discussed and presented in the institution (Cezar, Pers. comm.), and
- considering the long run nature of the effects of beef farming decision making, this strategy would take a long time to be effective mainly in relation to the technologies depending on farm investments.

Therefore, the implementation of EMBRAPA's participatory approach, outlined in section 3.2.1 (Chapter 3), has been inadequate to solve the overall problems of the different FD-MUs. Although there was evidence that the institution is pursuing

solutions for “bottle necks”, there was also evidence that the research planning and implementation must be adjusted through another approach to establish better research feed back. Finally, this research provided strong evidence that such an approach of integrating the farmers into research planning was welcome among farmers (Box 8.11, Chapter 8).

### 10.3.2 Sub-hypothesis 2.1

*Farmers adjust technologies and research findings to their specific situations and conveniences better than formal researchers.*

On the basis of the research data this sub-hypothesis cannot be rejected, since there was clear evidence that farmers have in fact adjusted some technologies to the conditions of their particular situations. The survey indicated that only eight farmers of the entire sample population were using “correctly” EMBRAPA’s recommendation to control endo-parasites, even though 32 per cent of the farmers in Campo Grande and 44 per cent in Pantanal declared that they knew of the technology. For example, C1 adjusted the technology by suppressing the control of endo-parasites in the peak of the dry season. C1 considered the control inconvenient in this period because it matches with calving and feed scarcity. Individual animal response can be affected due to technology adjustment, but such effects must be compared against gains of the cattle herd as whole, which under a specific situation is more important than considering the gains of animals individually. This, therefore, seemed to be the rationality of the decision of C1 in adjusting the above technology. In addition, P1 stated: *“I am also using feed supplements for males during the dry season...I have exchanged ideas not with researcher but with...veterinarians and other farmers...I have prepared the ration by myself in a very simple way and at low cost”*.

The evidence presented in the previous section, in relation to pasture recovery, also supports the acceptance of this sub-hypothesis. These findings are in agreement with

Röling (1990) who has emphasised the farmers' ability of adapting and transforming knowledge into practices suitable for their specific situations. Ferreira (1997) has also pointed out that farmers adapt knowledge before it becomes a routine by means of practical "trial and error". These observations and the findings of this research support the concept that the learning process of farmers is developed on the basis "experience-based knowledge" (Checkland and Scholes, 1993).

#### **10.4 Group 3 of hypotheses: Environment concerns**

##### **10.4.1 Hypothesis 3**

*Farmers running beef cattle systems dependent on native pasture are more concerned about environmental conservation than farmers running systems on cultivated pastures.*

Although basic concepts of nature conservation were identified as being well known among the farmers in both regions, there was evidence that the farmers in Pantanal running beef production systems on native pasture have been more concerned about environmental conservation than the farmers of Campo Grande running systems on cultivated pasture. Firstly, there was significant evidence that the farmers of Pantanal considered the objective of being recognised for nature conservation as more important than did the farmers of Campo Grande (see Table 6.10 in Chapter 6). In addition, there was also significant evidence that transferring knowledge for children, as an objective, is likely to be more important in Pantanal than among farmers of Campo Grande. Therefore, it is expected that the concern with nature conservation is more accentuated in the FD-MUs in Pantanal than in Campo Grande.

The survey also indicated that the farmers in Pantanal tend to conserve the pastures better in the long term by adjusting the stocking rate to the annual variation of the pasture carrying capacity and by using lower grazing pressure than is the case in Campo Grande. It is suggested that the annual inundation in the Pantanal has had a

strong influence in the learning process of how to manage the natural resources, which can only be learnt through a close relationship between man and nature. In addition, the case studies also indicated that in Pantanal the perception of nature conservation is strongly marked by observing and developing a close relationship with the wildlife in order to establish an “equilibrium” with the beef cattle activity.

A marked pride in being a “pantaneiro” was highlighted as expressing the strong link developed for more than two centuries between farm families and the natural environment. Although the farmers running beef production on native pasture demonstrated a high concern for nature conservation, this does not mean that there was not evidence of deleterious effects on the environment from their farming activities. In fact, although macro effects of large-scale deforestation within the Pantanal were not observed, there was evidence that indiscriminate use of fire and overgrazing in the past did affect the environment.

#### 10.4.2 Sub-hypothesis 3.1

*The ecosystem has a strong effect on farmers' attitudes, goals, objectives, and decisions, as well as in the structure of their knowledge information systems.*

The assumption behind this sub-hypothesis is that where the control on the environment is limited and farming is directly dependent on the natural resources, the environment has had a strong influence in farm family life. There was evidence from the data to support the above hypothesis.

##### Attitudes

There was significant evidence of the likelihood that the farmers of Pantanal have the attitude of considering as more important the involvement of family members in strategic (long run) decisions, as compared with the farmers of Campo Grande (see Table 6.13 in Chapter 6). This can be explained because the majority of land in the Pantanal has been obtained through inheritance (see section 6.3 in Chapter 6). In

addition, the majority of the “pantaneiro” families were formed from the union of the descendants of a few families who started farming in the region 200 years ago (Ribeiro, 1984; Barros, 1998). This demographic characteristic is explained as a result of the regional isolation and the appropriating of vast areas by a few families, after a decadent phase of the colonial exploration of gold mines located in one border of Pantanal (Ribeiro, 1984; Barros, 1998). However, according to both Ribeiro and Barros, the establishment of farm families in the Pantanal was an adventure marked by difficult access, confrontation with tribal resistance, wild animals and tropical diseases. These are the historical factors that can explain why in this ecosystem the involvement of family members in long term decision-making is so marked and why the environment has had a strong influence in the “pantaneiro”.

Although there was evidence that many farmers in Pantanal have the attitude of being “followers” instead of first experimenters of a new technology or product, this did not constitute a marked attitudinal difference between the two regions. The results indicated that in both regions the frequency to be leaders with new technology was low (see Table 6.11 in Chapter 6). The majority of the farmers take some time before a decision is made. In both regions, intuition was not recognised by farmers as the basis on which they take decisions (see Table 6.12 in Chapter 6). Rather the majority of the farmers were more or less divided into attitudes to take decisions on basis of a cautious problem analysis ( $\pm 50\%$ ) and problem analysis combined with intuition ( $\pm 50\%$ ) (see Table 6.12 in Chapter 6).

### Goals and objectives

Although the farmers in both regions considered equally seven objectives (see Table 6.10 in Chapter 6) as forming the most important group, the ranking of each objective within the regions was different as well as their levels of importance. For example, the objectives: “*be recognised for nature conservation*”, “*have a herd of high quality*”, and “*increase income and profit*” are in first place in the ranking of Pantanal, while in Campo Grande these two first objectives are ranked in second place and the last in third. In addition, there was statistical significance indicating

that the farmers are likely to consider these objectives more important in Pantanal than the farmers in Campo Grande. The objective “*increase income and profit*” is probably ranked at important place in Pantanal because the current unfavourable economic situation has affected more drastically the farmers in this region than in Campo Grande. This can be explained due to low regional beef productivity associated with breeding cow activities (see Table 6.7 in Chapter 6), which are less profitable as comparable to the dominant breeding cows plus rearing and fattening of males in Campo Grande (Cezar, 1982a).

From a positivist point of view there was evidence that the ecosystem has influenced the way in which the objectives of the farmers of Pantanal were ranked. The objective “*be recognised for nature conservation*” was probably ranked in first place due to the total dependency on the natural resources to run the beef cattle activity and the evidence of a close relationship between the “pantaneiro” and the environment. In addition, it may be possible that to “*have a herd of high quality*” is placed as a first objective to be pursued among the farmers of Pantanal in order to change the present “status quo” of the cattle from Pantanal, which is considered of lower quality in the market than those produced from the improved pasture.

### Decisions

There was strong evidence that the environment has had a marked influence on farming activities, since in Campo Grande, 62 percent of farmers were involved with breeding cows plus rearing and fattening of males, while in Pantanal only 30 percent of the farmers were involved with this activity. The majority of farmers in Pantanal are involved with breeding cows, and breeding cows associated with the rearing of males. The reason relates to the fact that the production system in Pantanal is based on native pasture, which is not adequate to fatten cattle. Furthermore, introducing cultivated pasture in the vast areas of Pantanal is not feasible due to the natural phenomenon of annual inundation.

This research also indicated that the farmers of Pantanal use the practice of seasonal mating significantly less than the farmers in Campo Grande. This decision is probably due to the extensive characteristics of the beef cattle activity in Pantanal, where the practice to keep the bulls separated from the cows is not a simple task under those conditions. Feed supply during the dry season appears not to be a feasible practice in Pantanal, only a small percentage of the farmers in Pantanal use this practice (see Table 6.24 in Chapter 6). It was also observed that the ecosystem affects the system of cattle disposal. The preference of the farmers in Pantanal is to bring cattle to be sold at auctions, which are located at strategic points in the region. A reason for this is that the access condition of the farms is precarious. This condition becomes worse during the flood period, when many farms can be only accessed by plane.

#### Structure of knowledge information systems

The data from the survey (questionnaire) indicated that on the average, the farmers in both regions tend to allocate about the same level of importance to the mechanisms to obtain knowledge and information (see Table 6.30 to Table 6.36 in Chapter 6). However, as mentioned in section 10.2, the findings from the case studies indicated that, independent of region, there is no unique and common structure for all information systems; each farmer group develops its own system.

Although the presence of similar components was observed, there was evidence that each case aggregates new elements and builds the structural links of its information system on the basis of its own social values, as mentioned in section 10.2. Accepting this finding as the most important characteristic of the information networks, the above sub-hypothesis cannot be rejected. In this way, there was evidence from the case studies that the farmers look for and exchange information with neighbouring farmers, friends and “trusted persons” who share regionally common interests in farming.

## 10.5 Group 4 of hypothesis: Synthesis – Conceptual Model

### 10.5.1 Hypothesis 4 – A General Model

*A dynamic, participatory and learning knowledge information system, taking into account the characteristics of information and knowledge flows of the beef cattle farmers, can be proposed to create and disseminate information and technologies which better meet farmer's need in the region.*

This hypothesis was outlined in Chapter 4 as a resultant synthesis of the issues concerned with the development of technological innovations. A conceptual framework of a dynamic, participatory knowledge information system was proposed (see Figure 4.6 in Chapter 4) on the basis of problem understanding and adaptation outlined in the literature review (i.e. Jones and Wallace, 1986; Röling, 1988, 1990). Conceptual frameworks have been reported along the lines of the Röling “school”. For example, Cobbe (1993) presented a “complete” and segmented useful framework, where the feedback links determine a circular and iterating configuration between the segments and actors of the AKIS.

However, a crucial and key aspect of the functioning of the model proposed here is to take into account the *diversity* of the farmers’ information knowledge networks and in particular “how” farmers develop their information systems; such facets have not been properly studied and incorporated into the previous models, highlighted. Skerratt (1998) has pointed out a similar observation. The acceptance of the former hypotheses is evidence of the importance of such a diversity, which stems from the social “construction” of the knowledge networks. In addition, there is evidence that EMBRAPA has not met the majority of the farmer’s needs because such diversity has not been properly taken into account.

The current work, therefore, has been focused on this reality in order to propose a conceptual framework for a participatory knowledge information system, which



takes into account the dominant characteristics of the existing farmers' knowledge information network, rather than "accepting" a generalised framework to meet the overall needs of farmers. The objective is therefore to formulate a conceptual model based on a better understanding of the **farmer groups**, in order to improve the efficiency of the technological innovations and dissemination of information.

In fact, the framework of Figure 4.6 (Chapter 4) was perceived as a contribution to improve EMBRAPA's approach by focusing the research demands on the production systems (farmers), as discussed in Chapter 3. However, the model of Figure 4.6 has been reworked into a new general conceptual framework (see Figure 10.1) in order to incorporate farmers' *knowledge* networks, described in Chapter 9. The rationality added into this new framework is that the farmers' knowledge networks are represented by the six groups of farmers, which are represented by the case study knowledge networks of C1, C2, C3, P1, P2 and P3. In addition, such groupings are considered in all phases (see Figure 10.1) of technological innovation within a participatory approach, and are given the same level of importance.

Although this framework can seem over institutional, it should be understood that its purpose is to approximate technological innovations to farmers' needs and, at same time, to improve the efficiency of a research institution concerned with applied research. It is not intended to provide a detailed description on of how to operate such a framework, since the main goal of this thesis is conceptual. However, it seems important to highlight a general approach of how each phase is expected to work, as represented in Figure 10.1.



Figure 10.1: A general view

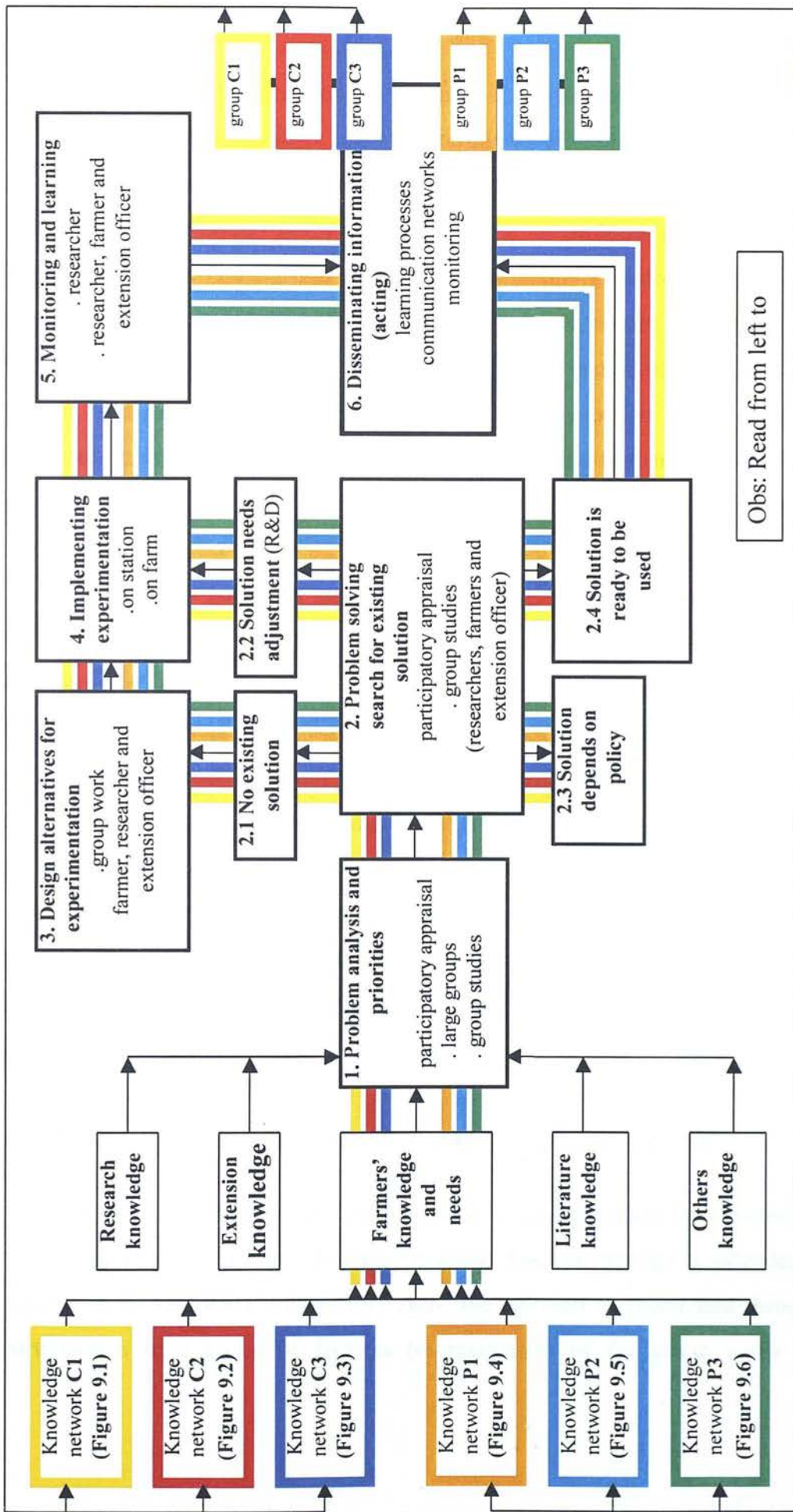


Figure 10.1: A general conceptual participatory model to create and disseminate information: applied case CNPCC-EMBRAPA

### **10.5.1.1 Phase 1: Problem analysis and priorities**

This phase must be understood as the most important of the overall process of technological innovation, since it is the determinant of the benefits to be “harvested” ahead. Firstly, the knowledge and needs from each group of farmers (distinct colors in Figure 10.1) is placed as the central feedback for problem analysis. This means that each group of farmers must be treated individually in order to identify specific problems. As highlighted in Chapter 4, the process should encompass farmers belonging to a similar social status, located at similar ecosystem and involved with similar production systems (Röling, 1990). The participation of the research and extension in this phase must be to stimulate and aid the farmers in identifying and categorising the problems.

It is important to point out here that the farmers involved in this research had difficulty in defining exact technical problems (see section 8.2.2.1, Chapter 8) and therefore such a matters must be taken into account in attempting to gain the desired information. Participatory Rural Appraisal (PRA) (see Chapter 4) involving representative farmers of a target group, researchers, extension officers and others agricultural agents can be used. However, it is crucial to understand that the farmers, in this case, are the most important actors. Once a consensus of the problems has been met, small group studies can work together in order to organise and categorise the information. Case studies can also be applied as a complementary method to obtain deep insights into the causes of problems, which may be not possible to identify through PRA.

### **10.5.1.2 Phase 2: Problem solving – searching for existing solution**

This phase is similar to the process of decision-making, where the decision-maker has to find a solution for the identified problem. Such an analogy is extended in the process of technological innovation, since the solution is researched through the participation of a group of farmers (representative of the group under study),

researchers and extension officers. Four alternative outcomes are presented in Figure 10.1: (2.1) there is no existing solution; (2.2) the existing solution needs adjustment (R&D); (2.3) the solution depends on policy; and (2.4) the existing solution is ready to be used.

It is expected the farmers can bring a rich contribution in searching for alternative solutions or even in relation to the adequacy of existing solutions to their production systems (outcomes 2.2, 2.3 and 2.4). For example, this thesis has indicated that the existing solution for recovery of the degraded pasture has not been suitable for the majority of the farmers. This means that a common problem can not share common solutions. A reversal situation can also be identified where a common problem to groups of farmers can share common solutions, but this has to be negotiated and appreciated with the peers.

#### **10.5.1.3 Phase 3: Design alternatives for experimentation**

Phase 3 follows the outcome in which no solution was found (2.1). Again, the farmer's knowledge and experience can bring a valuable contribution concerning the way in which to devise or evaluate alternative experimental options that are suitable to their specific situations. The farmer should not be asked to bring a contribution concerning experimental methods; rather, it is expected that the farmers add applied knowledge and experience to the research endeavour.

Technical knowledge (research and extension) usually defines "what" are the factors to be experimented with, "why" certain variables have to be measured, and "why" relationships between variables have to be identified. When a participatory approach is applied, a worthwhile learning process is established and knowledge is enlarged in two ways, since the farmer can also indicate others factors, variables and relationships that – from the farmer's point of view – are important and were not identified by the researchers or extension officers. It is crucial to understand that it is not expected that the farmers will substitute the knowledge and skills of the

researchers to deal with agricultural research; rather it is necessary to understand that farmers think and can contribute to “what” is the best for them. In understanding and accepting this approach, the farmer is participating in the decision process of technology innovation. This is the expected “synergism” between the actors (researchers, farmers and extension officers) in supporting a mutual learning process and a proper functioning of the model (Röling, 1990; Röling and Engel, 1991; Cobbe, 1993).

#### **10.5.1.4 Phase 4: Implementing experimentation**

Experimenting with alternatives is a resultant phase from Phase 3 or from a situation in which the solution needs adjustment (2.2). The implementation of experimentation is almost always under research and extension co-ordination, but this does not mean that under specific situations the responsibility for experimentation cannot be extended to farmers. No clear rule can be established on where to develop the experimentation, whether in the research station or on a private farm. The learning process of the farmers can be facilitated through experimenting on farm. However, sometimes under certain circumstances of operational and experimentation complexities, the experimentation cannot be carried out on a private farm and the decision should be to carry it out at the research station. Nevertheless, it seems adequate that the adjustment of a particular technology (2.2) should be carried out at farm level, since it is expected that at this stage the operational and experimental complexities to develop the technology is already reduced. In addition, the technology adjustment on-farm has the advantage of being carried out in the environment where it likely to be applied.

#### **10.5.1.5 Phase 5: Monitoring and learning**

A criticism of the linear “top-down” strategy of traditional research is that the farmers have been considered merely as “receivers” or “adopters” of “technology packages” (see section 3.1.6 and 3.1.9, Chapter 3). In addition, it has also been

pointed out that the flow of knowledge from experimental results is usually towards the researchers (Cornwall *et al.*, 1994) and a limited contribution to expand the farmers' knowledge. A reversal strategy is envisaged in the Phase 5, where the farmer is involved into a participatory monitoring and learning process also during the experimental stage of the technology development. Moreover, it is implicit that the "traditional research culture" must change from a "closed", to an "open" attitude, in order to expand the knowledge of the farmer, researcher and extension officer. It is also expected that the farmer can aggregate others perceptions, which are not usually perceived by the researchers or even extension officers. In so doing, the farmers can understand and perceive the fundamentals of the research results.

#### **10.5.1.6 Phase 6: Disseminating information**

This thesis has been concerned with how farmers' knowledge networks are developed, and it has been demonstrated that there is no a single model to represent such networks. Firstly, this implies that the dissemination of information must take into account the individual characteristics of each network, in order to disseminate information to the majority of the farmers. In this case, the knowledge networks of C1, C2, C3, P1, P2 and P3 implicitly represent such characteristics (see Figure 10.2). Figure 10.2, therefore, is complementary to Figure 10.1 to highlight the characteristics of the information networks (see Chapter 9) into dissemination of information, and at same time, as a link to expand the framework in order to incorporate the information flow from CNPGC-EMBRAPA. In the light of the research findings from this thesis, Figure 10.1 has to be expanded further in order to incorporate the social complexities of the information networks. Further, it is also necessary to add a research feedback to achieve the final objective of this thesis. Such an expansion is modularly presented in the next sections (Figures 10.3 to 10.6).

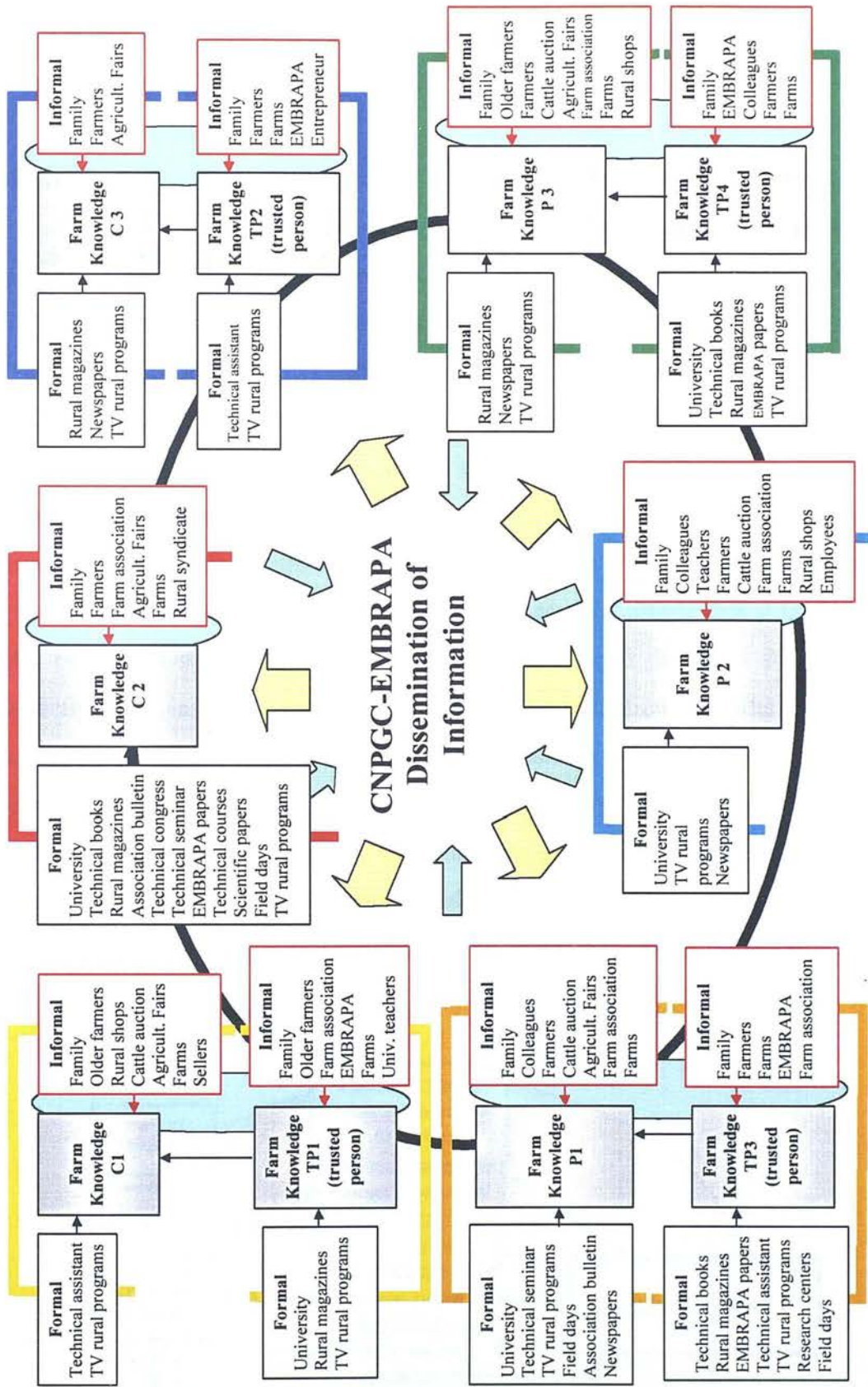


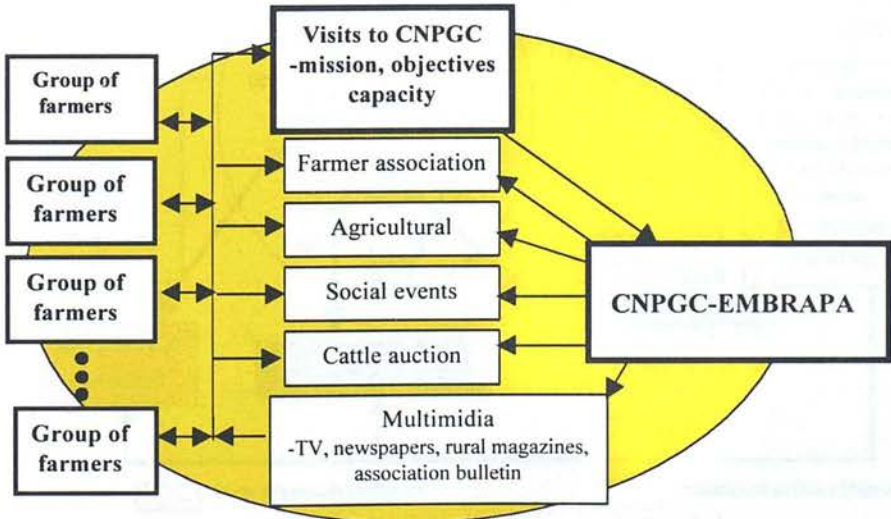
Figure 10.2: Diagram of Dissemination of Information – Phase

**10.5.1.7 Expanded conceptual model for a participatory knowledge information system for beef farmers: the Dissemination of Information Module and the applied case of CNPGC-EMBRAPA**

*Social link*

Firstly, this research has indicated that a “social link” is probably the most important characteristic in establishing relationships between knowledgeable members of farmers’ knowledge information networks (Chapter 8 and Chapter 9). This research has also indicated the absence of a suitable relationship between CNPGC-EMBRAPA and the farmer communities (Tables 6.31, 6.33 and 6.35 in Chapter 6, and Chapter 8). This could be explained as a past gap in establishing a functioning “social link” with the majority of farmers. In fact, it is necessary to think of mechanisms which create social opportunities for EMBRAPA to express its “common grounds” with farmers’ interests, and to demonstrate that it is able to aid the farmers in solving their problems, in order to open the doors for integrating effectively the institution into the farmers’ social information networks. Therefore, it appears crucial for CNPGC-EMBRAPA to understand that it is necessary to establish a “friendly dialogue”, for example, by promoting visits of farmers to the institution, as well as acting and communicating in their environment (see Figure 10.3). In addition to direct actions with farmers, the mass media, in particular television, can be used as complementary and strategic means in establishing a link.

**Figure 10.3: Social link between CNPGC and beef farmers**

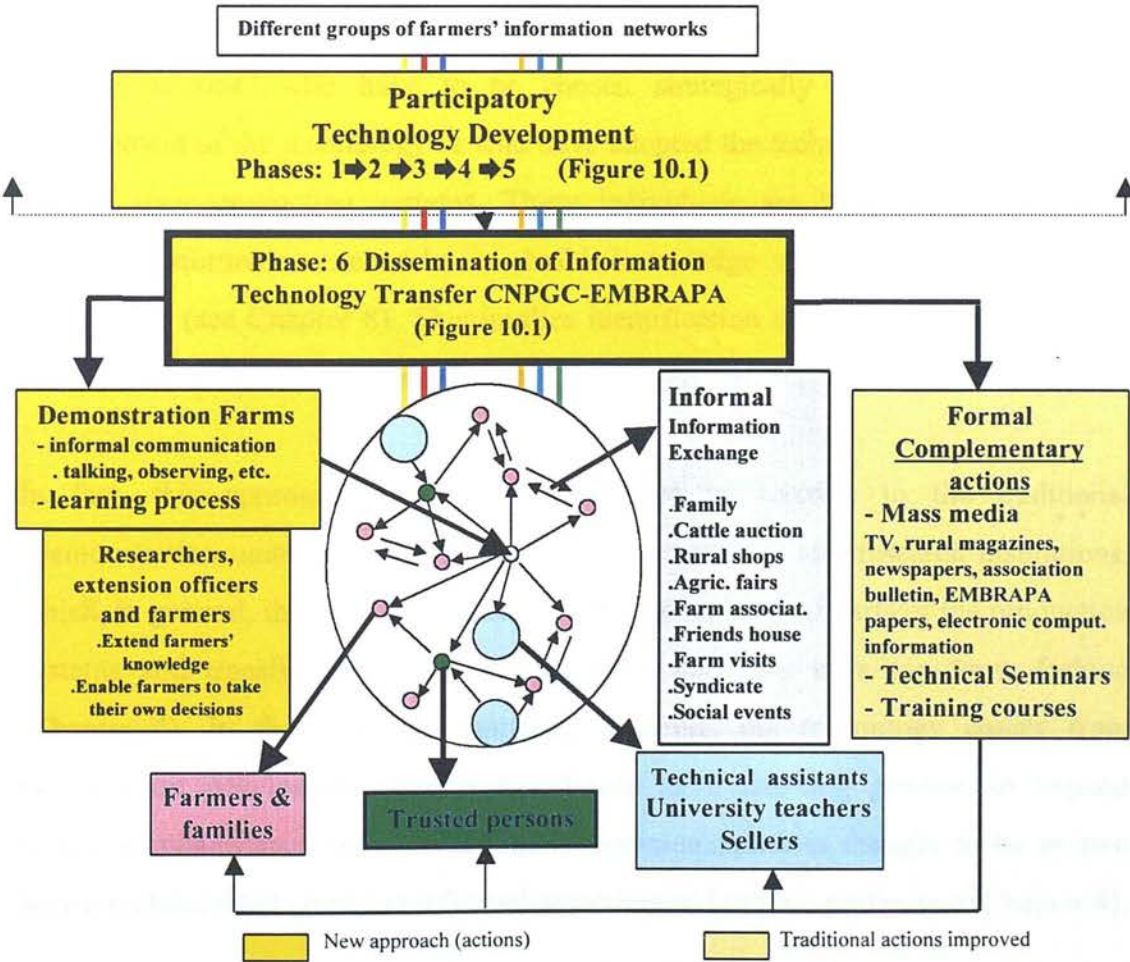




*Information flow from CNPGC-EMBRAPA: linking formal to informal*

Figure 10.4 comprises, therefore, a conceptual expanded diagram for the information flow from CNPGC-EMBRAPA to farmers. This thesis has pointed out that the development and dissemination of information to farmers cannot be considered as an independent process apart from the farmers' social knowledge information networks. Basically this approach follows two main courses through *informal demonstration farms* and *formal complementary actions*. The social complexities of farmers' knowledge construction and farmers' preference to obtain information are presented in this model and discussed below. In addition, farmers' knowledge should be enlarged within a new learning and integrated process of technology transfer. The learning process is developed and knowledge is expanded through a communication process of "dialogue", which permit the farmers interact with the informants within the farmers' realm (Cobbe 1993) and enabling them to take their own decisions.

**Figure 10.4: Technology dissemination flow from CNPGC-EMBRAPA**



Firstly, the central part of above diagram represents the complexities of the farmers' information networks which is given by its main members (farmers, farmers and family, "trusted persons", technical assistants, University teachers and sellers) and associated mechanisms (informal and formal) and localities that the farmers use to exchange and obtain information. Secondly, this central part comprises the different groups of farmers' knowledge information networks (each group is individually considered) as a key aspect of the approach. Such diversity (group of farmers) has not been reflected in other frameworks, for example, Ramirez (1997). Thirdly, the framework comprises an information flow from CNPGC-EMBRAPA taking into account the above characteristics and adding "demonstration farms" as key starting point to disseminate the information (technology). The reason to start with demonstration farms is based on research findings, which have indicated that the farmers' preference to obtain new experiences is by observing "in loco", in the field, the practices of other farmers (see Table 6.36 in Chapter 6 and Chapter 8).

Demonstration farms, therefore, can be thought of as farms of regional "leaders" or "trusted persons" who have to be chosen strategically to participate in the development of the technology or who have adopted the technology as an integrated part of their production systems. These individuals are "key" elements in the farmers' information networks to build knowledge and to disseminate new experiences (see Chapter 8). This implies identification of these individuals within farmer communities to be worked with.

In fact, this approach comprises an advance in relation to the traditional "demonstration units" and "field days" used by extension and research institutions, which, in general, the technologies have presented as isolated parts of the production systems and transferred to farmers as closed packages in a top-down fashion (Chapter 4). In the proposed approach, however, the technology comes from participatory development and is transferred as a *learning process* to expand farmer's knowledge, where the dominant communication is thought to be in **two way** directions (dialogue) and informal according to farmer's preference (Chapter 8).

Communication has been recognised as the most important issue in the adequacy, efficacy and legitimacy of an AKIS (Cobbe, 1993). Cobbe (1993) has reported a comprehensive review and discussion on underlying concepts of communication complexities. Although communication is a basic mechanism of relationships between persons and their natural and social environment, the goal of communication should be always to pass a message across so that the “receiver” can obtain the message with accuracy. The fact that people exchange information in different forms does not mean that communication is taking place. According to Cobbe (1993) the most important condition for communication to take place is in establishing a “common realm” (common ground) between interlocutors in order to permit **two way** (dialogue) message transmission and to obtain expansion of the knowledge. This supports the research findings, since information and farmer’s knowledge is passed across informal communication (dialogue ⇔ exchanging experiences) from farmer to farmer (see Chapter 8). Therefore, *dialogue* and *common ground* comprise key factors incorporated into the above conceptual institutional information flow, in order to pass technological information to farmers.

Röling (1998) has argued that “communicative rationality” is presented as a new reliance and crucial ingredient of the emergent paradigm to deal with rural problems, since the dominance of economic and market thinking have failed to ensure sustainable agriculture development in broader sense (social welfare and environmental). Röling’s approach is in agreement with Bennett (1986) and Kloppenburg (1991) who make a claim for new approaches which incorporate *social understanding* and *local knowledge*, rather than finding solutions solely on the traditional technology development associated with concept of “rational man”.

*“ It means social learning, negotiation, conflict resolution, accommodation, agreement, collaboration, collective decision-making, covenant, cooperation, participation and synergy. It means overcoming social dilemmas so as to move from selfish and mistrustful action to joint action. It means developing solutions which emerge from interaction.”* (Röling, 1998).

The aspirations behind the claims of new approaches, and supporting this thesis, does not mean that the development of the science and scientific knowledge has to be neglected or even placed at an inferior acknowledgeable dimension, in contrast with the critiques of Molnar, *et al.* (1992) and Flora (1992). Rather, the claim is to aggregate farmers' and others knowledge as complementary to the scientific endeavour at democratic and participatory solutions. It is important to point out that nobody is better prepared than the leadership of scientific community to understand the intricacies of natural phenomena to expand science and to develop technologies.

Therefore, it is not difficult for CNPGC-EMBRAPA to use the approaches of Figure 10.1 and 10.4. The key aspect is change in the cultural "conception" of the institutional instruments to generate and disseminate the information, which have so far followed a traditional "top-down" approach, and at the same time, have not taken into account the characteristics of farmers' information networks. In order to change the "traditional" culture into an integrative effort, Cobbe (1993) has pointed out that the communication process and content require special care, and the participation of social scientists, particularly communication specialists in the interdisciplinary team.

In addition to communication issues, CNPGC-EMBRAPA has also favoured methods associated with mass media, mainly written communication (see section 10.2.1). In contrast to this, however, there is evidence from this research that, at present, the majority of the farmers do not like to read, while television alone was presented as having potential for complementary communication with farmers (see Chapter 6 and Chapter 8). From this context, four hypotheses arise:

- (i) the rationality of CNPGC-EMBRAPA could be based on a false illusion that the farmers, in the region, are users of mass media following current "patterns" of urban societies;
- (ii) according to Garforth (1986), the farmers do not use the mass media because the *quality* and *relevance* of media content do not satisfy the perspective of the farmers;
- (iii) it could be a combined effect of both or even an issue related to how to stimulate the majority of the farmers using mass media to obtain information;

(iv) CNPGC-EMBRAPA has favoured mass media to others “actors” such as agricultural professionals (technical assistants, University teachers, sellers), policy makers, banking personal, GOs, NGOs, etc., who are directly or indirectly involved with farmers, as indirect way to disseminate information to farmers. A clear understanding of these issues is important for CNPGC to communicate with its clients.

The framework of Figure 10.4, therefore, considers mass media as a complement in the information flow rather than a centralised focus. Complementary action is applied also with technical seminars and training courses, since the majority of the farmers did not consider such mechanisms important for them in order to obtain knowledge and information (see Table 6.36 in Chapter 6). Although there is evidence from case studies that some farmers with higher education level use such mechanisms to obtain information, they are not exclusive, and the observation “in loco” is still preferred (see Chapter 8). However technical seminars, training courses and written information are generally recognised as adequate mechanisms to transfer knowledge and information for technical professionals, but a differentiation in content and relevance of these mechanisms in relation to target public must be applied.

The demand for the amount and quality of information is growing fast and society has benefited from a new era of electronic and computing facilities. However, there is evidence from this research that on average, farmers are not using these facilities in order to obtain information (see Chapter 6). This research did not identify the reasons, but issues related to socio-economic factors such as cultural, human skills, level of education, age and financial condition to access these facilities are the most probable. Other hypotheses comprise unavailability of information or even problems related to applicability and communicability of information. Garforth (1986) has pointed out that uneven distribution of skills and access to communication technology may increase the relative disadvantage of less favoured groups. However, communication through electronic computing facilities cannot be left aside from an

agricultural information system in a country like Brazil, where the agribusiness has an important role in the domestic and global economies. Agricultural professionals, farmers, younger farmers' successors and other people involved in farm businesses, who have education and skills, are naturally users of electronic computing facilities. These perceptions, by themselves, justify the incorporation of this mechanism into a complementary information action.

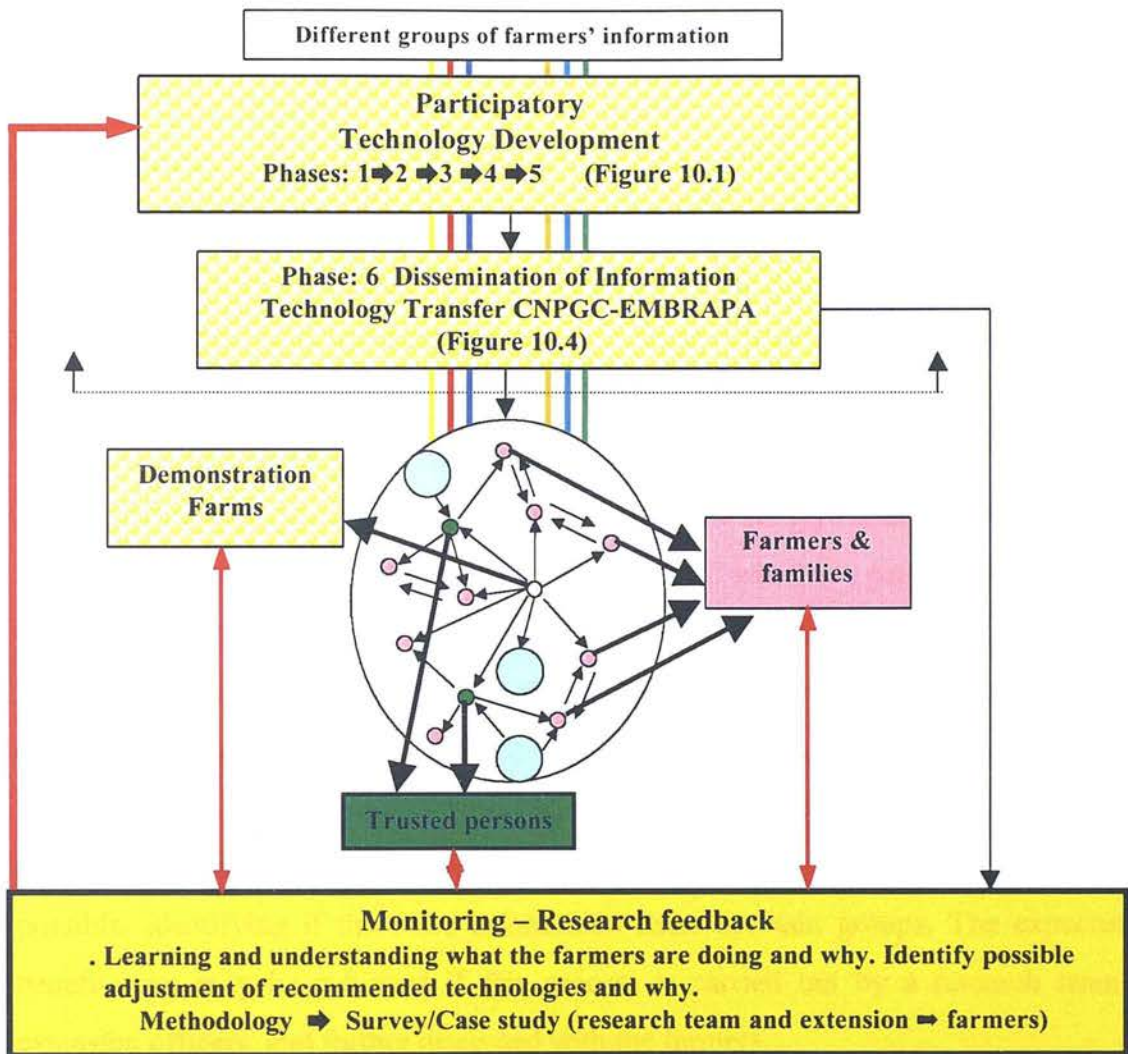
It is important to point out that this approach links the development of a *formal* knowledge (research) to the farmers' *informal* knowledge networks. This is expected because the knowledge is developed using a participatory approach (real needs) and presented through key elements of the networks (mechanisms, people and communication), and finally disseminated among the members of the networks through their usual informal mechanisms.

### ***Monitoring - Research feedback***

It has been pointed out in this thesis that farmers adjust the technologies to their particular situation (see section 10.3.1). In doing so, knowledge is transformed into practices that better fit to the production systems (Röling, 1990; Ferreira, 1997). The reasons for such adjustments, therefore, comprise an important feedback for research within a dynamic knowledge information system (see Chapter 4).

Figure 10.5 represents, conceptually, a monitoring process to understand farming practices and identify the reasons for possible adjustments of the recommended technologies. Although, the information is to be generated within a participatory approach with farmers, where the farmers' need and realities of the different groups are taken into account, nobody can expect that information (technology) is not subjected to adjustment as consequence from dynamics of physical, environmental and socio-economic conditions.

Figure 10.5: Monitoring – Research Feedback



Monitoring has not been a priority in the research agenda of CNPGC-EMBRAPA.

The reasons can be pointed as being:

- (i) the research team is more concerned with new “discoveries” within the research endeavour;
- (ii) traditionally, in a restrict sense, monitoring does not provide status to the researcher;
- (iii) monitoring is time and resource demanding, which competes with the traditional biological research lines;
- (iv) lack of an adequate institutional policy of R&D;

(v) monitoring has been considered solely as an attribution of socio-economic researchers, who, in general, have been focused to cost/benefit analysis to attend government and funding institutions.

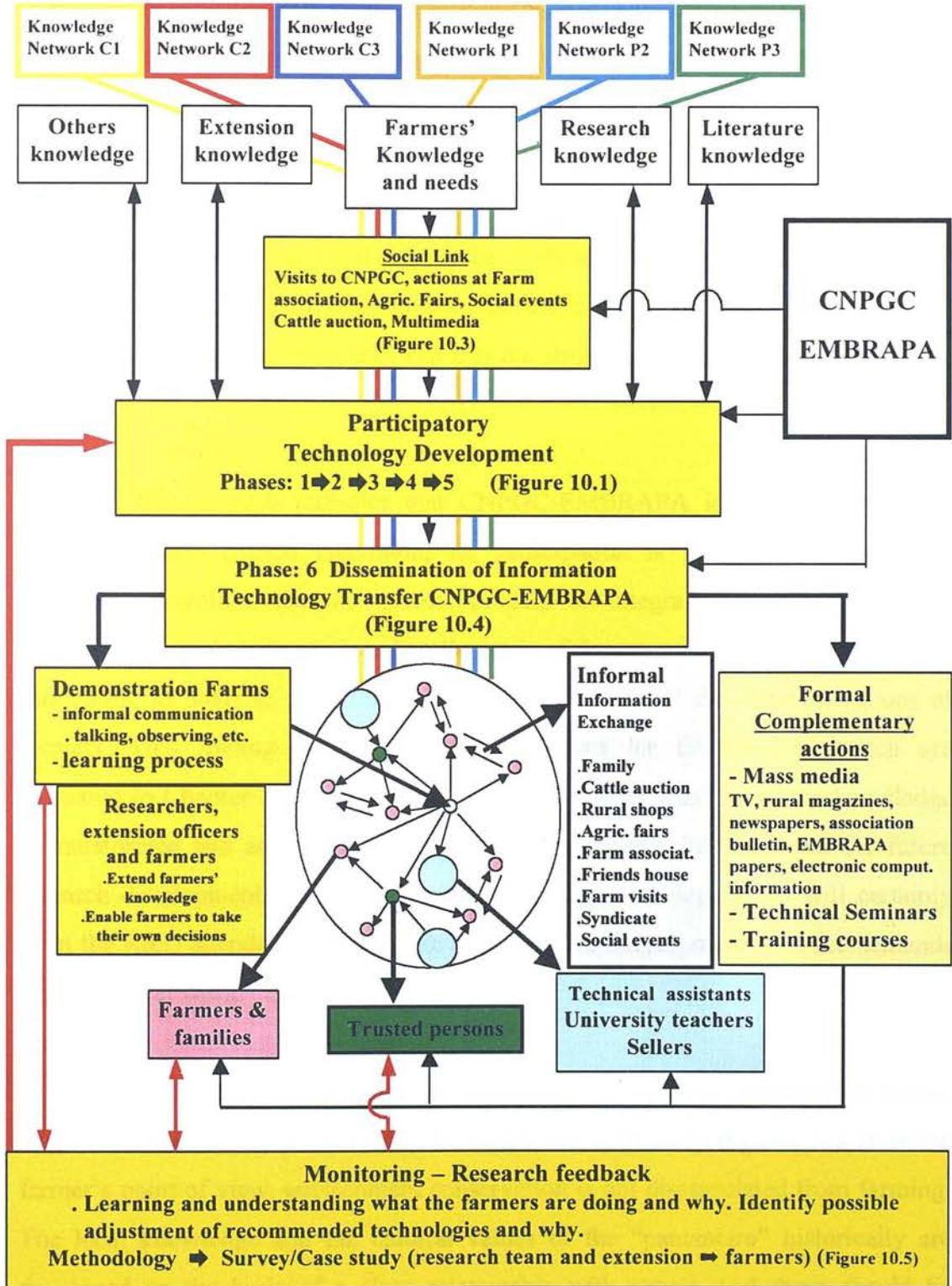
Another vision of monitoring is, therefore, introduced in the above approach and a high priority in the research agenda is expected. In this approach, *qualitative analysis*, qualitative inquiry, is the focus rather than the traditional cost/benefit analysis on the basis of quantitative data. Such vision is in agreement with (Midmore, 1996, 1998).

Firstly, the monitoring methodology (e.g. survey/case study) should assure that the target sample comprises farmers and “trusted persons” who have participated directly in the process of technology dissemination (e.g. visits to the demonstration farms). Secondly, the target sample should also include farmers that did not participate directly in the process. The latter group could provide an indication of the efficacy of the information dissemination and associated knowledge transformation. Thirdly, the monitoring process must be extended for the different groups of farmers, and if possible, identifying if there are information links between groups. The expected benefits can only be achieved if this process is carried out by a research team, extension officers, and further discussed with the farmers.

Finally, Figure 10.6 comprises a synthesis of the modules and represents an expanded conceptual model to create and disseminate technology for beef farmers, applied to the case CNPGC-EMBRAPA. This synthesis specifically addresses the hypotheses of this thesis and comprises a key step towards improving an institutional research approach.



Figure 10.6: An expanded participatory conceptual model to create and transfer technology for beef farmers, applied to CNPGC-EMBRAPA



## 10.6 Conclusion

A primary conclusion stemming from this Chapter is that the research hypotheses were adequately formulated to the selected agricultural context, and that the methodological approaches applied to this research provided key important insights concerning the issues of the hypotheses. The insight into the farmer's information networks comprises a key contribution to understanding how farmers develop their knowledge. The most important point is that there are different information networks closely related with the socio-economic characteristics of the FD-MUs (exemplified by the case studies), and that the networks are strongly linked on the basis of social links.

Although this research indicates that CNPGC-EMBRAPA is well respected and considered as a trusted institution, its participation is peripheral within these networks. Therefore, the institutional process of integration within the farmer communities needs to be reviewed on the basis of the conceptual model presented in this thesis, in order to meet the technological demands of the different groups of farmers. This finding has important implications for EMBRAPA, which are discussed in Chapter 11. However, understanding “how” and “why” the knowledge is transformed and adjusted in the networks comprises a key feedback for future research development. The implementation of such a research focus will certainly open the R&D agenda to approximate technological development with the demands from the “real world” of the FD-MUs.

A key example from this research is that, at present, basic concepts of nature conservation are well known among the farmers in both study regions, but from the farmer's point of view, environment conservation is not disassociated from farming. The local knowledge and the cultural values of the “pantaneiro” historically are developed on the basis of a close relationship with nature, and these should be properly acquired and explored in order to bring a contribution to protect and understand better the complex Pantanal. The discussion concerning the

understanding of the relations between the FD-MU and the environment indicated that this knowledge field should be explored further, since there is strong evidence of its implications in the farming life of a community, which in turn also has implications for policies and technology development.

Finally, within this thesis, it has been possible to bring case study/empirical evidence to support a conceptual framework for a beef cattle knowledge information system where farming problems, technological innovation and information dissemination are developed under a learning participatory approach, in which the participation of the farmer's knowledge and needs are the crucial and key components of system's synergism and efficiency. The implications of this, and other key findings of the research, are presented in Chapter 11.

# Chapter 11

## Implications and Recommendations

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### 11.1 Introduction

This thesis is concerned with the process of generating and disseminating technological innovations for a beef cattle knowledge information system. The research problem evolved from issues following from a rapid regional development within the Brazilian beef industry. An overview of agricultural research and transfer of technology provides evidence of the need to review the institutional approaches of agricultural research agencies to face the new paradigms, with EMBRAPA cited as the case study. Further, the complexities of the process of farm decision making and its interdependency with the social construction of knowledge were highlighted. In addition, it was emphasised that a participatory learning approach associated with changing in institutional culture to research is required, in order to overcome the neglect of farmer knowledge in conventional technological innovation.

The social characteristics of the research problem were addressed satisfactorily worked out through the combination of quantitative and qualitative methods. The literature review had provided the background concerning the techniques, and at the same time highlighted the importance of social science methods for dealing with the behavioural complexities of decision-making, which cannot be studied solely through the use of numerical values. Finally, data were obtained and analysed, the research hypotheses were discussed and a conceptual framework of a dynamic, participatory knowledge information system taking into account the diversity of the group of farmers was proposed. The aim of this Chapter is a summary of key points from the methodological approach adopted in this thesis together with important reflections for government, research and extension.

## **11.2 Methodological approach**

The aim of this sub-section is to highlight a number of key points concerning the methodological approaches applied within this research, as a contribution for potential users of this approach and for those interested in methodology development.

Firstly, and most importantly, the combination of quantitative and qualitative methods in this thesis has been demonstrated as an adequate set of complementary methodological approaches in order to elicit data to assess the key research issues. In this case, the questionnaire was an indispensable methodology providing standardised data on characteristics and possible “patterns” of population behaviour. Information on a large number of variables from farmers were obtained, allowing the application of statistical procedures in order to make comparisons between regions and explore relationships (e.g. factor and cluster analysis to find groups of farmers according to the selected variables), which otherwise could not be obtained with confidence. On the other hand, qualitative data from in-depth interviews of representative cases were appropriate for obtaining deep insights into the research issues which otherwise could not have been obtained. In fact, the application of in-depth interviewing, in this case, has confirmed the findings in the literature review that this methodology is the best way to find and to explain reasons of the “how” and “why” of human behaviour and attitudes, by providing opportunity for interviewees to express feelings and perceptions about their realities. However, the case study approach takes time and in general cannot be applied to a large sample, and the interviews should therefore rely on representative cases. In addition to these overall observations, more specific points are presented as follows:

### **11.2.1 Methodological background**

Firstly is crucial that the researcher has an in-depth knowledge of the implications and relationships of the key methodological steps before starting with the field research. Although this seems to be obvious, it is natural that the researcher tends to concentrate

on the design of the questionnaire without knowing the proper implications and relationships with later steps such as multivariate analysis and case studies. A full understanding of these steps is necessary in order to explore efficiently the potential of this approach. A key question, for example, is: what are the implications related to nominal, categorical, ordinal and numerical (continuous and discrete) variables in a multivariate analysis? Other questions such as *how many*, *what* kind or *how* the variables should be selected to be used into multivariate analysis in order to find possible groups of farmers, need to be answered before field research begins. However, it appears much more important that the researcher can clearly visualise the interdependence of all steps within a theoretical framework. Apart from Creswell (1994) who has brought contributions to the theoretical discussion of paradigms related with combination of quantitative and qualitative methods and theoretical models, some of these issues appear to require better clarification within the social research literature. The author feels that the available information needs to be improved, since there is no consistent orientation in the literature with examples from social research, which can be used in order to help researchers to take their initial methodological decisions. Such issues have serious implications for questionnaire design, and are discussed below.

### 11.2.2 Questionnaire

There is substantial information available from literature to support the technical design of a questionnaire as an isolated methodology to elicit data. However, it seems important to aggregate theoretical background and procedures as fundamentals to accomplish the combination of questionnaire (survey - quantitative data), multivariate analysis (selection of representative cases for case studies) and in-depth interview (case studies – qualitative data) within a “complete” (enlarged) theoretical framework. These reasons, in addition to the questions in the above section, comprise a significant debate on how to accept qualitative data from a small number of cases as representative “perceptions” of an entire group, since what people say is subjected to personal emotion, individuality, character and personality. Although “repetition” of case studies and “triangulation” have

been presented to identify indication and confirmation of “patterns” (Yin, 19984), it seems there is space to explore procedures taking into account the questionnaire as a way to link the information from case studies and the entire population sample. In fact, the questionnaire could be used as an integrated part, strategically planned for this purpose. For example, some “clues” related to the questions to be applied to the case studies could be included within the questionnaire to find indicators of “patterns”. Of course, this needs to be developed into a theoretical base, but most important is that the questionnaire and case study should be thought of as being within a theoretical framework rather than as isolated methodologies.

### **11.2.3 Multivariate analysis (factor and cluster analysis - identify group of farmers)**

The available computer packages (e.g. SPSS) facilitates the application of multivariate analysis. However a key aspect of such an analysis is the selection of the variables to be used in order to achieve a purposeful outcome. This selection should be focused in the direction of those variables or group of variables, which represent best the aim of the analysis. For example, in this thesis, only two groups of variables related with *information* and *social attributes* were selected, since the purpose of the analysis was to group farmers according to these aspects, even though the survey (questionnaire) provided data on many other aspects. It may also advisable to carry out the factor analysis separately for each group of variables in order to reduce the data into factors representing the groups of variables to be used in the cluster analysis. Once satisfactory clusters have been identified, a key point is the selection of representative cases for further analysis. In this research, an objective approach was applied, based on the smallest “distance” from the cases to the center of the cluster. However, other statistical procedures can be applied, such as discriminant analysis (see Ferreira, 1997 and SPSS, 1993).

#### **11.2.4 Case study (in-depth interview - identify the social knowledge networks)**

Guidance on operation and analysis of in-depth interviews is described in the literature (Patton, 1983; Yin, 1984; Patton 1990; Robson, 1996). The in-depth interview comprised an adequate method to trace back and to understand the social construction of the farmers' knowledge network. However, given the complexity of the social construction of farmers' knowledge associated with the large diversity of farm decision making, it seems important to define a priori "what" level and knowledge focus we are interested in studying. For example, a detailed and deep insight cannot be obtained if the knowledge is treated in a general sense, since farmers use different information networks for the different levels of decisions. In addition, a strategy of interviewing the nominated "trusted" persons as complement, in order to trace back the network, comprises an important experience from this thesis. Further, the semi-structured nature of the interview based on the thesis hypotheses comprised a key strategy for carrying out and analysing the qualitative data from the interviews, since it facilitated a clear focus upon the research issues. However, it is also important to note that the success in obtaining the desired data also depends on the ability of the interviewer to adapt the interview course to facilitate the discovery of unanticipated issues.

### **11.3 Implication for policy makers: government, research and extension**

#### **11.3.1 General policies**

- Locally, Brazilian farmers are facing economic difficulties as a result of decreasing meat prices and an unfavourable relation between cost of inputs and value of product. At the same time, there are new challenges to increase the efficiency and sustainability of the beef production systems, such as recovering degraded pastures and minimising future depletion of natural resources. An eco-regional approach is indicated as a framework unit to take decisions at different levels in order to face the issues of sustainable development. An eco-regional approach should be understood



as a methodological framework to aggregate the components of a specific system. In addition, biophysical and socio-economic knowledge can be acquired and developed to understand better how farming is or should be operated within limited geographical regions.

- The challenge of sustainable food production requires participatory actions, which must be initiated at the farm level as the centre of the issue. That is, it is no longer sufficient to consider farmers solely as primary producers: rather, they must also be considered as managers of ecosystems. However, in general, farmers have minimal capital to invest (i.e. to recuperate the productivity of the pastures and to control soil erosion), and the government has not provided any sign of change in the policy of absence of financial support for beef cattle farmers.
- This thesis has emphasised that rural people's knowledge is a valuable resource that has been overlooked for scientific and policy decisions; in addition, the diversity of farmer's goals, objectives and needs have not been considered adequately by the policy makers. In this way, a participatory approach has been presented as a better way to reduce the distances between the farmer and decision-makers. An embodied consensus to involve rural people's knowledge is crucial in order to achieve sustainable development.

In supporting the above points, this author identifies the following specific perceptions within the thesis:

### **11.3.2 Government policies**

- The satisfaction of farmers has been negatively affected by the recent economic planning (see section 6.13 in Chapter 6). Although there is an agreement with the policy to control inflation, the farmers disagreed with undue impact on price relation of input/products (see section 8.2.2.1 in Chapter 8) .

- A strong feeling of pessimism, lost of importance and uncertainty is generalised among the farmers, and the extent of this socio-economic impact has not been predicted (see Box 8.8 in Chapter 8).
- The farmers are reducing operational, maintenance and investment costs in order to cope with the present economic situation, which to some extent is leading to undesirable environmental effects and reduction of job opportunities in the rural areas (see Boxes 8.8 and 8.9 in Chapter 8).
- In spite of past mistakes, basic concepts of nature conservation are well known among the farmers, but their understanding of nature conservation is not disassociated from farming activities (see Box 8.14 in Chapter 8), which should be considered into environmental policies.
- The perception of nature conservation in Pantanal was developed through farm family generations of “pantaneiros”, which must be preserved as a way to protect that environment.
- No doubts remains that the farmers are upset with the internal and external pressures of the environmental issues on farming, which, associated with land invasion and unfavourable policies, constitute new stressful factors affecting farm family stability (see Box 8.8 and section 8.2.3 in Chapter 8).
- As part of society, and an as agent directly involved with nature, the farmer would like to participate with his/her knowledge and experience to create environmental and agricultural policies (see Box 8.14 in Chapter 8).
- This thesis has shown that the farmers can be clustered according to goals, objectives, attitudes and information (see Chapter 7); this is evidence of the diversity of farmer groups, which contrast with the misunderstanding and usual pragmatic approach of considering the farm units as similar in the context of agricultural policies.

### 11.3.3 Research policies

- It is urgent and necessary to review the conventional approach of neglecting local farmer knowledge in the process of technological innovation. It is crucial to understand that, to consider farmer knowledge in the process of technological innovation, it is necessary to change the traditional attitude in order to experiment with a new complementary, participatory and learning approach, as suggested in this thesis.
- The current situation demands mobilisation of all types of available knowledge from those directly involved in agriculture, which can only be gathered through steady actions to select, compile and to explore the interfaces between the different sources without restrictive labelling as indigenous, local, practical, applied, or scientific.
- Institutional mobilisation is necessary to change a rooted productivist culture which has dominated the technological innovation, towards a more “friendly approach” that identifies the rules that govern the decisions of the FD-MUs as “preparation” before innovations are researched. In fact, it is necessary: (a) to induce change in the institutional culture from a top-down attitude to a learning and participatory action together with farmers enabling the researchers to understand in-depth farmers’ needs and integrate farmers’ knowledge into research endeavour; (b) to explore the social links of the information networks in order to facilitate technology development and information dissemination.
- The need of support from sociological studies to pursue these new ways ahead is clear and crucial; this can only be achieved by integrating sociologists into the existing research teams.
- No doubt remains that EMBRAPA must review the high input technological alternative of recovering the degraded pastures in order to aid those farmers, whose capital is scarce, but who are equally important in the social context of beef meat production.
- Finally, a “pilot” test of the conceptual model developed in this thesis should be locally carried out in order to validate and adjust it to the realities of technological

innovation environments. It is expected that such a pilot test of all phases of the diagram presented in Figure 10.1 (Chapter 10) would be a worthwhile learning process for all participants (farmer, research, and extension). In this way, a thematic technical problem could be elicited from the different groups of farmers to be worked out following the recommended participatory steps. Equally important should be selection of an information network to explore and understand “how” to “utilize” the social links and mechanisms for information dissemination. In addition to this suggestion is linked an awareness of context as a key element of the model feasibility. In fact, a “pilot” test can clarify the research agenda.

#### **11.3.4 Extension policy: farm decision making unit and knowledge information systems**

- The process of the FD-MU is complex because it is dynamic and continuous to achieve often conflicting multiple goals and objectives in an uncertain environment. The dynamic element is probably the most important characteristic of the decision process. Multiple goals and objectives of the farm family unit, including non-monetary values, is common among farmers. Among other factors, socio-economic evolutions associated with needs of the farm family are responsible for the way that the goals and objective change over time. The neo-classical economic concept of decisions of “rational man”, which implies profit maximisation as the only goal, and that the decision maker lives in the world with full certainty, are not adequate in giving understanding of farm decision making.
- Any useful contribution to aid farm decision making is only possible on the basis of complementary farmers’ knowledge and an understanding of the rules that govern farm decision making. Complementary here means that the farmers’ knowledge should be enlarged through an integrated action, which begins with identification of farmers’ needs, generates technology to addressed needs and explicates relations and fundamentals supporting the technological information, in such a way, that the farmers can understand them in their production context and make their own

decisions. This is in contrast with the traditional linear top-down fashion of “closed package” (research ⇒ extension ⇒ farmer), which has guided most of the methodological approaches used to understanding farmer’s decision making and to recommend solutions. Each farmer develops his/her own action model to take decisions based on their own beliefs, values, experiences and knowledge. Locally, farmers develop their knowledge and information on the basis of experiences and interacting within social networks, with a marked relationship with “trusted persons”.

- The written word does not so far facilitate dissemination of information to the majority of the farmers, since there is strong evidence that farmers, in general, do not like to read. On the other hand, informal mechanisms by means of observing, talking and listening, which are developed through social relationships within a community, seemed to be much more effective.
- Demonstration fields at a regional leader’s farm must be explored much more as a key mechanism to disseminate information. Farmers’ preference to see the experiences “in loco”, in a similar environment to theirs, must be considered very seriously in the process of dissemination of new experiences (see sub-section 8.2.1.3 and sections 8.3 in Chapter 8, and Appendix 8.1).
- Rural programs on television were confirmed as a powerful mechanism to communicate with the farmers. This seems to be an effective way to be associated with demonstration fields in order to improve the transferring of information. In this way, it seems to be also opportune to point out that the communication should be directed to “empower” the farmer to take decisions as a learning process.
- Locally, this thesis was innovative in identifying how the farmers’ knowledge is socially developed. It is anticipated that the identified frameworks of the different existing knowledge information networks will provide a useful contribution to improve the efficiency of information dissemination. However, the most important aspect to be considered institutionally is that there is no “configuration” for a unique “recipe” of mechanisms to be followed in order to improve the efficiency of information transfer. Each group of farmers demands a specific combination of the

mechanisms, according to the characteristics of each farmer knowledge information system and interest.

- It appears crucial for EMBRAPA to understand that it is necessary, firstly, to establish a “friendly” dialogue, and social relationships, with the existing farmer groups and their social networks in order to reduce the distance from the majority of the farmers to improve institutional efficiency. In fact, it is necessary to think in mechanisms, which create social opportunities for EMBRAPA to express its common “grounds” with farmers’ interest and to demonstrate that it is able to aid the farmers in solving their problems, and to integrate the institution into the social information networks.

#### **11.4 Implications for research**

- Social science plays a crucial role in understanding and finding solutions for farm decision making, in the context of research issues. Methodological approaches different from those for dealing with natural phenomena (e.g. statistical analysis) are necessary to study and understand the farmer, farm family and local farm community as the central actors of farming and environmental decisions.
- Monitoring and identifying “how” and “why” farmers are adjusting EMBRAPA’s technology appears as an important institutional step in a way to integrate farmer’s knowledge and experience in the process of technological innovation. Although this thesis brought forward evidence that the technologies are being adjusted, it is necessary for additional and specific research to be carried out in this way.
- Further research is necessary to identify the rules and the social complexities that govern the process of beef farm decision making, as a contribution to technological innovation and recommendation.
- Further research is also required in order to understand better the relations between FD-MUs and the environment, since there is strong evidence of this relationship in the farming decision-making process, which in turn has implications for technological innovation.

- Social links appear as a driving factor in the construction of farmer's information networks. It appears important to identify with the farming community "how" they think that such a link between EMBRAPA and the farmers can be socially built, in order to improve the inclusion of the institution within the networks. In this way, further and complementary research is necessary in order to understand better the social links between the farmers and their "trusted persons".

## Bibliography

- Almas, R. and Nygard, B. (1994) European values and the new biotechnologies: post-materialism or a new arena of rural-urban conflict? In Symes, D. and Jansen, A.J. (eds) *Agricultural Restructuring and Rural Change in Europe*. Agricultural University Wageningen. Wageningen. p.167-179.
- Alston, J.; Norton, G.W. and Pardey, P.G. (1995) *Science under Scarcity: principles and practice for agricultural research evaluation and priority setting*. Cornell University Press. London. 585p.
- Amanor, K.S. (1993a) Introduction. In de Boef, W.; Amanor, K.S.; Wellard, K. and Bebbington, A. (eds) *Cultivating Knowledge: genetic diversity, farmer experimentation and crop research*. Intermediate Technology Publications Ltd. p.17-19.
- Amanor, K.S. (1993b) Farmer experimentation and changing fallow ecology in the Krobo district of Ghana. In de Boef, W.; Amanor, K.S.; Wellard, K. and Bebbington, A. (eds) *Cultivating Knowledge: genetic diversity, farmer experimentation and crop research*. Intermediate Technology Publications Ltd. p.35-43.
- Amanor, K.S.; Wellard, K.; de Boef, W. and Bebbington, A. (1993) Introduction. In de Boef, W.; Amanor, K.S.; Wellard, K. and Bebbington, A. (eds) *Cultivating Knowledge: genetic diversity, farmer experimentation and crop research*. Intermediate Technology Publications Ltd. p.1-13.
- Anderson, J.R.; Dillon J.L. and Hardaker, B. (1977) *Agricultural Decision Analysis*. The Iowa State University Press. Iowa. 344p.
- Anderson, J.R.; Pardey, P.G. and Roseboom, J. (1994) Sustained growth in agriculture: a quantitative review of agricultural research investments. *Agricultural Economics*. **10**(2): 107-123.
- ANUALPEC 95 (1995) *Anuário Estatístico da Pecuária de Corte*. São Paulo. FNP, 1995. 268p.
- ANUALPEC 98 (1998) *Anuário da Pecuária Brasileira*. São Paulo: Argos Comunicação FNP, 1998. 385p.
- Arce, A. and Long, N. (1994) Re-positioning knowledge in the study of rural development. In Symes, D. and Jansen, A.J. (eds) *Agricultural Restructuring and Rural Change in Europe*. Agricultural University Wageningen. Wageningen. p.75-86.
- Arias, L.F. (1982) Una metodología para el estudio de los sistemas de producción agropecuaria. In Vaccaro, L.P. (ed) *Sistemas de Producción con Bovinos en el Tropicó Americano*. Universidad Central de Maracay. Instituto de Producción Animal. Colonia Tovar, 1982. p.29-46.
- Arruda, Z.J. and Corrêa, E.S. (1992) *Avaliação Técnico-Econômica de Sistemas de Produção de Gado de Corte: o sistema físico de produção do CNPGC*. Campo Grande. EMBRAPA-CNPGC, Março 1992. (EMBRAPA-CNPGC. Comunicado Técnico, 42). 7p.
- Ashby, J.A. (1991) Adopters and adapters: the participation of farmers in on-farm research. In Tripp, R. (ed) *Planned Change in Farming Systems: progress in on-farm research*. John Wiley & Sons. Chichester. p.273-286.
- Babu, P.V.S.C.; Dent, J.B. and Edwards-Jones, G. (1996) Common property resource



- management and the role of institutions. *The Joint Congress of International Union of Anthropological and Ethnological Sciences (IUAES) and the International Geographers Union (IGU) "Livelihoods from Resource Flows"*. Linköping University, Sweden, August 19-22. 1996. (In press).
- Barcellos, A. de O.; Leite, G.G.; Vilela, L.; Hutton, E. M.; Souza, F.B.; Andrade, F.P. de; Zoby, J.L.F.; França, D.M.S.; Souza, M.A and Karia, C.T. (1990) *Recomendações para formação e utilização de pastagens de capim vencedor*. Planaltina: (EMBRAPA-CPAC. Comunicado Técnico, 58). 6p.
- Barcelos, A. de O. (1996) Sistemas extensivos e semi-extensivos de produção de pecuária bovina de corte nos Cerrados. In *Simpósio sobre os Cerrados 8.; International Symposium on Tropical Savanas.,1*. Brasília 1996. Planaltina: EMBRAPA-CPAC. p.130-136.
- Barros, A.L. de (1998) *Gente Pantaneira: crônicas de sua história*. Lacerda Editores. Rio de Janeiro. 251p.
- Bartlett, C.D.S. and Ikeorgu, J.E. (1979) Selecting innovations for small farmers. In *Rapid Rural Appraisal: A Conference held at the Institute of Development Studies*. 1979. University of Sussex.
- Bebbington, A.J. (1994) Composing rural livelihood: from farming systems to food systems. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.88-93.
- Belshaw, D.G.R. (1978) Village viability assessment procedures in Tanzania: decision-making with curtailed information requirements. In *Rapid Rural Appraisal. Workshop on Rapid Rural Appraisal held at Institute of Development Studies*. 1978. University of Sussex.
- Benfer, A.R. and Furbee, L. (1990). Knowledge acquisition lessons from anthropology. *AI Applications*. 4(3):19-26.
- Bennett, J.W. (1986) Research on farmer behaviour and social organisation. In Dahlberg, K.A. (ed) *New Directions for Agriculture and Agricultural Research: neglected dimensions and emerging alternatives*. Rowman & Allanhheld. Totowa. p.367-402.
- Béranger, C. and Vissac, B. (1994) An approach to livestock farming systems: theoretical and methodological aspects. In Gibon, A. and Flamant, J.C. (eds) *The Study of Livestock Farming Systems in a Research and Development Framework. Proceedings of the Second International Symposium on Livestock Farming Systems*. Saragossa, September 11-12, 1992. EAAP Publication No. 63, 1994. p.5-16.
- Bianchin, I.; Honer, M.R.; Nunes, S. and Nascimento, Y.A. do. (1995) The effect of stocking rates and treatment schemes on the weight gain of weaned Nelore steers in Brazilian savana. *Tropical Animal Health and Production*. 27:1-8.
- Botchway, J. (1993) Implications of farming and household strategies for the organisation of a development project. In de Boef, W.; Amanor, K.S.; Wellard, K. and Bebbington, A. (eds) *Cultivating Knowledge: genetic diversity, farmer experimentation and crop research*. Intermediate Technology Publications Ltd. p.27-34.
- Box, L. (1986) Commoditisation and the social organisation of crop reproduction: conceptualisation and cases. In Long, N.; van der Ploeg, J.D.; Curtin, C. and Box, L. *The Commoditization Debate: labour process, strategy and social*

- network. Agricultural University Wageningen. p.100-122.
- Box, L. (1990) Agrarian knowledge networks: a conceptualisation. In Box, L. (ed) *From Common Ignorance to Shared Knowledge: knowledge networks in the Atlantic Zone of Costa Rica*. Studies in Sociology. Agricultural University Wageningen. 28:1-7.
- Box, L. (1993) Virgilio's theorem: a method for adaptive agricultural research. In Chambers, R.; Pacey, A. and Thrupp, L. A. (eds) *Farmer First: farmer innovation and agricultural research*. Intermediate Technology Publications Ltd. London. p.61-68.
- BRASIL Ministério do Meio Ambiente, dos Recursos Hídricos e da Amazonia Legal. Secretaria de Coordenação dos Assuntos de Meio Ambiente. Programa do Meio Ambiente. Projeto Pantanal. (1997) *Plano de Conservação da Bacia do Alto Paraguay (PCBAP). Resumo Executivo*. Brasília, 1997. 49p.
- Brenner, M. (1985) Survey interviewing. In Brenner, M.; Brown, J. and Canter, D. (eds) *The Research Interview: uses and approaches*. Academic Press. London. p.10-21.
- Brenner, M.; Marsh, P. and Brenner, M. (1978) Introduction. In Brenner, M.; Marsh, P. and Brenner, M. (eds) *The Social Contexts of Method*. Croom Helm Ltd. London. p.9-15.
- Brouwers, J.H.A.M. (1993) *Rural people's response to soil fertility decline: the Adja case (Benin)*. Wageningen Agricultural University Papers. 93-4. 143p.
- Bruin, de R. and Roex, J. (1994) Farmer initiatives as countervailing power: a new approach to sustainable agricultural development. In Symes, D. and Jansen, A.J. (eds) *Agricultural Restructuring and Change in Europe*. Agricultural University Wageningen. p.195-208.
- Brum, P.A.R. and Souza, J.C. de (1985) Níveis de nutrientes minerais para gado, em lagoas ("baías" e "salinas") no Pantanal Sul-Mato-Grossense. *Pesquisa Agropecuária Brasileira*. Brasília. 20(12):1451-1454.
- Brum, P.A.R. de; Souza, J.C. de; Comastri Filho, J.A.; Almeida, I.L. de (1987) Deficiências minerais de bovinos na sub-região dos Paiaguas, no Pantanal mato-grossense. II. cobre, zinco, manganês e ferro. *Pesquisa Agropecuária Brasileira*. Brasília. 22(9/10):1049-1060.
- Bryman, A. (1989) *Research Methods an Organisational Studies*. Unwin Hyman. London. p. 34-70.
- Bryman, A. and Burgess, R.G. (1994) Development in qualitative data analysis: an introduction. In Bryman, A. and Burgess, R.G. (eds) *Analysing Qualitative Data*. Routledge. New York. p.1-17.
- Bunting, H. (1992) Feeding the world in the future. In Spedding, C.R.W. (ed) *Fream's principles of food and agriculture*. Blackwell Scientific Publications. London. p.256-290.
- Burgess, R.G. (1982) Approach to field research. In Burgess, R.G. (ed) *Field Research: A Sourcebook and Field Manual*. George Allen & Unwin. London. p 1-9.
- Bywater, A.C. (1990) Exploitation of the systems approach in technical design of agricultural enterprises. In Jones, J.G.W. and Street, P.R. (eds) *Systems Theory Applied to Agriculture and the Food Chain*. Elsevier Applied Science. London. p.61-88.
- Canter, D.; Brown, J. and Groat, L. (1985) A multiple sorting procedure for studying

- conceptual systems. In Brenner, M.; Brown, J. and Canter, D. (eds) *The Research Interview: uses and approaches*. Academic Press. London. p.79-114.
- Capriles, M. (1982) Sistemas de producción de leche y carne para los Llanos Occidentales Venezolanos. In Vaccaro, L.P. (ed) *Sistemas de Producción con Bovinos en el Tropico Americano*. Universidade Central de Maracay. Instituto de Producción Animal. Colonia Tovar, 1982. p.89-112.
- Centro de Gado de Leite-EMBRAPA (1994) *Desafios para Pesquisa de Sistemas Pecuários : Workshop sobre modelos físicos de produção*. Centro Nacional de Pesquisa de Gado de Leite-EMBRAPA. Coronel Pacheco, 1994. 78p.
- Cezar, I.M. (1981) Modelo bioeconômico de produção de bovinos de corte. I. Descrição do modelo. *Pesquisa Agropecuaria Brasileira*. 17(6):941-949.
- Cezar, I.M. (1982a) Modelo bioeconômico de produção de bovinos de corte. II. Avaliação econômica na introdução de pastagem cultivada em um sistema extensivo de cria no Brasil Central. *Pesquisa Agropecuaria Brasileira*. 17(7):1093-1104.
- Cezar, I.M. (1982b) Uma retrospectiva dos trabalhos em sistemas no Centro Nacional de Pesquisa de Gado de Corte. In Instituto Interamericano de Cooperación para la Agricultura (IICA). Convenio IICA-Cono sur/BID. *Dialogo III. Seminario sobre sistemas en investigación agropecuaria*. Montevideo, 1982. p.87-97.
- Cezar, I.M. (1994) Importancia dos modelos físicos de sistemas de produção animal em instituições de P&D. In Centro de Gado de Leite-EMBRAPA *Desafios para Pesquisa de Sistemas Pecuários: Workshop sobre modelos físicos de produção*. Centro Nacional de Pesquisa de Gado de Leite-EMBRAPA. Coronel Pacheco, 1994. p. 61-64.
- Cezar, I.M. (1995) Sistemas alternativos de produção de novilho precoce. In *Anais do 1º Encontro Nacional de Novilho Precoce*. Secretaria de Agricultura do Estado de São Paulo-CATI, Campinas, SP. p.39-55.
- Cezar, I.M.; Euclides Filho, K. (1996) Novilho precoce: reflexos na eficiência e economicidade do sistema de produção. Campo Grande. EMBRAPA-CNPQC. Documentos 66. 31p.
- Chambers, R. (1992) *Rural appraisal: rapid, relaxed and participatory*. Discussion Paper 311 Institute of Development Studies. October 1992. 90p.
- Chambers, R. (1993) Reversals, institutions and change. In Chambers, R.; Pacey, A. and Thrupp, L. A. (eds) *Farmer First: farmer innovation and agricultural research*. Intermediate Technology Publications Ltd. London. p.181-195.
- Chambers, R. (1994a) *Challenging the Professions: frontiers for rural development*. Intermediate Technology Publications Ltd. London. 143p.
- Chambers, R. (1994b) Foreword. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.xiii-xvi.
- Chambers, R.; Pacey, A. and Thrupp, L.A. (1993). Introduction. In Chambers, R.; Pacey, A. and Thrupp, L.A. (eds) *Farmer First: farmer innovation and agricultural research*. Intermediate Technology Publications. p.xvii-xx.
- Checkland, P. and Scholes, J. (1993) *Soft Systems Methodology in Action*. John Willey & Sons. Chichester. 329p.
- Child, D. (1990) *The Essentials of Factor Analysis*. Cassell Education Ltd. London. 120p.

- Chudleigh, P.D. and Cezar, I.M. (1982) A review of bio-economic simulation models of beef production systems and suggestions for methodological development. *Agricultural Systems*. 8(4): 273-289.
- Cicourel A.V. (1967) *Method and Measurement in Sociology*. Collier-Macmillan Canada Ltd. Toronto. 247p.
- Clark, J. and Murdoch, J. (1997) Local knowledge and the precarious extension of scientific networks: a reflection on three case studies. *Sociologia Ruralis*. 37 (1): 38-60.
- Clay, E.J. (1978) Direct and indirect methods of observation in rapid rural appraisal. *In Rapid Rural Appraisal. Workshop on Rapid Rural Appraisal held at Institute of Development Studies*. 1978. University of Sussex.
- CNPC (Conselho Nacional de Pecuária de Corte) (1993) Indicadores da pecuária bovina no Brasil. *DBO Rural*. Ano 13, N 174-A.
- Cobbe, V.R. (1993) *Agricultural Knowledge & Information Systems: concepts and models*. University of Wisconsin-Madison. Department of Agricultural Journalism. Bulletin 45. June 1993. 100p.
- Coelho, R.W. (1982) Um sistema pecuarário para produção de carne no Rio Grande do Sul. *In Instituto Interamericano de Cooperación para la Agricultura (IICA). Convenio IICA-Cono sur/BID. Dialogo III. Seminario sobre sistemas en investigación agropecuaria*. Montevideo, 1982. p.109-112.
- Collinson, M. (1979) Understanding small farmers. *In Rapid Rural Appraisal: A Conference Held at the Institute of Development Studies*. 1979. University of Sussex.
- Collinson, M. (1988) The development of African farming systems: some personal views. *Agricultural Administration & Extension*. 29(2): 7-23.
- Conlin, S. and Wiggins, S. (1979) A review of the December 1979 conference and its papers. *In Rapid Rural Appraisal: A Conference Held at the Institute of Development Studies*. 1979. University of Sussex.
- Conway, G.R. (1990) Agroecosystems. In Jones, J.G.W. and Street, P.R. (eds) *Systems Theory Applied to Agriculture and the Food Chain*. Elsevier Applied Science. London. p.205-234.
- Conway, G.R. and Barbier, E.B. (1990) *After the Green Revolution: sustainable agriculture for development*. Earthscan Publications Ltd. London. 205p.
- Cornwall, A.; Guijt, I. and Welbourn, A. (1994) Acknowledging process: challenges for agricultural research and extension methodology. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.98-117.
- Corrêa, A.S. (1994) *Produção de Carne no Brasil Central: problemas e perspectivas*. EMBRAPA-CNPGC, Campo Grande. 25p.
- Corrêa, A.S.; Arruda, Z.J.; Corrêa, E.S.; Kessler, R.H.; Figueredo, G.R.de; Ruiz, M.E. and Carvalho, E.G. de (1985) *O Sistema de Produção de Gado de Corte Implantado no CNPGC*. Campo Grande: EMBRAPA-CNPGC, 1985 (EMBRAPA-CNPGC. Documentos, 32). 31p.
- Corrêa, E.S. (1986) Modelo Físico de Produção - o caso do Campo Experimental de Terenos, MS. In *Anais Reunião Annual da Sociedade Brasileira de Zootecnia*, 23. Campo Grande. p.419.
- Corrêa, E.S. (1994) *Avaliação dos Desempenhos Reprodutivo e Produtivo em um*

- Sistema de Produção de Gado de Corte*. MS Thesis. UNESP. Campus de Jaboticabal, São Paulo. Faculdade de Ciências Agrárias e Veterinárias. 106p.
- Corrêa, E.S. and Arruda, Z.J. (1988) *Avaliação Preliminar do Sistema de Gado de Corte Implantado no CNPGC, período 1983/84 a 1986/87*. Campo Grande, EMBRAPA-CNPGC, 1987. (EMBRAPA-CNPGC. Documentos, 38). 30p.
- Corrêa, E.S.; Cezar, I.M.; Vieira, A.; Boock, A. (1998) A difusão e transferência de tecnologia no CNPGC. Campo Grande: EMBRAPA-CNPGC- Programa 13 Suporte a programas de desenvolvimento rural e regional Projeto 13.094.161. Relatório Projeto em Andamento. 10p.
- Cox, P.G. (1996) Some issues in the design of agricultural decision support systems. *Agricultural Systems*. **51**(3): 1-27.
- Creswell, J.W. (1994) *Research Design: qualitative & quantitative approaches*. SAGE Publications. London. 228p.
- Crosson, P. and Anderson J.R. (1993) *Concerns for Sustainability: Integration of Natural Resources and Environmental Issues in the Research Agendas of NARS*. ISNAR Research Report No 4. The Hague: International Service for National Agricultural Research. 43p.
- Cubillos, G. (1982) Sistemas de producción de leche en las zonas tropicales. In Vaccaro, L.P. (ed) *Sistemas de Producción con Bovinos en el Trópico Americano*. Universidade Central de Maracay. Instituto de Producción Animal. Colonia Tovar, 1982. p.59-74.
- de Wit, C.T. (1990) Understanding and managing changes in agriculture. In Jones, J.G.W. and Street, P.R. (eds) *Systems Theory Applied to Agriculture and the Food Chain*. Elsevier Applied Science. London. p.235-249.
- Dent, J.B. (1990) Optimising the mixture of enterprises in a farming system. In Jones, J.G.W. and Street, P.R. (eds) *Systems Theory Applied to Agriculture and the Food Chain*. Elsevier Applied Science. London. p.113-130.
- Dent, J.B. (1991) Potential for systems simulation in farming systems research? *Proceedings of the International Symposium on Systems Approaches for Agricultural development*, 2-6 December, Bangkok, Thailand. p. 325-339.
- Dent, J.B. (1993) Potential for systems simulation in farming systems research. In Penning de Vries, F.W.T.; Teng, P. and Metselaar, K. (eds) *Systems Approach for Agricultural Development*. Kluwer Academic Publishers. p.325-339.
- Dent, J.B. (1994) The human response. In *Fifth International Congress for Computer Technology in Agriculture. Enabling Technologies for Land Use and Resource Management*. 29 June-5 July 1994. Stoneleigh: RASE. P.40-45
- Dent, J.B. and Anderson, J.R. (1971) Systems, management and agriculture. In Dent, J.B. and Anderson, J.R (eds) *Systems Analysis in Agricultural Management*. John Wiley & Sons Australasia Pty. Ltd. London. p.17-33.
- Dent, J.B. and Blackie, M.J. (1979) *Systems Simulation in Agriculture*. Applied Science Publishers Ltd. London. 180p.
- Dent, J.B. and McGregor, M.J. (1994) Preface. In Dent, J.B. and McGregor, M.J. (eds) *Rural and Farming Systems Analysis: European perspectives*. Cab International. Wallingford. p.xvii-xix.
- Dent, J.B.; Edwards-Jones, G. and McGregor, M.J. (1995) Simulation of ecological, social and economic factors in agricultural systems. *Agricultural Systems*. **49**: 337-351.
- Dent, J.B.; Harrison, S.R. and Woodford, K.B. (1986) *Farm Planning with Linear*

*Programming: Concept and Practice*. Butterworths. 209p.

- Dent, J.B.; McGregor, M.J. and Edwards-Jones, G. (1994) Integrating livestock and socio-economic systems into complex model. In Gibon, A. and Flamant, J.C. (eds) *The Study of Livestock Farming Systems in a Research and Development Framework. Proceedings of the Second International Symposium on Livestock Farming Systems*. Saragossa, September 11-12, 1992. EAAP Publication No. 63, 1994. p.25-36.
- Dent, J.B.; McGregor, M.J. and Edwards-Jones, G. (1996) The interaction between soil and social scientists in rural land use planning. In *The role of Soil Science in Interdisciplinary Research. American Society of Agronomy and Soil Science Society of America*. Special Publication 45. p.113-122.
- Dey, I. (1993) *Qualitative Data Analysis: A User-Friendly Guide for Social Scientists*. Routledge. London. 285p.
- Dillon, J.L. (1971) Interpreting systems simulation output for managerial decision-making. In Dent, J.B. and Anderson, J.R. (eds) *Systems Analysis in Agricultural Management*. John Wiley & Sons Australasia Pty. Ltd. London. p.85-120.
- Douglas, C.D. (1986) *The Impact of Credit Policies on Small Farm Organisation and Growth: a case study of Jamaican farmers*. Agricultural Economics Bulletin No 31. Department of Agricultural Economics and Business Management University of New England. Armidale.
- Drinkwater, M. (1994a) Knowledge, consciousness and prejudice: adaptive agricultural research in Zambia. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.32-40.
- Drinkwater, M. (1994b) Developing interaction and understanding: RRA and farmer research groups in Zambia. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.133-139.
- Duran, H. (1994) Processo de geração y desarrollo de tecnologia y modelos físicos. In Centro de Gado de Leite-EMBRAPA *Desafios para Pesquisa de Sistemas Pecuários : Workshop sobre modelos físicos de produção*. Centro Nacional de Pesquisa de Gado de Leite-EMBRAPA. Coronel Pacheco, 1994. p.40-41.
- Echeverria, L.C.R. and Gardner, A.L. (1978) *Aplicação de um Enfoque de Sistema na Pesquisa de Produção Animal*. Resumo dos temas apresentados no seminário realizado no Centro Nacional de Pesquisa de Gado de Corte, 1978. Centro Nacional de Pesquisa de Gado de Corte-EMBRAPA. Campo Grande, MS. 85p.
- Edwards-Jones, G. and Hopkins R. (1995) A knowledge-based system for predicting the environmental impacts of system level changes to European agricultural systems. *Proceedings BCPC Symposium No 63: Integrated crop protection: Towards sustainability?* 1995. p.123-130.
- Edwards-Jones, G. and McGregor, M. (1994) The necessity, theory and reality of developing models of farm households. In Dent, J.B. and McGregor, M. (eds) *Rural and Farming Systems Analysis: European perspectives*. Cab International. Wallingford. p.338-352.
- EMBRAPA (1990) *CAPIM Tanzania I*. Campo Grande : EMBRAPA-CNPGC, 1990. Folder.

- EMBRAPA Centro Nacional de Pesquisa de Gado de Corte (1984). *Brachiaria brizantha cv. marandu*. Campo Grande: (EMBRAPA-CNPGC. Documentos, 21).
- EMBRAPA Centro Nacional de Pesquisa de Gado de Corte (1993a) *Mombaça*. Campo Grande: EMBRAPA-SPSB. Folder.
- EMBRAPA Centro Nacional de Pesquisa de Gado de Corte (1993b) *Recomendações para Estabelecimento e Utilização do Stylozanthus guianenses cv. Mineirão*. Campo Grande: (EMBRAPA-CNPGC. Comunicado Técnico , 49). 6p.
- EMBRAPA Centro Nacional de Pesquisa de Gado de Corte (1995) *Suplementação Mineral*. Campo Grande, MS. CNPGC Divulga, 13. 5p.
- EMPRAPA-DPD (1995) *Prospecção de Demandas Tecnológicas: manual metodológico para o SNPA*. Edited by Castro, A.M.G., Cobbe, R.V. and Goedert, W.J., Brasília: EMBRAPA-DPD, 1995. 82p.
- Engel, P. (1990) Knowledge management in agriculture and information systems. *Knowledge in Society: The International Journal of Knowledge Transfer*. 3 (3): 28-35.
- Engel, P. (1996) Diving into the deep: choosing a knowledge system perspective. Chapter 2 of *Facilitating Innovation*. Wageningen: Doct. Dissertation. 1995. In Roling, N. (ed) *AKIS 1996 Agricultural Knowledge and Information Systems. Readings*. Wageningen Agricultural University. p.186-214.
- Eponou, T. (1993). *Partners in Agricultural Technology: linking research and technology transfer to serve farmers*. ISNAR Research Report No. 1. The Hague: International Service for National Agricultural Research. 85p.
- Errington, A. (1984) Adviser or decision-taker? The role of the consultant agronomist on Britain's farms today. *Agricultural Manpower*. 9: 9-16.
- Errington, A. (1985a) Delegation on the farm. *Farm Management Unit*. University of Reading. Study 8. 65p.
- Errington, A. (1985b) The delegation of decision-taking. *Farm Management* 5 (10): 415-423.
- Errington, A. and Gasson, R. (1994) Farming systems and the farm family business. In Dent, J.B. and McGregor, M.J. (eds) *Rural and Farming Systems Analysis*. Cab International. Wallingford. p.181-192.
- Errington, A. and Tranter, R. (1991) *Getting Out of Farming? Part Two. : The Farmers*. University of Reading, Farm Management Unit, Study 27. November 1991. 157p.
- Ewell, P. (1990) Links between on-farm research and extension in nine countries. In Karmowitz, D. (ed) *Making the Link: agricultural research and technology transfer in developing countries*. Westview Press. London. p.151-196.
- FAO (1992) *Sustainable Development and the Environment: FAO Policies and Actions*. Stockholm 1992 - Rio 1992. FAO. Rome. 88p.
- Fernandes, E. and Costa, F.P. (1983) *Estudo Exploratório da Pecuária de Corte – Microrregião Homgênea Alto Taquari.- Mato Grosso do Sul*. (EMPAER. Documentos, 3) EMPAER, Campo Grande.
- Ferreira, G. (1997) *An Evolutionary Approach to Farming Decision Making on Extensive Rangelands*. Unpublished Phd Thesis. Institute of Ecology and Resource Management University of Edinburgh. 469p.
- Flora, B.C. (1992) *Critique*. Reconstructing agriculture: the case for local knowledge. *Rural Sociology*. 57(1):92-97.

- Flores, M.X. (1995) Apresentação. In Castro, A.M.G., Cobbe, R.V. and Goedert, W.J. (eds) *Prospecção de Demandas Tecnológicas: manual metodológico para o SNPA*. Brasília: EMBRAPA-DPD, 1995. 82p.
- Flores, M.X. and Silva, J. (1992) *Projeto EMBRAPA II: do Projeto de Pesquisa ao Desenvolvimento Sócio-econômico no Contexto do Mercado*. Brasília: EMBRAPA-SEA, 1992.(EMBRAPA-SEA. Documentos, 8). 55p.
- Flores, X.M. (1991a) *Projeto EMBRAPA: a pesquisa agropecuária rumo ao século XXI*. Brasília: EMBRAPA-SEA, 1991. (EMBRAPA-SEA. Documentos, 4). 38p.
- Flores, X.M. (1991b) *Pesquisa Agropecuária no Brasil*. Brasília: EMBRAPA-SEA, 1991. (EMBRAPA-SEA. Documentos, 6). 23p.
- Flores, X.M. and Nascimento, J.C. (1992) *Desenvolvimento Sustentável e Competitividade na Agricultura Brasileira*. Brasília: EMBRAPA-SEA, 1992. (EMBRAPA-SEA. Documentos, 10). 30p.
- Flores, X.M.; Quirino, T.R.; Nascimento, J.C. Rodrigues, G.S. and Buschinelli, C. (1991) *Pesquisa para Agricultura Auto-Sustentável: Perspectivas de política e organização na EMBRAPA*. Brasília: EMBRAPA-SEA, 1991. (EMBRAPA-SEA. Documentos, 5). 28p.
- Foddy, W. (1995) The open vs closed question. In Foddy, W. *Constructing Question for Interview and Questionnaire*. Cambridge University Press. Cambridge. p.126-152.
- Forb, S.A. and Babb, E.M. (1989) Farmer sources and use of information. *Agribusiness* (5): 465-476.
- Frank, B.R (1995a) Constraints limiting innovation adoption in the north Queensland beef industry. I: a socio-economic means of maintaining a balanced lifestyle. *Agricultural Systems*. 47: 291-321.
- Frank, B.R.(1995b) Constraints limiting innovation adoption in the north Queensland beef industry. II: non-adoption is an intelligent response to environmental circumstances. *Agricultural Systems*. 47: 323-346.
- Freire, P. (1972) *Pedagogy of the oppressed*. Sheed and Ward Ltd. London. 186p.
- Freire, P. (1974) Extension or Communication. In Freire, P. (author) *Education: the practice of freedom*. Hazell Watson and Viney Ltd. p.85-162.
- Freudenberger, K.S. (1994) Challenges in the collection and use of information on livelihood strategies and natural resource management. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.124-133.
- Fujisaka, S. (1994) Will farmer participatory research survive in the International Agricultural Research Centres? In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.227-235.
- Garcia, A.R. (1998) Nova lei ambiental exige atenção. *DBO Rural*. São Paulo. Abril, 1998. p.148.
- Garforth, C. (1986) Mass media and communication technology. G.E. Jones (ed) *Investing in Rural Extension: strategies and goals*. Elsevier Applied Science publishers. London. p 185-192.
- Garforth, C. (1998) Preface. In Wallace, I. (ed) *Rural Knowledge Systems for the 21<sup>st</sup> Century: rural extension in western, central and eastern Europe*.



- Proceedings of the symposium held at Reading, Cambridge and Edinburgh, 6-17 July 1997. AERDD, The University of Reading. 1998. vii.
- Gartner, J.A. (1990) Extension education: top(s) down, bottom(s) up and other things. In Jones, J.G.W. and Street, P.R. (eds) *Systems Theory Applied to Agriculture and the Food Chain*. Elsevier Applied Science. London. p.325-350.
- Gasson, R. (1971) Use of sociology in agricultural economics. *Journal of Agricultural Economics*. **22**:29-38.
- Gasson, R. (1973) Goals and values of farmers. *Journal of Agricultural Economics*. **24**: 521-537.
- Gasson, R. and Errington, A. (1993) *The Farm Family Business*. CAB International. 290p.
- Gibbon, D. (1994) Farming systems research/extension: background concepts, experience and networking. In Dent, J.B. and McGregor, M.J. (eds) *Rural and Farming Systems Analysis: European perspectives*. Cab International. Wallingford. p.3-18.
- Giles, A.K. and Stanfield, M. (1990) Decision making. In Giles, A.K. and Stanfield, M. *The Farmer Manager*. Allen & Unwin. Wallingford. p.43-58.
- Gladwin, C.H. (1989) Ethnographic Decision Tree Modelling. Qualitative Research Methods, *Series 19*. SAGE Publications. London. 96p.
- GOVERNO DO BRASIL (1998) *Balanço dos 24 meses do Real*. <http://www.brasil.gov./htm>, consulted in 28/05/98.
- Gupta, A.K. (1993) Scientists' views of farmers' practices in India: barriers to effective interaction. In Chambers, R.; Pacey, A. and Thrupp, L. A. (eds) *Farmer First: farmer innovation and agricultural research*. Intermediate Technology Publications Ltd. London. p.24-30.
- Hair, J.F.; Anderson R.E. and Tathmam, R. L. (1987) *Multivariate Data Analysis with Readings*. Macmillan Publishing Company. New York. 449p.
- Hammersley, M. (1989) *The Dilema of Qualitative Method: Herbert Blumer and the Chicago Tradition*. Routledge. London. 270p.
- Hassanein, N. and Kloppenburg, J.R. (1995) Where the grass grows again: knowledge exchange in the sustainable agriculture movement. *Rural Sociology*. **60**(4): 721-740.
- Hildebrand, P.E. (1990) Farming systems research-extension. In Jones, J.G.W. and Street, P.R. (eds) *Systems Theory Applied to Agriculture and the Food Chain*. Elsevier Applied Science. London. p.131-144.
- Hildreth, R.J. and Armbruster, W.J. (1981) Extension program delivery - past, present, and future: an overview. *American Journal of Agricultural Economics*. **4**: 853-858.
- Hughes, C. (1994) From field notes to dissertation: analysing the stepfamily. In Bryman, A. and Burgess, R.G. (eds) *Analysing Qualitative Data*. Routledge. New York. p.35-46.
- IBGE (1995) INTERNET-INSTITUTO BRASILEIRO DE GEOGRAFIA
- IBGE (1998a) Census of Agriculture - Mato Grosso do Sul (April, 02/98) <http://www.ibge.gov.english/noticias/2trim98/preso020498.HTM>. Consulted in 28 of June, 1998.
- IBGE (1998b) Censo Agropecuário 95/96-Confronto de resultados: efetivo do rebanho. <http://www.ibge.org/informações/esta.1.htm>. Consulted in 28 of June,

1998.

- IDS WORKSHOP (1993) Farmers group and workshops. In Chambers, R.; Pacey, A. and Thrupp, L. A. (eds) *Farmer First: farmer innovation and agricultural research*. Intermediate Technology Publications Ltd. London. p.122-126.
- IICA (1982) *Dialogo III. Seminario sobre Sistemas en Investigación Agropecuaria*. Instituto Interamericano de Cooperación para la Agricultura. Convenio IICA - Cono Sur/BID. Montevideo. 171p.
- IICA (1987) *Dialogo XX. Integración de Rubros en Sistemas de Producción*. Instituto Interamericano de Cooperación para la Agricultura. Convenio IICA - Cono Sur/BID. Molestina, C.J.(ed). Montevideo. 123p.
- ISNAR (1995) *Report of a Workshop: Research Policies and Management for Agricultural Growth and Sustainable Use of Natural Resources*. The Hague: International Service for National Agricultural Research. December 7-9, 1994. 60p.
- Jackson, C.; Mandal, S. and Carruthers, I. (1978) Notes on rapid land ownership and management studies. In *Rapid Rural Appraisal. Workshop on Rapid Rural Appraisal Held at Institute of Development Studies*. 1978. University of Sussex.
- Jacobsen, B.H. (1994) Farmer's decision making behaviour: empirical findings from Denmark. In Jacobsen, B.H.; Pedersen, D.E.; Christtensen, J. and Svend Rasmussen (eds) *Farmer's Decision Making - a descriptive approach*. Proceedings from the 38th EAAE Seminar, October, Copenhagen. 1994. p.77-89.
- Jiggins, J. (1994) Foreword. In Dent, J.B. and McGregor, M.J. (eds) *Rural and Farming Systems Analysis: European perspectives*. Cab International. Wallingford. p.xiii-xvi.
- Johnson, I.R. and Thornley, J.H.M. (1985) Dynamic model of the response of a vegetative grass crop to light, temperature and nitrogen. *Plant, Cell and Environment*. 8: 485-499.
- Jones, J.R. and Wallace B.J. (1986) Social science in farming systems research. In Jones, J.R. and Wallace, B.J. (eds) *Social Science and Farming Systems Research: methodological perspectives on agricultural development*. Westview Press. London. p.1-20.
- Jones, J.W. (1993). Decision support systems for agricultural development. In F.W.T. Penning de Vries; P.S. Teng, and K. Metselaar (eds.) *Systems Approaches for Agricultural Development*. Kluwer Academic Publishers. p.459-471.
- Kaimowitz, D. (1991) The evolution of links between extension and research in developing countries. In Rivera, W.M. and Gustafson, D.J. (eds) *Agricultural Extension: worldwide institutional evolution & forces for change*. Elsevier. London. p.101-112.
- Kichel, A.N.; Miramda, C.H.B. and Zimmer, A.H. (1997) Fatôres de degradação de pastagens sob pastejo rotacionado com ênfase na fase de implantação. In *Simpósio sobre Manejo de Pastagens 14*. 1997. Piracicaba. FEALQ. p.193-211.
- Kirk, J. and Miller, M.L. (1986) *Reliability and Validity in Qualitative Research*. SAGE Publications. London. 87p.
- Kloppenborg, J.R. (1991) Social theory and the de/reconstruction of agricultural

- science: local knowledge for an alternative agriculture. *Rural Sociology*. 56(4): 519-548.
- Krzanowski, W.J. (1996) *Principles for Multivariate Analysis*. Clarendon Press. Oxford. 563p.
- Laneri, J.L. (1982) Investigación en sistemas de producción arroz-ganadería en el Paraguai. In Instituto Interamericano de Cooperación para la Agricultura (IICA). Convenio IICA-Cono sur/BID. *Dialogo III. Seminario sobre sistemas en investigación agropecuaria*. Montevideo, 1982. p.124-126.
- Le Gal, P.-Y. (1995) From decision-making process analysis to modelling and simulation of farm management: application to work organisation in two rice-based farming systems. Paper presented to the *International Symposium Systems Approach for Agricultural Development*. IRRI, Los Banos, Philippines, 6-8 December 1995 (in press).
- Leeuwis, C. (1990) Equivocations on knowledge system theory: an actor-oriented critique. *Knowledge in Society*. 3(3): p.19-27.
- Leeuwis, C. (1993) *Of computers, myths and modelling: the social construction of diversity, knowledge, information, and communication technologies in Dutch horticulture and agricultural extension*. Agricultural University Wageningen. 468p.
- Long, N. and Vilareal, M. (1994) The interweaving of knowledge and power in development interfaces. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.41-52.
- Longley, C. and Richards, P. (1993) Selection strategies of rice farmers in Sierra Leone. In de Boef, W.; Amanor, K.S.; Wellard, K. and Bebbington, A. (eds) *Cultivating Knowledge: genetic diversity, farmer experimentation and crop research*. Intermediate Technology Publications Ltd. p.51-57.
- Low, A.R.C.; Waddington, S.R. and Shumba, E.M. (1991) On-farm research in Southern Africa: the prospects for achieving greater impact. In Tripp, R. (ed) *Planned Change in Farming Systems: progress in on-farm research*. John Wiley & Sons. Chichester. p.257-272.
- Lund, M. (1994) Solving complex problems: descriptive and normative implications. In Jacobsen, B.H.; Pedersen, D.E.; Christtensen, J. and Svend Rasmussen (eds) *Farmer's Decision Making - a descriptive approach*. Proceedings from the 38th EAAE Seminar, October, Copenhagen. 1994. p.31-41
- Macedo, M.C.M. (1997) Sustainability of pasture production in the savanas of Tropical America. In *International Grassland Congress. Section 21. Temperate and Tropical Native Grassland*. Winnebag/Saskatoon. June 1997. p.7-16.
- Manly, B.F.J. (1986) *Multivariate Statistical Methods. A Primer*. Chapman and Hall London. 159p.
- Mardsen, D. (1994) Indigenous management and management of indigenous knowledge. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.52-57.
- Mason, J. (1994) Linking qualitative and quantitative data analysis. In Bryman, A. and Burgess, R.G. (eds) *Analysing Qualitative Data*. Routledge. New York. p. 89-110.

- Mato Grosso do Sul (1990) *Atlas Referencial*. Secretaria de Planejamento e Coordenação Geral. Campo Grande, MS. 1990. 28p.
- Matose, F. and Makamuri, B. (1994) Trees, people and communities in Zimbabwe's lands. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.69-74.
- Maurya, D.M. (1993) The innovative approach of indian farmers. In Chambers, R.; Pacey, A. and Thrupp, L. A. (eds) *Farmer First: farmer innovation and agricultural research*. Intermediate Technology Publications Ltd. London. p.9-14.
- McGraw, K.L. and Harbison-Briggs, K. (1989) *Knowledge Acquisition: principles and guidelines*. Pentice-hall International, Inc. Englewood Cliffs. 376p.
- McGregor, M.J.; Willock, J. and Deary, I. (1995) Farmer stress. *Farm Management*. 9(2): 57-65.
- McGregor, M.J.; Willock, J.; Dent, J.B.; Deary, I.; Sutherland, A.; Gibson, G.; Morgan, O. and Grieve, B. (1996) Links between psychological factors and farmer decision making. *Farm Management*. 9 (5): 228-239.
- Melo, G.A.F. (1982) Enfoque de sistema na pesquisa de gado de leite. In Instituto Interamericano de Cooperación para la Agricultura (IICA). Convenio IICA-Cono sur/BID. *Dialogo III. Seminario sobre sistemas en investigación agropecuaria*. Montevideo, 1982. p.100-107.
- Merrill-Sands, D.; Biggs, S.D.; Bingen, R.J.; Ewell, P.T.; McAllister, J.L. and Poats, S.V. (1991) Integrating on-farm research into national agricultural research systems: lessons for research policy, organisation and management. In Tripp, R. (ed) *Planned Change in Farming Systems: progress in on-farm research*. John Wiley & Sons. Chichester. p.287-316.
- Midmore, P. (1996) Towards a postmodern agricultural economics. *Journal Agricultural Economics*. 47(1):1-17.
- Midmore, P. (1998) Rural policy reform and local development programmes: appropriate evaluation procedures. *Journal of Agricultural Economics*. 49(3): 409-426.
- Millar, D. (1993) Farmer experimentation and the cosmovision paradigm. In de Boef, W.; Amanor, K.S.; Wellard, K. and Bebbington, A. (eds) *Cultivating Knowledge: genetic diversity, farmer experimentation and crop research*. Intermediate Technology Publications Ltd. p.44-50.
- Milligan, G.W. (1981) A review of Monte Carlo tests of cluster analysis. *Multivariate Behavioral Research*. 16:379-407.
- Mitchell, J.C. (1983) Case and situation analysis. *Sociological Review*. 31: 187-211.
- Molenaar, N.J. (1991) Recent methodological studies on survey questioning. *Quality and Quantity*. 25 : 167-187.
- Molnar, J.J.; Duffy, P.A.; Cummins, K.A. and van Santen, E. (1992) *Critique*. Agricultural science and agricultural counterculture: paradigms in search of a future. *Rural Sociology*. 57(1): 83-91.
- Morgan, O., Gibson, G., Willock, J.; Sutherland, A.; Deary, I.; McGregor, M.J., Dent, J.B. and Grive, R. (1996) The use of cluster analysis to develop a taxonomy of farmers based on the Edinburgh study of decision making on farms. In Beers, G., Huirne, R.B.M. and Pruitts, H.C. (eds) *Farmers in Small-Scale and Large-Scale Farming in a New Perspective: objectives, decision making and*

- information requirements*. Agricultural Economics Research Institute (LEI-DLO). p.86-96.
- Moris, J. and Copstake J. (1993) *Qualitative Enquiry for Rural Development: review*. Intermediate Technology Publications Ltd. London. 117p.
- Morris, W.T. (1971) Management decisions - art or science? In Yewdall, G.A. (ed) *Management Decision-Making*. David & Charles (Publishers) Limited. Newton Abbot. p.1-35.
- Mostyn, B. (1985) The content analysis of qualitative research data: a dynamic approach. In Brenner, M ; Brown J and Canter, D. (eds) *The Research Interview: uses and approaches*. Academic Press. London. p.115-145.
- Moxey, A.P.; White, B.; Sanderson, R.A. and Rushton, S.P. (1995) An approach to link an ecological vegetation model to an agricultural economic model. *Journal of Agricultural Economics*. 46(3): 381-397.
- O'Dell, W.F. (1992) Effective business decision making. *Small Business Reports*. 17(3): 68-71.
- Okali, C.; Sumberg, J. and Farrington, J. (1994) *Farmer Participatory Research: rhetoric and reality*. Intermediate Technology Publications. London. 159p.
- Okely, J. (1994) Thinking through field work. In Bryman, A. and Burgess, R.G. (eds) *Analysing Qualitative Data*. Routledge. New York. p.18-34.
- Parr, T. and Eatherall, A. (1994) *Demonstrating Climate Change Impacts in the UK: The Doe Core Model Programme*. Institute of Terrestrial Ecology. Global Atmosphere Division Department of the Environment. 18p.
- Patton, M.Q. (1980) *Qualitative evaluation methods*. Sage Publications. Beverly Hills.
- Patton, M.Q. (1983) *Qualitative Evaluation Methods*. SAGE Publications Ltd. London. 379p.
- Patton, M.Q. (1990) *Qualitative Evaluation and Research Methods*. SAGE Publications, London. 531p.
- Pearce, D.W. and Turner, R.K. (1990) *Economics of Natural Resources Environment*. Harvester Wheatsheaf. London. 378p.
- Penning de Vries, F.W.T.; van Keulen, H. and Rabbinge, R. (1995) Natural resources and limits of food production in 2040. In Bouma, J.; Kuyvenhoven, A.; Bouman, B.A.M.; Luyten, J.C. and Zandstra, H.G. (eds) *Eco-Regional approaches for Sustainable Land Use and Food Production: Proceedings of a symposium on eco-regional approaches in agricultural research*, 12-16 December 1994, ISNAR, The Hague. Kluwer Academic Publishers. London. p.65-88.
- Pereti, M. (1982) Sistema real de producción agrícola ganadero (Lote 14) de la estación experimental regional agropecuaria Marcos Juárez del INTA. In Instituto Interamericano de Cooperación para la Agricultura (IICA). Convenio IICA-Cono sur/BID. *Dialogo III. Seminario sobre sistemas en investigación agropecuaria*. Montevideo, 1982. p.63-67.
- Perkin, P. and Rehman, T. (1994) Farmer's objectives and their interactions with business and life styles: evidence from Berkshire, England. In Dent, J.B. and McGregor, M.J. (eds) *Rural and Farming Systems Analysis*. CAB International. Wallingford. p.193-212.
- Pinstrup-Andersen, P. (1982) *Agricultural Research and Technology in Economic Development*. Longman Group Limited. Essex. 261p.
- Pinstrup-Andersen, P. and Pandya-Lorch, R. (1995) Prospects for world food security

- and distribution. In Bouma, J.; Kuyvenhoven, A.; Bouman, B.A.M.; Luyten, J.C. and Zandstra, H.G. (eds) *Eco-Regional approaches for Sustainable Land Use and Food Production: Proceedings of a symposium on eco-regional approaches in agricultural research*, 12-16 December 1994, ISNAR, The Hague. Kluwer Academic Publishers. London. p.89-112.
- Pott, E.B.; Almmeida, L. de; Brum, P.A.R. de; Rullio, R.R.; Souza, J.C. de and Aroeira, J.A.D.C. (1988) Desempenho reprodutivo de bovinos na sub-região dos paiaguas do pantanal mato-grossense. *Pesquisa Agropecuária Brasileira*. Brasília. 23(1):87-96.
- Potter, C. and Loble, M. (1992) Ageing and succession on family farms: the impact on decision-making and land use. *Sociologia Ruralis*. 32(2/3): 317-334.
- Pottier, J. (1994) Agricultural discourses: farmer experimentation and agricultural extension. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.83-88.
- Prain, G. (1993) Mobilising local expertise in plant genetic resources research. In de Boef, W.; Amanor, K.S.; Wellard, K. and Bebbington, A. (eds) *Cultivating Knowledge: genetic diversity, farmer experimentation and crop research*. Intermediate Technology Publications Ltd. p.102-110.
- Preston, T.R. (1982) Sistemas de producción de carne y leche para pequenos productores. In Vaccaro, L.P. (ed) *Sistemas de Producción con Bovinos en el Trópico Americano*. Universidade Central de Maracay. Instituto de Producción Animal. Colonia Tovar, 1982. p.159-170.
- Pretty, J.N. and Chambers, R. (1994) Towards a learning paradigm: new professionalism and institutions for agriculture. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.182-202.
- Rabbinge, R. (1995) Eco-regional approaches, why, what and how. In Bouma, J.; Kuyvenhoven, A.; Bouman, B.A.M.; Luyten, J.C. and Zandstra, H.G. (eds) *Eco-Regional approaches for Sustainable Land Use and Food Production: Proceedings of a symposium on eco-regional approaches in agricultural research*, 12-16 December 1994, ISNAR, The Hague. Kluwer Academic Publishers. London. p.3-12.
- Ramirez, R. (1997) Understanding farmers' communication networks: combining PRA with agricultural knowledge systems analysis. *Gatekeeper Series*. International Institute for Environment and Development. London. 66: 2-17.
- Regazzi A.J. (1996) *Técnicas de Análise Multivariada*. Universidade Federal de Viçosa. Departamento de Informática. Viçosa. 59p.
- Rhoades, R and Booth, R.H. (1982) Farmer-back-to farmer a model for generating acceptable agricultural technology. *Agricultural Administration*. 11: 127-137.
- Rhoades, R. (1993) The role of farmers in the creation of agricultural technology. In Chambers, R.; Pacey, A. and Thrupp, L. A. (eds) *Farmer First: farmer innovation and agricultural research*. Intermediate Technology Publications Ltd. London. p.3-9.
- Ribeiro, R.A. (1984) *Taboco - 150 anos: Balaio de Recordações*. Prol Editora Gráfica. São Paulo. 232p.
- Richards, P. (1985) *Indigenous Agricultural Revolution*. Hutchinson. London. 192 p.

- Richards, P. (1993) Agriculture as a performance. In Chambers, R.; Pacey, A. and Thrupp, L. A. (eds) *Farmer First: farmer innovation and agricultural research*. Intermediate Technology Publications Ltd. London. p.39-43.
- Riethoven, J.J.M.; ten Berge, H.F.M. and Drenth, H. (1995) Software developments in the SARP project: a guide to applications and tools. In *SARP Research Proceedings*. September, 1995. Wageningen. 301p.
- Risso, D.F. and Grierson, J. (1982) Resena y evaluación del trabajo en sistemas de producción del Centro de Investigaciones Agrícolas Alberto Boeger, Uruguay. In Instituto Interamericano de Cooperación para la Agricultura (IICA). Convenio IICA-Cono sur/BID. *Dialogo III. Seminario sobre sistemas en investigación agropecuaria*. Montevideo, 1982. p.129-140.
- Robson, C. (1996) *Real World Research: a resource for social scientists and practitioner-researchers*. Blackwell. Oxford. 510p.
- Rodrigues, J.B. (1985) *Histórias de Mato Grosso do Sul*. Editora do Escritor. São Paulo. 184p.
- Röling, N. (1985) Extension science: increasingly preoccupied with knowledge systems. *Sociologia Ruralis*. **35**(3/4): 269-290.
- Röling, N. (1988) *Extension Science: information systems in agriculture development*. Cambridge University Press. Cambridge. 233p.
- Röling, N. (1990) The agricultural research-technology transfer interface: a knowledge systems perspective. In Kaimowitz, D. (ed) *Making the Link: agricultural research and technology transfer in developing countries*. Westview Press. London. p.1-42.
- Röling, N. (1992) The emergence of knowledge system thinking. *Knowledge and Policy* **5** (1): 42-64.
- Röling, N. (1993) Agricultural knowledge and environmental regulation in Netherlands: a case study of the Crop Protection Plan. *Sociologia ruralis*. **33**(2): 261-280
- Röling, N. (1994a) Interaction between extension services and farmer decision making: new issues and sustainable farming. In Dent, J.B. and McGregor, M.J. (eds) *Rural and Farming Systems Analysis: European perspectives*. Cab International. Wallingford. p.280-291.
- Röling, N. (1994b) Facilitating sustainable agriculture: turning policy models upside down. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.245-247.
- Röling, N. (1998) The changing information needs of rural communities. In Wallace, I. (ed) *Rural Knowledge Systems for the 21<sup>st</sup> Century: rural extension in western, central and eastern Europe*. Proceedings of the symposium held at Reading, Cambridge and Edinburgh, 6-17 July 1997. AERDD, The University of Reading. 1998. p. 50-66.
- Röling, N. and Engel, G.H. (1991) The development of the concept of agricultural knowledge information systems (AKIS): implications for extension. In Rivera, W.M. and Gustafson, D.J. (eds) *Agricultural Extension: worldwide institutional evolution & forces for change*. Elsevier. London. p.125-137.
- Romero, C. and Rehman, T. (1989). *Multiple Criteria Analysis for Agricultural Decisions*. Elsevier. Amsterdam. 257p.
- Rosa, I.V. (1991) Doença da vaca caída: a benção disfarçada. *O Corte*. **17**:14-15.

- Rosa, I.V.; Moraes, S.S. and Nicodemo, M.L.F. (1993b) Efeito da restrição mineral no período seco sobre o desempenho de bovinos em crescimento. In *Anais da XXX Reunião da Sociedade Brasileira de Zootecnia*. Rio de Janeiro. 1993. p.433.
- Rosa, I.V.; Reis, R.A.T. and Nicodemo, M.L.F. (1993a) Restrição mineral no período seco e desempenho de bovinos em recria. In *Anais da XXX Reunião da Sociedade Brasileira de Zootecnia*. Rio de Janeiro. 1993. p.429.
- Ruiz, I.N. (1982) Sistemas de producción estudiados en Chile por INIA In Instituto Interamericano de Cooperación para la Agricultura (IICA). Convenio IICA-Cono sur/BID. *Dialogo III. Seminario sobre sistemas en investigación agropecuaria*. Montevideo, 1982. p.63-67.
- Salas, M.A. (1994) 'The technicians only believe in science and cannot read the sky': the cultural dimension of the knowledge conflict in the Andes. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.57-69.
- Saltiel, J.; Bauder, J.W. and Polakovich, S. (1991) Adoption of sustainable agriculture practices: diffusion, farm structure and profitability. *Rural Sociology*. **59**(2): 333-349.
- Sanders, J.O. and Cartwright, T.C. (1979) A general cattle production systems model. I: structure of the model. *Agricultural Systems*. **4**(3): 217-227.
- SAS Institute Inc. (1985) *SAS User's Guide: Statistic, Version 5 Edition*. Cary, NC. 956p.
- Scoones, I. and Thompson, J. (1994a) Introduction. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.1-12.
- Scoones, I. and Thompson, J. (1994b) Knowledge, power and agriculture - towards a theoretical understanding. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.16-32.
- Seidel, J. (1995) Qualitative data analysis. In Seidel, J.; Friese, S. and Leonard, D.C. *The Ethnograph v4.0: A User's Guide*. Qualis Research Associates. Amherst. Appendix E.
- Seidel, J.; Friese, S. and Leonard, D.C. (1995) *The Ethnograph v4.0: A User's Guide*. Qualis Research Associates. Amherst. 299 p.
- Shah, P. (1994) Participatory watershed management in India: the experience of the Aga Khan Rural Support Programme. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.117-124.
- Shaull, R. (1972) Foreword. In Freire, P. (author) *Pedagogy of oppressed*. Sheed and Ward Ltd. London. p.9-15.
- Sheatsley, P.B. (1983) Questionnaire construction and item-wording. In Rossi, P. *et al* (eds) *Handbook of Survey Research*. Academic Press. London.
- Sipiläinen, T. (1994) Empirical findings on farmers' decision making in long-term investments. In Jacobsen, B.H., Pedersen, D.E., Christtensen, J. and Svend Rasmussen (eds) *Farmer's Decision Making - a descriptive approach*.



- Proceedings from the 38th EAAE Seminar*, October, Copenhagen. 1994. p.91-102.
- Sizoo, E. (1993) Culture and Dutch policy. In Box, L.; Mossanne, A.; Sizoo, E.; and Vink, N. (eds) *Culture and Communication; the forgotten dimension in development cooperation*. Royal Tropical Institute. The Netherlands. Bulletin 329. p.17-23.
- Skerratt, S (1995) *A Critical Appraisal of the Socio-Economic Evaluation of Agri-Environmental Policy*. The case of ESAs. PhD Thesis. University of Edinburgh. 277p.
- Skerratt, S. (1998) *Social and Informational Networks of Farmers*. Discussion Paper for IMAGES (Improving Agri-Environmental Policies: A Simulation Approach to the Role of the Cognitive Properties of Farmers and Institutions) FAIR CT 96 2092). 63p.
- Skerratt, S.J and Dent, J.B. (1994) Farmer's adoption and non adoption of agri-environmental initiatives: the case of Breadalbane ESA, Scotland. In Jacobsen, B.H.; Pedersen, D.E.; Christtensen, J. and Svend Rasmussen (eds) *Farmer's Decision Making - a descriptive approach*. Proceedings from the 38th EAAE Seminar, October, Copenhagen. 1994. p.135-155.
- Souza, J.C. de; Conrad, J.H.; Mott, G.D.; McDowell, L.R.; Ammermann, C.B.; Blue, W.G. (1982) Interrelações entre minerais no solo, plantas forrageiras e tecido animal no norte de Mato Grosso. 4. zinco, magnésio, sódio e potássio. *Pesquisa Agropecuária Brasileira*. Brasília. 17(1):11-20.
- Souza, J.C. de; Conrad, J.H.; Blue, W.G.; Ammermann, C.B.; McDowell, L.R. (1981) Interrelações entre minerais no solo, plantas forrageiras e tecido animal. 3. manganês, ferro e cobalto. *Pesquisa Agropecuária Brasileira*. Brasília. 16(5): 739-746.
- Souza, J.C. de; Gomes, R.F.C.; Silva, J.M. da; Euclides, V.P.B. (1985) Efeito de suplementação mineral em pastagens adubadas de capim Colonião. *Pesquisa Agropecuária Brasileira*. Brasília. 20(2):259-269.
- Spedding, C.R.W. (1988) A systems approach to agriculture. In Spedding, C.R.W. (ed) *An Introduction to Agricultural Systems*. Elsevier Applied Science Publishers Ltd. p.15-40.
- SPSS Inc. (1993) *SPSS for Windows: Base System Syntax Reference Guide, Release 6.0*. SPSS Inc. Chicago.
- Strauss, A. and Corbin, J. (1990) *Basics of Qualitative Research: grounded theory procedures and techniques*. Sage Publications. London. 270p.
- Strauss, A.L. (1987) Introduction. In Strauss, A.L. (author) *Qualitative Analysis for Social Scientist*. Cambridge University Press. Cambridge. p.1-39.
- Street, P.R. and Jones, J.G.W. (1990) Preface. In Jones, J.G.W. and Street, P.R. (eds) *Systems Theory Applied to Agriculture and the Food Chain*. Elsevier Applied Science. London. p.ix-xi.
- Sudan, S. and Bradburn, N.M. (1997) *Response Effects in Surveys: a review and synthesis*. Aldine Publishing Company. Chicago. 257p.
- Sumberg, J. and Okali, C. (1993) Farmers, on-farmer research, and new technology. In Chambers, R.; Pacey, A. and Thrupp, L. A. (eds) *Farmer First: farmer innovation and agricultural research*. Intermediate Technology Publications Ltd. London. p.109-122.
- Supit, I.; Hooijer, A.A. and van Diepen, C.A. (eds) (1994) *System Description of the*

- WOFOST 6.0 Crop Simulation Model Implemented in CGMS: an agricultural information system for European Community*. Volume 1: Theory and Algorithms. European Commission. Luxemburg. 146p.
- Sutherland, A.J.; McGregor, M.J.; Dent, J.B.; Willock, J.; Deary, I.; Gibson, G.; Grieve, R. and Morgan, O. (1996) Edinburgh farmer decision making study: elements important to the farmer. In Beers, G.; Huirne, R.B.M. and Pruis, H.C. (eds) *Proceedings of 43rd EAAE Seminar. Farmers in Small-Scale and Large-Scale Farming in a New Perspective: objectives, decisions making and information requirements*. p.162-171.
- Swift, J. (1978) Notes on rapid rural appraisal in dry pastoral areas of west Africa. In *Rapid Rural Appraisal. Workshop on Rapid Rural Appraisal held at Institute of Development Studies*. 1978. University of Sussex.
- Thapa, B.; Sinclair, F.L. and Walker, H.D. (1995) Incorporation of indigenous knowledge and perspectives in agroforestry development. Part 2: case-study on the impacts of explicit representation of farmers' knowledge. *Agroforestry Systems*. **30**: 249-261.
- The National Environment Secretariat, Government of Kenya; Clark University; Egerton University and The Center for International Development and Environment (1990) *Participatory Rural Appraisal Handbook*. Natural Resources Management Support Series No 1. February 1990. 90p.
- Theis, J. and Grady, M. (1991) *Participatory Rapid Appraisal for Community Development: a training manual based on experiences in the Middle East and North Africa*. International Institute for Environment and Development. 150p.
- Thrupp, L.A.; Cabarle, B. and Zazueta, A. (1994) Participatory methods and political processes: linking grassroots actions and policy-making for sustainable development in Latin America. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.170-177.
- Tripp, R (1991a) The farming systems research movement and on-farm research. In Tripp, R. (ed) *Planned Change in Farming Systems: progress in on-farm research*. John Wiley & Sons. Chichester. p.3-16.
- Tripp, R (1991b) The limitations of on-farm research. In Tripp, R. (ed) *Planned Change in Farming Systems: progress in on-farm research*. John Wiley & Sons. Chichester. p.247-256.
- Uphoff, N. (1994) Local organisation for supporting people-based agricultural research and extension: lessons from Gal Oya, Sri Lanka. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.213-220.
- van den Ban, A.W. and Hawkins, H.S. (1996) *Agricultural Extension*. Blackwell Science Pty Ltd. Carlton. 294p.
- van der Ploeg, J.D. (1993) Rural sociology and the new agrarian question. *Sociologia Ruralis*. **33**(2): 240-260.
- van Dusseldorp, D. and Box, L. (1993) Local and scientific knowledge: developing a dialogue. In de Boef, W.; Amanor, K.S.; Wellard, K. and Bebbington, A. (eds) *Cultivating Knowledge: genetic diversity, farmer experimentation and crop research*. Intermediate Technology Publications Ltd. p.20-26.
- van Huylenbroeck, G. (1994) Investment decision support with the CAM multicriteria

- method. In Jacobsen, B.H., Pedersen, D.E., Christtensen, J. and Svend Rasmussen (eds) *Farmer's Decision Making - a descriptive approach. Proceedings from the 38th EAAE Seminar*, October, Copenhagen. 1994. p.395-409.
- van Keulen, H. (1993) Options for agricultural development: a new quantitative approach. In Penning de Vries, F.W.T.; Teng, P. and Metselaar, K. (eds) *Systems Approach for Agricultural Development*. Kluwer Academic Publishers. p.355-365.
- van Keulen, H. and Veeneklaas, F.R. (1993) Options for agricultural development: a case study for Mali's fifth Region. In Penning de Vries, F.W.T.; Teng, P. and Metselaar, K. (eds) *Systems Approach for Agricultural Development*. Kluwer Academic Publishers. p.367-380.
- Villegas, L. (1982) Implementación del sistema CATIE para producción de leche. In Vaccaro, L.P. (ed) *Sistemas de Producción con Bovinos en el Trópico Americano*. Universidade Central de Maracay. Instituto de Producción Animal. Colonia Tovar, 1982. p.75-88.
- Walker, D.H.; Sinclair, F.L. and Thapa, B. (1995a) Incorporation of indigenous knowledge and perspectives in agroforestry development. Part 1: review of methods and their application. *Agroforestry Systems*. **30**: 235-248.
- Walker, D.H.; Sinclair, F.L.; and Kendon, G. (1995b) A knowledge-based systems approach to agroforestry research and extension. *Artificial Intelligence Applications*. **9**(3):61-72.
- Wallace, I.; Mantzou, K. and Taylor, P. (1996) *Policy options for agricultural education and training in sub-Saharan Africa: report of a preliminary study and literature review*. AERDD, The University of Reading. Reading. 41p.
- WCED (World Commission on Environment and Development) (1990) *Our Common Future*. Oxford University Press. Oxford. 352p.
- Weber, E. U. (1994) Behavioral decision theory: insights and applications. In Jacobsen, B.H., Pedersen, D.E., Christtensen, J. and Svend Rasmussen (eds) *Farmer's Decision Making - a descriptive approach. Proceedings from the 38th EAAE Seminar*, October, Copenhagen. 1994. p.13-29.
- Wellard, K. (1993) Linking local knowledge systems and agricultural research: the role of NGOs. In de Boef, W.; Amanor, K.S.; Wellard, K. and Bebbington, A. (eds) *Cultivating Knowledge: genetic diversity, farmer experimentation and crop research*. Intermediate Technology Publications Ltd. p.136-142.
- Willock, J; Deary, I.; McGregor, M.; Sutherland, A.; Dent, B. and Greive, R. (1994) Decision-making on family farms. In Jacobsen, B.H., Pedersen, D.E., Christtensen, J. and Svend Rasmussen (eds) *Farmer's Decision Making - a descriptive approach. Proceedings from the 38th EAAE Seminar*, October, Copenhagen. 1994. p.63-75.
- Winarto, Y.T. (1994) Encouraging knowledge exchange: integrated pest management in Indonesia. In Scoones, I. and Thompson, J. (eds) *Beyond Farmer First: Rural people's knowledge, agricultural research and extension practice*. Intermediate Technology Publications Ltd. London. p.150-154.
- Wood, G.D. (1979) The social and scientific context of RRA. In *Rapid Rural Appraisal: A Conference held at the Institute of Development Studies*. 1979. University of Sussex.
- World Bank (1992) *Development and the Environment*. World Development Report

1992. Oxford University Press. Oxford.
- World Bank (1996) World Development Indicators 1996 CD-ROOM, World Bank.
- Wright, A. (1971) Farming systems, models and simulation. In Dent, J.B. and Anderson, J.R. (eds) *Systems Analysis in Agricultural Management*. John Willey & Sons Australasia Pty. Ltd. London. p.17-33.
- Yin, R. K. (1984) *Case Study Research: design and methods*. SAGE Publications. London.171p.
- Zimmer, A.H. and Euclides Filho, K. (1997) Brazilian beef cattle production. In Gomide, J.A. (ed) *International Symposium on Animal Production under Grazing*. November, Viçosa, MG, 1997. p.1-29.

# Appendix 5.1

## Steps to Perform Factor Analysis

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### 5.1.1 Correlation matrix

The research problem defines the relevant universe for analysis. However, a correlation matrix is the first step in the application of factor analysis (Hair *et al.*, 1987). In social research, the decision would be to examine either the correlation between the variables and the correlation between the respondents (Hair *et al.*, 1987). If the objective of the analysis were to summarise characteristics expressed by variables, the factor analysis would be applied to a correlation matrix of the variables (Hair *et al.*, 1987). This was reported as the most common type of factor analysis. Since one of the objectives of factor analysis is to obtain factors that help explain these correlations, the variables must be related to each other for the factor model to be appropriate (SPSS, 1993). It has also been reported that if the correlation between two variables is small, it is unlikely that they share common factor. Therefore, a correlation matrix between variables is the first step to perform factor analysis.

### 5.1.2 Factor extraction

The factors are determined by factor extraction. Using principal component analysis, linear combinations are constructed taking into account all variables (Hair *et al.*, 1987) The first combination retains the largest quantity of sample variance. The next principal component (factor) accounts for the second largest amount of variance and successive components will retain progressively smaller parts of the total variance. The method forms components not correlated with each other.

Several criteria have been reported to select ideal number of factors (Hair, *et al.*, 1987; Child, 1970; SPSS, 1993). However the most common criterion is the

*eigenvalue* or *latent root* which indicates the total variance explained by each factor. This criterion suggests that only factors that accounts for *eigenvalue* greater than 1 should be selected. This implies that factor with variance lesser than 1 is not better than a single variable. The explanation for this relies on the transformation of the variables to standardised form with mean zero and standard deviation 1, and consequently variance 1. However, Hair *et al.*, (1987) pointed out critical comments on this criterion due the risk of loosing dimensions. In this way, examining the percentage of total variance, explained by each factor, also has been suggested. A combination of these two criteria has been advised. Plotting the *eigenvalue* against the factors in their order of extraction provides a graphic criterion to be used, which is known as *scree plot*. The approach of this criterion is based on the shape of the curve. Normally, starting with the first factor, the curve slopes steeply down initially and after several factors it becomes almost a horizontal line. The point where the line first begins to be straightened is an indication of the ideal number of factors to extract.

### 5.1.3 Rotation

This phase is concerned with methods to facilitate the interpretation of the factors. The factor correlation matrix shows the relationship between the factors and each variable. Normally, it is difficult to interpret the factors within this matrix in a meaningful sense (Child, 1970). This is because often most of the factors are correlated with many variables. Considering that the objective of the factor analysis is to obtain factors that express obvious meaning, the *rotation* phase transforms the initial matrix into one that is more easily interpreted. Orthogonal rotation, for example, maintains the axes at right angles. The most common method is *Varimax* whose purpose is to minimise the number of variables that have high loading at one factor.

#### 5.1.4 Interpreting and naming the factors

Once a satisfactory solution is met, the next phase is attempted to assign some meaning to the factors. According to Hair *et al.* (1987), the process involves interpretation of the pattern of factor loading for each variable and its associated sign. However, before interpretation, a minimum level of significance for a factor loading should be selected. Of course, variables with higher loading will influence to a greater extent the “name” to represent the factor. The process of naming is based on subjective opinion and can vary according to the analyst involved. If meaningful names are assigned, and these entirely represent the underlying nature of the factors, this will facilitate the presentation and understanding of factor solution.

# Appendix 5.2

## Agglomerative Procedures for Cluster Analysis

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The procedure descriptions presented in this Appendix are based on Hair *et al.* (1987).

### 5.2.1 Single linkage

This method is based on minimum distance between clusters. It has also been referred to as *nearest neighbour* approach. This procedure identifies the two individuals with the shortest distance and places them in the first cluster. The next shortest distance is found and either a third individual joins the first two individuals to form a cluster or a two-individual cluster is formed. The procedure continues until all individuals are in one cluster. The main implication with this method was reported as eventually the individuals within cluster are placed in such way to form long line as "snake-like chains". This means that individuals at the end of the chain may be very dissimilar.

### 5.2.2 Complete linkage

The procedure has been reported as being similar to *single linkage* except that the criterion of clustering is based on maximum distance. In this method the distance between two clusters is taken as the distances between their two furthest individuals. For this reason, it is commonly known as *furthest neighbour* approach. Also it is a diameter method. The procedure is called complete linkage because all objects in a cluster are linked to each other at some maximum distance or by minimum of similarity. It can be said that within-group similarity equals group distance. This method eliminates the snaking problem identified in the single linkage



### 5.2.3 Average linkage

This method starts in same way as single and complete linkage. However, the cluster criterion is based on *average* distance from individuals in one cluster to individuals in another. The partitioning is based on all members of the clusters rather than on a single pair of extreme members as is performed in the two above methods. An implication of this method is that it tends to combine clusters with small variance and also it tends to produce clusters with approximately the same variance.

### 5.2.4 Ward's method

In this method the means of all variables are calculated for each cluster. Then, for each case, the *squared Euclidean distance* to the cluster means is calculated. These distances are summed for all of the cases. The two cluster that merge, at each step, are those that result in the smallest increase in the overall sum of the squared within-cluster distances. It has been reported that this procedure tends to combine cluster with a small number of cases and it is also biased to produce clusters with approximately the same number of individuals.

### 5.2.5 Centroid

In the *centroid* method the distance between two clusters is the distance between their centroids (means). The characteristic of this method is that a new centroid is computed each time individuals are grouped. This means that there is a change in the centroid every time a new individual or group of individuals is added to an existing cluster. However, one disadvantage of this method is that the distances at which the clusters are combined can decrease from one step to the next. This is considered undesirable since clusters merged at a later stage are more dissimilar than those merged at early stages. Another reported limitation of this method is that it requires metric data, which limits its application in social sciences.

# Appendix 5.3

## Questionnaire

EMBRAPA - National Centre for Beef Cattle Research  
University of Edinburgh  
Institute of Ecology and Resource Management  
(Data survey for thesis work of Ivo Martins Cezar)

### 1. IDENTIFICATION

Name of the farmer:.....

Number of the producer:.....

Strata:.....

Region: Campo Grande ☐ (1)      Pantanal ☐ (2)

Location: .....

Date:.....\.....\.....

### 2. RESOURCES

Total area.....	ha		
Cropping.....	ha		
Native pasture .....	ha		
Improved pasture.....	ha		
B. decumbens.....	ha		
Vencedor.....	ha		
B. humidicola.....	ha		
Colonião.....	ha	Andropogon.....	ha
B. brizanta.....	ha	Tanzania.....	ha
Mombaça.....	ha	Others.....	ha

### 2. OWNERSHIP AND ACTIVITIES

1. What the percentage of the farm was obtained from **inheritance, purchasing or renting**?

**purchasing**                   .....%

**inheritance**                   .....%

**renting**                       .....%

2. If part or the total area was obtained through inheritance, would you know how long the farm has belonged to the family?.....years

3. What has been the economic contribution of the following activities?

**beef cattle**.....%           **cropping**.....%

**dairy** .....%               **forestry**.....%

4. What has been the cattle activity?

Breeding cows  (1) Breeding cows + rearing of males  (2)

Breeding cows, rearing and fattening of males  (3)

Rearing of males  (4) Rearing and fattening of males  (5) Fattening  (6)

5. Herd structure?

Total of males after weaning .....

Total of females after weaning .....

Total heads .....

**4. DEMOGRAPHIC INFORMATION**

6. Sex :  male (1)  female (2)

7. Age : .....years less than 25  (1) 26-39  (2) 40-59  (3) > 60  (4)

8. What is your level of formal education?

primary  concluded (1)  uncompleted (2)

secondary  concluded (3)  uncompleted (4)

university  concluded (5)  uncompleted (6)

agricultural sciences ( Agronomy, Veterinary)  YES (1)  NO (2)

9. Local of residence?

city (1)

farm (2)

10. How many days do you spend per month in the farm?.....days/month

11. Marital status?  single (1)  married (2)  divorced (3)  widow (4)

12. How long have you been farmer?.....years

13. How long have you been involved with beef cattle?.....years

14. How is important the following factors for you have became a farmer?

	not important				very important
family tradition	1	2	3	4	5
parent's inheritance	1	2	3	4	5
spouse's inheritance	1	2	3	4	5
friend advice	1	2	3	4	5
advice from relatives	1	2	3	4	5
knowledge	1	2	3	4	5
profit business	1	2	3	4	5
safe business	1	2	3	4	5
enjoy the style of living	1	2	3	4	5
to have other income	1	2	3	4	5

15. Have you and family had other sources of income?  yes (1)  no (2)

16. If YES, what has been the percentage of contribution from the following sources?

employee .....% liberal professional.....%

entrepreneur.....% income from spouse.....%

building rent .....%      other.....%

17. How is important for you to take holidays?

not important 1 2 3 4 5 very important

18. Does your spouse came from farm family?

YES (1)     NO (2)

19. How many children do you have? .....children

20. How many children live at your home? .....

21. How many children have participated with you in the farm business?.....

22. Are you member of farmer association?     yes (1)     no (2)

23. How is important for you to be a member of the association?

not important 1 2 3 4 5 very important

### 5. GOALS AND OBJECTIVES

This part of the questionnaire was drawn to understand your objectives as a farmer. In this way, several statements include some aspects related with family which can or can not be able to express your objectives. However, the indication of the importance of each one will show more or less the significance of the statement to express your objectives.

24. To what extent, do you agree with these statements to express your goals and objectives?

	Strongly disagree				Strongly agree
	1	2	3	4	5
. Belong to rural community	1	2	3	4	5
. Guarantee land ownership	1	2	3	4	5
. Increase standard of family living	1	2	3	4	5
. Create opportunity of work for children	1	2	3	4	5
. Leave the business for the next generation	1	2	3	4	5
. Run the business without risk	1	2	3	4	5
. Be recognised as a top farmer	1	2	3	4	5
. Increase profits	1	2	3	4	5
. Run the business without loan	1	2	3	4	5
. Expand the business	1	2	3	4	5
. Spend more time on the farm	1	2	3	4	5
. Transfer knowledge for the children	1	2	3	4	5
. Spend more time with the family	1	2	3	4	5
. Have a herd of high quality	1	2	3	4	5
. Keep the pastures clean	1	2	3	4	5
. Be recognised by the quality of the buildings	1	2	3	4	5
. Be recognised by nature conservation	1	2	3	4	5

**6. STRATEGIC DECISIONS ( long term decisions mainly investments)**

This part is related with long term decisions, mainly those related with investments inside and outside farm such as: establishment and pasture recovery, buying of bulls, semen, females for reproduction, building, buying of land, investments on others sectors of economy, etc. The main focus is to understand how decision process is developed knowing who participate in the decisions, what decisions were taken and how the information are gathered.

25. How would you classify the importance of the following individuals in long term decisions?

	not important			extremely important		
personal	1	2	3	4	5	
spouse	1	2	3	4	5	
son	1	2	3	4	5	
father	1	2	3	4	5	
technical advisers	1	2	3	4	5	
other farmers	1	2	3	4	5	
friend	1	2	3	4	5	

26. Have you invested money outside of the farm business in last five years?

YES (1)  NO (2)

27. Have you invested money in the farm business in the last five years?

YES (1)  NO (2)

. If YES, move to 29

28. If NO, to what the extent the following motives have affected your decision?

	Strongly disagree			Strongly agree		
. No surplus of capital	1	2	3	4	5	
. To avoid risk	1	2	3	4	5	
. The farm does not need investments	1	2	3	4	5	
. Low profitability of farming	1	2	3	4	5	
. Advanced age	1	2	3	4	5	
. Lack of stable economy	1	2	3	4	5	
. Absence of successors	1	2	3	4	5	
. Family demands for money	1	2	3	4	5	
. The farm conditions do not allow	1	2	3	4	5	
. Avoid more work	1	2	3	4	5	
. Future expectation in the business is bad	1	2	3	4	5	
. Risk of land invasion	1	2	3	4	5	

If NO, go to.....49

29. If YES, what motives have affected your decision to invest in the farming business?

	not important				very important
. Surplus of capital available	1	2	3	4	5
. Credit facilities available	1	2	3	4	5
. Profit attractiveness	1	2	3	4	5
. Increase profit	1	2	3	4	5
. Agrarian reform	1	2	3	4	5
. Create opportunities for family	1	2	3	4	5

**6.1 Establishment of new areas of improved pasture**

30. Have you established new areas of improved pastures?

YES (1)     NO (2)

. If No, go to.....32

31. If YES, What has been the established proportion with and without cropping?

with cropping                    .....%

without cropping                .....%

**6.2 Pasture recovering**

32. Have you observed if in your farm there is pasture which needs to be recovered?

YES (1)     NO (2)

. If NO, go to.....44

33. If YES, what percentage of total pasture needs to be reformed?.....%

34. Have you invested money to recover degraded pasture?

YES (1)     NO (2)

If YES, go to .....36

35. If NO, what is the importance of the following motives?

	not important				very important
<b>no capital</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>high cost of the technology</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>low price of the cattle</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>no information how to do</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>do not have machinery</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>do not believe in the economic benefits</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

. If NO, go to .....44

**(a) Pasture recovering directly without cropping**

36. What percentage of improved pasture did you recover without cropping?.....%

If pasture was not recovered without cropping, go to .....39

37. In this process of pasture recovering without cropping, have you used lime?

YES  (1)    NO  (2)

38. And what about fertiliser?

YES  (1)    NO  (2)

(b) Pasture recovering with cropping

39. What percentage have you recovered with cropping?.....%

. If was not recoverd with cropping go to.....44

40. Has the cropping activity been under growers contract?

YES (1)  NO (2)

41. If YES, What is the importance of the following motives for your decision?

	not important				very important
no cropping experience	1	2	3	4	5
no machinery	1	2	3	4	5
avoid risk	1	2	3	4	5
avoid more work	1	2	3	4	5

42. What is the importance of the following motives have favourably influenced your decision to use cropping in the process of pasture recovering?

	not important				very important
quick pay back by cash cropping	1	2	3	4	5
work for children	1	2	3	4	5
increase soil fertility	1	2	3	4	5
increase income	1	2	3	4	5
use the available machinery	1	2	3	4	5
control weeds	1	2	3	4	5
eliminate the original grass	1	2	3	4	5

43. What percentage of the area have you used winter crops?.....%

6.2 Genetic potential of the herd

If the farm does not have breeding cows, go to.... 48

44. Have you invested money to improve the genetic potential

buying better bulls?  YES (1)  NO (2)

artificial insemination?  YES (1)  NO (2)

buying better females ?  YES (1)  NO (2)

45. Are you using cross breeding?

YES (1)  NO (2)

. IF NO, go to.....47

46. If you are using cross-breeding what level of importance of the following factors in your decision?

	not important				very important
personal experience	1	2	3	4	5
technical advisers	1	2	3	4	5
assistance from EMPAER	1	2	3	4	5
experience others farmers	1	2	3	4	5
EMBRAPA	1	2	3	4	5
tax incentives	1	2	3	4	5

decrease age at slaughter      1    2    3    4    5

increase cattle weight      1    2    3    4    5

47. Please could you mention at least three factors, which do not use crossing breeding?

.....  
.....  
.....

**6.4 Building**

48. If, have you invested money in building in the last five years, please indicate?

fences     YES (1)     NO (2)

watering     YES (1)     NO (2)

corrals     YES (1)     NO (2)

shelter places     YES (1)     NO (2)

mineral recipients     YES (1)     NO (2)

employee house     YES (1)     NO (2)

farmer house     YES (1)     NO (2)

others     YES (1)     NO (2)

**6.5 Cattle renting**

49. Have you rented cattle from other farmers?

YES (1)     NO (2)

50. Have you rented cattle to other farmers?

YES (1)     NO (2)

**7. TACTICAL DECISIONS (short term decisions)**

51. How would you classify the importance of the following individuals in your short term decisions such as buying of inputs, buying of cattle, selling, animal husbandry, pasture management and labour?

	not important			very important		
personal	1	2	3	4	5	
spouse	1	2	3	4	5	
son	1	2	3	4	5	
parents	1	2	3	4	5	
technical advisers	1	2	3	4	5	
other farmers	1	2	3	4	5	
friend	1	2	3	4	5	

**7.1 Buying input strategies**

52. How important are the following procedures in buying inputs?

	not important			very important		
price survey	1	2	3	4	5	
look for advertisement	1	2	3	4	5	
trust personal experience	1	2	3	4	5	
consult traditional suppliers	1	2	3	4	5	
consult other farmers	1	2	3	4	5	
consult technical advisers	1	2	3	4	5	
consult some known informant	1	2	3	4	5	
consult some friend	1	2	3	4	5	



53. When you are looking for inputs what is the importance of the following communication channels?

	not important				very important
telephone consult	1	2	3	4	5
fax	1	2	3	4	5
personal visiting	1	2	3	4	5

54. When do you want to buy inputs what is the importance of the following factors?

	not important				very important
quality	1	2	3	4	5
price	1	2	3	4	5
traditional suppliers	1	2	3	4	5
supplier confidence	1	2	3	4	5
credit	1	2	3	4	5
supplier friendship	1	2	3	4	5
technical assistance	1	2	3	4	5

## 7.2 Buying of animals

55. Have you bought cattle in the last five years?

YES (1)  NO (2)

. If NO, go to.....58

56. If YES, what categories have you bought?

females to breed  YES (1)  NO (2)

bulls  YES (1)  NO (2)

females to fatten  YES (1)  NO (2)

weaned calves  YES (1)  NO (2)

steer over one year  YES (1)  NO (2)

steer over two years  YES (1)  NO (2)

57. How have you distributed the buying of cattle?

auction .....%

direct in farms.....%

58. In your activity, what the level of importance of the following sources to provide information on offering of cattle?

	not important				very important
auction enterprises	1	2	3	4	5
farmers	1	2	3	4	5
specialised offices	1	2	3	4	5
bulletins	1	2	3	4	5
midia (newspaper, TV, etc)	1	2	3	4	5

**7.3 Selling of animals**

59. How is distributed your selling of those animal which are not sold to slaughtering?

- auction** .....%
- direct in farms**.....%

60. If you sell fat steer what is the weight at slaughtering?.....kg

61. If you sell fat steer what is the age at slaughtering?.....months

**7.4 Animal husbandry, selection and animal health**

*. If the farmer do not have breeding cows , go to...66*

62. Have you used mating season?

- YES (1)  NO (2)

63. Have you submitted the cows to pregnant test?

- YES (1)  NO (2)

64. Have you submitted the bulls to fertility test?

- YES (1)  NO (2)

65. Do you use control against endoparasite?

- YES (1)  NO (2)

*. If not, go to.... 69*

66. If YES, what months?

.....

67. What animal categories the control is applied?

- males up to 1 year**  YES (1)  NO (2)      **female up to 1 year**  YES (1)  NO (2)
- males 1 to 2 years**  YES (1)  NO (2)      **heifers 1 to 2 years**  YES (1)  NO (2)
- males over 2 years**  YES (1)  NO (2)      **heifers over 2 years**  YES (1)  NO (2)
- bulls**  YES (1)  NO (2)      **cows**  YES (1)  NO (2)

68. Do you know the EMBRAPA orientation of controlling endo-parasites on May, July and September only for animals up to two years old?

- YES (1)  NO (2)

**7.5 Mineral supplements**

69. Have you provided systematically mineral supplements during all year?

- YES (1)  NO (2)

70. If NO, what importance of the following motives for you do not provide mineral supplement?

	not important					strongly important				
<b>lack of information</b>	1	2	3	4	5					
<b>don't believe in the benefits</b>	1	2	3	4	5					
<b>high cost</b>	1	2	3	4	5					

**7.6 Protein and energy supply during the dry season**

71. How do you classify the importance of providing feed supplements during the dry season?

- no important 1 2 3 4 5 very important**

72. Have you provided feed supplements during the dry season?

YES (1)  NO (2)

. If NO, go to.....74

73. If YES, for what animal categories?

calves  YES (1)  NO (2)

weaned males  YES (1)  NO (2)

weaned females  YES (1)  NO (2)

steers over one year  YES (1)  NO (2)

steers over two years  YES (1)  NO (2)

74. If you have not provided feed supplements at the field how is the importance the following statements to explain your decision?

	not important					extremely important
the activity is breeding cows	1	2	3	4	5	
lack of information	1	2	3	4	5	
doubts on the benefits	1	2	3	4	5	
too much work	1	2	3	4	5	
cattle must be reared on pasture	1	2	3	4	5	

75. What percentage of the males has been fatten using feed-lot?.....%

76. What percentage of the fat steer has been classified as precocious steer?.....%

### 7.7 Pasture Management

77. Considering the differences of pasture production between wet and dry season which of the alternatives have you taken in order to define the stocking rate?

- pasture production during wet season (1)
- pasture production during dry season (2)
- average annual production (3)
- use a stocking rate for each season (4)

78. Looking at the activity as a business what is the order of importance of the following criteria that have you considered to define the quantity of cattle in the farm?

- pasture production in the long term ..... (1)
- pasture production in short term ..... (2)

79. Have you observed if the carry stocking capacity has decreased in the last five years?

YES (1)  NO (2)

80. How would classify the conditions of your pastures nowadays?

- overgrazed (1)
- undergrazed (2)
- equilibrium (3)

81. In relation to the pasture production in the long term how would you classify the pasture management that you have used?

not adequate 1 2 3 4 5 very adequate

82. Have you used intensive rotational pasture management (Voisin)?

YES (1)  NO (2)

83. If yes, how did you classify your satisfaction in relation to this method?

**no satisfaction 1 2 3 4 5 strong satisfaction**

84. How did you classify the importance of soil erosion in your farm?

**no important 1 2 3 4 5 very important**

85. What percentage of the area was implemented soil conservation?.....%

86. Most of farmers use overgrazing do you agree with this opinion?

YES (1)  NO (2)

87. If YES, in your opinion what is the level of importance of the following factors to keep herd greater than is recommended?

	not important				very important
as an alternative to save capital	1	2	3	4	5
to increase income	1	2	3	4	5
to have liquidity	1	2	3	4	5
strategy to face low prices and keep income	1	2	3	4	5
other.....	1	2	3	4	5

The next questions are to be applied only to Pantanal (native pasture)

88. What is the order of importance of the following factors in the pasture management?

size of farm	1	2	3	4	5
relation between low and high land	1	2	3	4	5
period (length) inundation	1	2	3	4	5
climatic conditions of previous year	1	2	3	4	5

89. Have you observed if the native vegetation has changed in your farm?

YES (1)  NO (2)

. If NO, go to .....95

90. What has been the effect on pasture quality?

**decreased the quality  (1) increased the quality  (2) did not change  (3)**

91. What has been the importance of this effect for beef industry in the region?

**not important 1 2 3 4 5 very important**

92. In your opinion what is the importance of the following factors in the changing of vegetation?

	not important				very important
the cyclic inundation	1	2	3	4	5
the cattle	1	2	3	4	5
fire	1	2	3	4	5
natural evolution	1	2	3	4	5
inundation of new areas	1	2	3	4	5
change of the wild life	1	2	3	4	5

93. Where have you observed the main changes?

"cordilheiras"  YES (1)  NO (2)

near lakes  YES (1)  NO (2)

between "cordilheira and vazante"  YES (1)  NO (2)

94. How did you classify the speed of the changes?

not significant 1 2 3 4 5 strongly significant

95. If your farm there is areas under the risk of inundation what have been the indicatives for you to take out the cattle from those areas before inundation?

.....  
.....

96. What has been the order of priority to take out cattle from inundation?

single cows .....

cow with calf at the foot .....

rearing cattle .....

take out all together .....

97. Do you have other farm outside Pantanal?

YES (1)  NO (2)

Specifics questions on Pantanal end up here

### 7.8 Labour

98. How many "cowboys" do you have?.....cowboys

99. What frequency have you changed "cowboys"?

often  (1) eventually  (2) rarely  (3)

100. What is the level of importance of the following factors you take in consideration to contract "cowboys"?

	not important				strongly important
grown up in the farm	1	2	3	4	5
grown up in the region	1	2	3	4	5
recommended	1	2	3	4	5
married	1	2	3	4	5
single	1	2	3	4	5
level of education	1	2	3	4	5

### 8. OPERATIONAL DECISIONS

This next questions are concerned about decisions of the day to day such as working with cattle, machinery, account, bank, order services, etc.

101. What the level of importance of the following individuals in the daily decisions?

	not important				very important
personal experience	1	2	3	4	5
spouse	1	2	3	4	5
son	1	2	3	4	5

parents	1	2	3	4	5
technical advisers	1	2	3	4	5
other farmers	1	2	3	4	5

102. Inform at least three decisions which demand more effort from you?

.....  
 .....  
 .....

**9. GENERAL**

**9.1 Information and knowledge demands**

103. EMBRAPA have recommended that the recuperation of degraded pasture should include the increasing of soil fertility (lime and fertiliser mainly phosphorus), improvement of physical conditions of the soil (soil preparation) and erosion control (when necessary). The process can be implemented directly or through cropping. What the degree do you think that the most of farmers agree with this technology?

**do not agree 1 2 3 4 5 strongly agree**

104. EMBRAPA have tested and made available several grasses and legume, in your opinion, if you know them, what is the level of importance of each one represent to the farmers of the region?

- B. brizantha**    ☒ YES (1) ☒ NO (2) **no important 1 2 3 4 5 very important**
- Andropogon**    ☒ YES (1) ☒ NO (2) **no important 1 2 3 4 5 very important**
- Tanzania**        ☒ YES (1) ☒ NO (2) **no important 1 2 3 4 5 very important**
- Mombaça**        ☒ YES (1) ☒ NO (2) **no important 1 2 3 4 5 very important**
- Vencedor**        ☒ YES (1) ☒ NO (2) **no important 1 2 3 4 5 very important**
- Mineirão**        ☒ YES (1) ☒ NO (2) **no important 1 2 3 4 5 very important**

105. EMBRAPA have provided yearly a publication on bull ranking of all Zebu breeds based on weight gain of the sons as contribution to help farmers to take decisions on choosing bulls or semen to buy, do you know this work?

☒ YES (1) ☒ NO (2)

106 If YES, have you used it?

☒ YES (1) ☒ NO (2)

107. What level of importance do you think about this information?

**not important 1 2 3 4 5 very important**

108. Could you inform three points that the farmers need more information to guarantee the success of their business?

.....  
 .....

109. Could you mention three main problems of beef production, which Embrapa should find solution?

.....  
 .....

110. Besides the above problems for EMBRAPA, could you indicate other kinds of problems which you are worried with?

.....  
 .....  
 .....

**9.2 Information methods**

There are several manners of getting information and knowledge on farm business have been used such as **reading, talking, observing, listening and watching**. How these different sources have been important for you will be the subject of the next questions.

111. What has been the level of importance of **reading** for your information and knowledge?

**not important    1   2   3   4   5    very important**

112. What have been the level of importance of the following sources of reading?

	<b>not important</b>					<b>very important</b>				
<b>journal supplements</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>magazines</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>association bulletins</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>extension publication</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>specialised books</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>EMBRAPA publications</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					

113. What have been the level of importance of **talking and listening** for your information and knowledge?

**not important    1   2   3   4   5    very important**

114. How would you classify the importance of the following locality to **talk and listen** in order to increase your knowledge?

	<b>not important</b>					<b>very important</b>				
<b>agricultural fairs</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>bars</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>leisure clubs</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>rope clubs</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>farmer association</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>rural syndicate</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>EMBRAPA</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>bank</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>friend's house</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>suppliers shop</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>cooperative</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>cattle auction</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>radio</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>television</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					

115. How would you classify the importance of **observing** in your process to obtain information and knowledge?

**not important 1 2 3 4 5 very important**

116. What is the level of importance where the following locality of observation can take place?

	<b>not important</b>					<b>very important</b>				
<b>other farms in the region</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>other farms in other regions</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>EMBRAPA</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>agricultural fairs</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>cattle auction</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					

117. What the level of importance of the following activities which have been useful for your knowledge?

	<b>not important</b>					<b>very important</b>				
<b>field days</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>courses</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					
<b>technical seminar</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>					

### 9.3 Behaviour and Decision Process

118. How do you act in relation to a new technology or product?

- try to incorporate them soon** ☐☐☐☐☐ (1)
- analyse the opportunity to use** ☐☐☐☐☐ (2)
- wait for other farmers experiment first** ☐☐☐☐☐ (3)

119. How do you take decision considering the below procedures?

- intuition** ☐☐☐☐☐ (1)
- analysis** ☐☐☐☐☐ (2)
- analysis and intuition** ☐☐☐☐☐ (3)

120. In your opinion, in order of importance, what decisions the farmer should concentrate more effort to guarantee success?

- production decisions** ..... (1)
- economic decisions**..... (2)
- technological decisions**..... (3)

### 9.4 Productive chain

121. How would classify the importance of the following factors in the way of you produce cattle?

<b>. beef meat price</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>. demands from slaughter industry</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>. demands from consumer</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>. demands from retail market</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>. chicken meat price</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>. pork meat price</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>



. future market of fat steers	1	2	3	4	5
. value of the land	1	2	3	4	5
. production costs	1	2	3	4	5

122. Do you know the cost to produce 1 kg of beef meat?

YES (1)  NO (2)

#### 9.4 Satisfaction

123. Do you think that the economic planning affected your satisfaction as a farmer?

YES (1)  NO (2)

*If YES, go to.....125*

124. If NOT, what the level of your satisfaction?

**no satisfaction 1 2 3 4 5 strong satisfaction**

*Go to..... 126*

125. How would you classify your satisfaction?

	no satisfaction					strong satisfaction				
before planning	1	2	3	4	5					
after planning	1	2	3	4	5					

126. Do you think that beef as business was affected?

YES (1)  NO (2)

*If YES, go to ....128*

127. If NOT, how would you classify beef as business?

**very bad 1 2 3 4 5 very good**

*Go to .....129*

128. If YES, how would you classify beef as business before and after planning?

	very bad					very good				
before planning	1	2	3	4	5					
after planning	1	2	3	4	5					

129. Do you desire to go out of the farming business?

YES (1)  NO (2) ⇒ **Thank you**

130. If YES, what level of importance of the following motives?

	not important					very important				
loosing money	1	2	3	4	5					
low profitability	1	2	3	4	5					
retirement	1	2	3	4	5					
to much work	1	2	3	4	5					
stress	1	2	3	4	5					
family problems	1	2	3	4	5					
lack of motivation	1	2	3	4	5					
no satisfaction	1	2	3	4	5					
risk of land invasion	1	2	3	4	5					Thank you

# Appendix 7.1: Factor loadings

**Table 7.1.1: Factor loadings and distance to the centroids of the clusters**

Case	Farmer	factor loadings								Distances	
		1-1	1-2	1-3	1-4	1-5	2-1	2-2	2-3		2-4
<b>C. Grande - Cluster 1</b>											
6	718	-1.1762	-0.2525	-0.9065	1.22316	-0.3606	-0.6205	1.1059	1.22586	1.2165	<b>1.5509676</b>
11	1189	-1.3875	0.58535	-0.9281	0.07195	0.47232	-1.555	0.9533	-0.3671	0.7746	1.6642521
16	1183	0.18624	1.23531	0.27502	1.53283	1.14562	-1.1737	0.3005	1.61109	0.9944	2.1343213
31	604	0.26124	1.22422	0.33224	0.7515	-0.9101	0.06529	0.7724	0.95754	0.5562	2.3522562
46	236	-0.5954	-1.667	0.48435	1.90549	0.74138	-1.2412	0.4966	0.3928	0.9309	2.5304469
29	791	-0.7016	-0.2002	1.58513	2.15272	-0.3741	-0.3796	0.654	1.15523	0.9453	2.8473193
1	824	-0.2579	0.90536	-2.7782	-0.101	-0.6926	-1.3679	-0.0565	1.35114	0.6569	2.94435
4	531	-1.0164	0.91887	-0.4999	0.85382	-0.4766	-1.7186	1.9732	-1.3773	-0.9101	3.1547265
5	985	-0.2891	1.43663	-3.4261	0.67096	1.07383	-1.2566	0.777	1.24446	1.2	3.280037
17	78	-0.4058	-1.6132	0.27649	-1.1594	3.16475	-1.8764	1.175	0.44099	0.8878	4.0702896
<b>Centroids</b>		<b>-0.538</b>	<b>0.257</b>	<b>-0.559</b>	<b>0.790</b>	<b>0.378</b>	<b>-1.112</b>	<b>0.815</b>	<b>0.663</b>	<b>0.725</b>	
<b>C. Grande - Cluster 2</b>											
24	244	1.47383	0.19331	0.35104	-0.5189	-0.0798	0.7817	-0.6075	-0.194	-0.2644	<b>1.1727243</b>
33	801	1.20624	0.62142	0.19714	0.67848	0.74893	1.57308	0.0074	0.07515	0.2791	1.5717492
21	928	0.42745	0.41017	0.54445	-0.2792	-0.3255	0.58753	-0.8145	-0.3262	0.7776	1.5955323
23	513	0.74624	-0.2157	0.07609	0.80624	0.5369	-0.1173	0.2326	0.51251	-0.7013	1.6691081
26	1182	0.88515	0.27674	0.13868	1.12113	0.50926	0.39196	-0.7343	0.05802	-0.2113	1.7003023
56	1054	1.59448	0.93376	0.01099	-0.9862	0.04615	0.306	-0.0778	0.54348	0.3768	1.7111061
51	937	1.76481	-0.1808	-0.4673	-0.9376	-0.3296	0.68352	-0.2885	-0.1518	-0.2552	1.7771326
40	587	0.2318	1.16638	-0.0406	-1.1395	-0.5994	1.29669	1.0246	-0.288	-0.6627	1.9644158
52	1007	1.14612	0.69916	0.21998	1.23786	0.85056	1.6486	0.4532	0.0009	0.5394	2.1023336
20	302	1.66212	0.8837	0.57154	-0.0394	-0.1108	0.84295	-0.4235	0.16974	-1.9661	2.1210454
53	313	0.76799	-1.0991	-0.3513	-1.0092	0.94779	0.85275	0.7936	-0.0281	-1.3662	2.3572923
54	924	1.09661	0.87169	-1.0349	-0.1773	0.49876	1.64618	1.089	-0.2116	0.9625	2.4276004
22	906	1.90936	0.21193	-0.2017	0.88696	0.4948	1.45783	0.2734	-1.1383	0.7836	2.451594
3	986	0.32903	1.58614	0.38581	-1.8707	1.07711	0.60628	0.8233	0.34785	0.6114	2.6069742
8	699	1.39496	0.08734	1.22477	-0.4445	-0.6453	0.04072	-1.122	1.42528	-1.1615	2.6143588
58	994	0.87066	0.09769	-0.0323	0.35515	-0.1221	0.26011	-0.6234	-2.3327	-0.1815	2.6377098
7	689	-0.6776	-0.0096	0.38101	-0.285	-0.2712	-0.5992	0.5179	-0.3463	-1.9596	2.6803146
44	1	0.15387	0.39116	1.27596	1.92347	0.22529	1.34027	0.9562	-0.0213	-1.1719	2.6998267
55	710	-0.5359	0.2376	0.33375	-1.023	0.44173	-0.0703	-0.1773	2.13422	0.0134	2.7992498
30	1194	-1.3819	1.25004	0.80803	-1.2045	0.838	0.81667	0.3547	1.30957	0.3578	3.0138592
37	708	2.24042	0.12957	-0.2345	-1.8007	-0.2541	1.54065	-1.2606	0.96189	-0.3909	3.0141993
45	384	1.38895	-1.1198	1.14623	1.67316	1.33891	0.68604	1.0344	0.3528	0.8568	3.1930225
32	415	0.07794	-0.6483	0.50336	0.80778	0.07947	0.65874	0.2175	0.58142	-3.0427	3.2183614
49	184	2.15453	0.30119	-0.0789	-0.2689	-1.176	2.07288	-1.0579	1.80929	-0.2819	3.2441359
10	234	0.78956	1.28134	-0.0779	-1.1261	1.15392	1.07696	-0.3431	-1.881	1.7334	3.3125524
14	877	0.72811	-0.1176	2.16613	-0.8842	-1.9501	-0.2167	0.6558	-1.9	0.9003	3.7933688
28	509	-0.9475	1.02725	1.57052	1.23127	1.62467	0.79718	1.7196	0.5478	-2.067	3.8354035
2	842	-1.3342	0.2283	2.2277	-1.9892	-1.374	0.4775	1.7316	-2.0474	-0.4541	4.4571614
<b>Centroids</b>		<b>0.720</b>	<b>0.339</b>	<b>0.415</b>	<b>-0.188</b>	<b>0.149</b>	<b>0.766</b>	<b>0.156</b>	<b>-0.001</b>	<b>-0.284</b>	
<b>C. Grande - Cluster 3</b>											
19	276	-1.0854	-0.8072	-0.5496	-0.6902	0.07166	-1.3488	-0.6072	-0.3044	-0.2334	<b>1.2327408</b>
50	855	-0.4862	-0.4239	0.2843	0.08252	-0.8341	-1.2646	0.0273	-0.916	0.2594	1.7012511
25	487	-0.0945	-0.4655	-0.5483	-0.9896	0.17846	-0.2623	-1.747	-0.5068	0.3199	1.7101611
47	289	-1.3765	-1.3759	0.16072	-0.099	-0.2962	-1.4886	0.0583	0.01031	0.2648	1.8160528
35	703	-0.1104	-0.586	0.35381	0.90411	-1.0238	0.11256	-0.609	-0.8077	-0.1807	1.8429296
60	261	-1.2161	0.25017	-0.138	0.25162	-1.4588	-0.9454	-0.0504	-0.7304	-0.0243	2.042316
18	220	-0.8539	-1.3597	-1.3531	-1.1577	-0.5065	-1.6372	-0.334	-0.9685	-0.3715	2.0746999
59	1022	-0.4731	-0.474	1.16578	-1.0421	-0.5214	0.26882	-1.5831	-0.2857	-0.9429	2.0968736
43	847	-0.8669	-1.1065	-1.8463	-0.0483	-0.6676	-1.1411	-0.336	-0.5513	-1.3299	2.1057157
39	111	-0.9016	-1.8449	0.12273	-0.1022	1.21315	-0.5597	-0.9731	-0.6721	-0.3708	2.1104802

Continuation Table 7.1.1

Case	Farmer	factor loadings								Distances	
		1-1	1-2	1-3	1-4	1-5	2-1	2-2	2-3		2-4
<b>C. Grande - Cluster 3</b>											
27	900	0.47368	-0.9375	0.20177	0.26774	-1.2066	-0.0136	-2.2945	-0.0312	0.1862	2.1404222
41	933	-1.0217	-0.1572	-0.7729	-1.303	-0.1409	0.0614	-1.9995	0.55721	-0.5805	2.141866
13	832	-0.7085	-0.2337	1.17549	-0.2335	0.47625	-1.4819	-0.4616	-0.7618	0.0818	2.1799403
12	301	-0.9857	-2.2188	-0.425	-0.4	-0.9635	-1.4813	-0.8144	-0.1845	-2.146	2.4457101
42	859	-0.9794	-2.0881	-0.7361	-1.1117	-0.3691	-1.2372	0.5999	-0.3111	-1.3993	2.5412993
57	402	-0.9639	-0.1987	1.15233	0.76748	-1.248	0.24939	-2.2527	-0.232	-0.3743	2.5871045
38	522	0.5895	0.21776	-0.4413	0.20873	-2.2436	-0.8031	-0.9887	0.7345	0.365	2.6719082
36	800	0.44369	-0.7834	-1.489	0.22743	-1.4985	-0.8354	0.4013	1.00142	-0.7424	2.6779294
9	42	-0.8291	-0.1101	-1.9449	-1.2444	-0.7094	-1.4687	-0.802	0.5801	-1.6565	2.7296216
34	849	-0.07	-1.9127	-0.4926	1.10839	-0.8438	-0.7993	-0.2029	-0.7071	-2.7361	3.1044228
48	1209	0.86028	-0.7481	-0.5073	-0.0423	0.21633	1.16318	-2.8157	0.16943	1.0069	3.4156358
15	1066	-1.0669	-1.7041	1.68221	-0.6556	1.16536	-0.7909	-3.3216	0.65979	1.9187	4.3893993
<b>Centroids</b>		<b>-0.533</b>	<b>-0.867</b>	<b>-0.225</b>	<b>-0.241</b>	<b>-0.510</b>	<b>-0.714</b>	<b>-0.959</b>	<b>-0.194</b>	<b>-0.395</b>	
<b>Pantanal - Cluster 1</b>											
94	73	0.4646	-0.3418	0.71268	0.46545	0.72388	0.67352	0.5551	-0.5195	0.7246	<b>1.165845</b>
61	19	0.38242	-1.1761	-0.2491	-0.2887	-0.2662	0.3843	0.2875	-0.5275	0.2502	1.1968383
88	215	0.48481	-0.9317	0.18765	0.97339	1.39862	1.15204	0.0886	-0.9625	0.1274	1.706801
67	181	1.91547	-1.2976	-0.3962	0.02803	0.50357	0.59136	-0.238	0.30572	-0.2569	1.9461703
69	114	0.53835	-1.4778	-0.9742	1.14721	0.75774	0.96833	-0.8015	-0.4548	0.1698	1.9879013
70	306	-0.2186	-0.5594	-0.857	0.12488	-1.1534	-0.0436	-0.4568	-0.2058	0.4887	2.0612263
77	288	-0.5991	-1.0551	0.92276	0.35618	1.06495	0.083	0.2673	0.72597	0.5696	2.2240528
65	157	1.03931	-0.76	-0.199	0.60013	-2.2141	0.62133	0.1614	-0.1085	0.0291	2.337538
91	211	-0.7054	-0.4924	0.967	1.0653	0.55555	0.09772	0.7119	-1.4627	0.8001	2.3512842
78	233	1.63944	0.1032	-0.0901	-0.8048	0.39882	2.01874	0.2037	-1.1285	0.4353	2.395829
92	298	0.47458	0.88025	1.58076	1.5609	-0.2401	1.44953	0.949	-0.0023	0.9193	2.662581
93	6	1.57629	-0.158	-0.5169	0.66427	-1.2359	1.6187	0.6692	1.30606	-0.7275	2.7455178
<b>centroids</b>		<b>0.583</b>	<b>-0.606</b>	<b>0.091</b>	<b>0.491</b>	<b>0.024</b>	<b>0.801</b>	<b>0.200</b>	<b>-0.253</b>	<b>0.294</b>	
<b>Pantanal - Cluster 2</b>											
82	196	-0.1187	1.11772	-0.6526	-0.5194	-0.2719	-0.5689	0.0119	0.10886	0.6711	<b>1.4580697</b>
85	244	-0.3955	-0.1717	1.05587	-1.2703	-0.3792	-0.2234	0.3865	1.15428	-0.1306	1.7629919
72	231	-1.2717	-0.1108	-0.2344	-0.0458	0.29952	0.33021	0.9465	0.08155	1.1667	1.7769787
63	2	-0.6527	-0.0816	-0.6838	-0.5649	0.90883	0.10151	1.1292	-0.4168	0.5084	1.8077076
80	188	-0.8565	0.78176	-0.6562	-0.2001	0.63964	0.06915	0.0234	1.52575	-0.7718	1.8307847
79	402	0.74716	0.63077	0.15924	-0.6811	-0.2267	0.89179	0.3438	0.1735	1.1957	1.9097527
66	156	-0.9648	1.80937	-0.8918	-1.5215	0.02758	0.52561	-0.0499	0.89325	0.0835	1.9974057
68	117	-0.0121	1.15507	-0.8532	-0.8861	1.67724	-0.4151	0.9986	1.65653	0.7523	2.1317653
73	292	-1.7473	1.84287	1.27858	-0.1072	1.46159	-0.6606	0.6126	1.2918	0.7045	2.6019053
81	167	1.02393	0.02984	0.4018	-1.9162	1.26744	-0.902	0.8013	0.24188	1.3952	2.6714271
86	1209	-1.6216	2.0367	0.94341	-0.0643	0.90549	0.86069	0.7167	0.97275	-1.2429	2.8716141
62	128	0.25708	-0.7334	1.76877	-0.9685	-0.4088	-1.491	1.2674	1.02688	0.2686	2.970524
75	236	-0.543	-0.0651	0.63386	-1.6498	-1.7739	0.22771	-0.1457	0.17971	-1.0744	3.0375196
84	188	0.55047	0.50698	-1.6499	-0.0623	2.17103	-0.7165	1.2471	1.51906	1.0418	3.1493209
87	193	-1.3997	1.90181	0.63892	0.11864	-1.2686	0.93831	-0.8416	-0.0078	1.4738	3.204249
<b>centroids</b>		<b>-0.467</b>	<b>0.710</b>	<b>0.084</b>	<b>-0.689</b>	<b>0.335</b>	<b>-0.069</b>	<b>0.497</b>	<b>0.693</b>	<b>0.403</b>	
<b>Pantanal - Cluster 3</b>											
74	255	-0.7351	1.30407	-0.0215	0.90199	-0.4631	-1.3467	-1.0896	-2.1455	0.5429	<b>1.8697062</b>
83	229	1.00088	0.72232	-0.1057	0.15943	-0.3427	-0.6434	-0.9935	-1.5355	0.586	2.0213137
90	300	-1.2163	-0.2104	-1.6325	1.43403	0.52522	-1.4286	0.3441	-0.9765	-0.1236	2.1653471
89	214	0.17574	0.37723	-1.3291	2.17337	0.26523	1.21127	0.5874	-1.2655	-0.5359	2.528122
76	203	-1.213	-0.397	-1.1848	0.36688	0.0745	-0.3497	0.0414	-0.2139	-2.1218	2.881228
71	248	-0.201	-0.6383	0.98926	0.18392	0.27265	-0.8207	-1.7916	-0.4713	1.0268	3.0460001
64	204	-0.8565	2.45791	-0.1457	1.88859	-2.4025	0.18386	1.6574	-3.0988	0.4335	4.0232921
<b>centroids</b>		<b>-0.435</b>	<b>0.517</b>	<b>-0.490</b>	<b>1.015</b>	<b>-0.296</b>	<b>-0.456</b>	<b>-0.178</b>	<b>-1.387</b>	<b>-0.027</b>	

# Appendix 8.1

## Interview Transcripts of “Trusted Persons”

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### 8.1.1 TP1 (trusted person of C1)

*“I am descended from a family of several generations of farmers. When my father died I was 12 years old, and my mother decided to move to Sao Paulo to educate the children. Later, I entered to a Veterinary Faculty, but after the first two years, I decided to move to a technical course of Animal Production, linked to the University of Sao Paulo. During that time, I used to meet the distinguished teachers and technicians from whom I learnt much more by informal talking than in the class room. In 1964, I went back to Campo Grande when I inherited a big farm. However, it was a weak farm of poor soils.*

*When I started to farm, the Brachiaria grass was not available, so I tried to improve the farm productivity with other practices. I was one of the first farmers to use artificial insemination in the region, but I had several difficulties to use it. I also used to bring mineral supplements from Sao Paulo...then I started to change the traditional beef farming system by experimenting the new practices. Many farmers came to my farm to see how I was obtaining 60 per cent calving rate, which was considered good for a grazing system of native pasture. At the beginning, I learnt with older farmers but I think that I learnt much by doing it myself.*

*Later on, I became closely involved with the livestock farmer association (ACRISUL). It was in ACRISUL that I obtained much information from the researchers of EMBRAPA. We used to have meetings with the researchers twice a month. I learnt very much with the researchers. During the three or four years that I stayed in front of ACRISUL I had also the opportunity to visit many places and farms in different regions, from where I learnt other experiences.... I had difficulties to learn by the books,... I preferred personal communication, which facilitates sharing of experiences and learning a lot from other farmers. When I read the magazine Globo Rural, the first thing that I read is the farmers' experience. However, my sources of information are much more by means of personal communication. We are lucky to have EMBRAPA here in the State. Many farmers, like Dr X, are successfully using the technologies from EMBRAPA. However, few farmers go directly to EMBRAPA because they prefer to speak with other farmers. A farmer told me that some farmers asked him to go to EMBRAPA to obtain information instead of going there by themselves.*

*I do not consider myself as a progressive farmer and I have not used advanced technologies. The best that I have done was to apply a mineral supplement to my conditions, to reduce the age of weaning and to implement sub-division of paddocks. I use a pasture rotation scheme based in groups of four paddocks linked to a central*

*corridor to move the cattle. In doing this, the herd management was systematised, the labour cost was reduced and the efficiency increased. In the past, we had too many cattle, and at the present time the pastures are degraded. Nowadays, I prefer to have less head of cattle in order to preserve the pastures for a longer time. The technology has advanced markedly in recent years.”*

### **8.1.2 TP2 (trusted person of C3)**

*“I grew up in farming. My family is a traditional farming family. I grew up learning the old system of farming at a time when the farm expenditures were much lower than the income. We did not move to the city to spend money on children’s education; all family members lived in the farm.... things have changed a lot...new people have entered into beef farming. These people are coming with new technologies...The pastures were degraded before they came. We did not know what to do, because we did not have the new knowledge to solve this problem. We had to learn with agronomists and new people, mainly entrepreneurs (big farmers from the industrial sector). They brought the new techniques. The entrepreneurs had money to experiment with the new techniques, while the traditional farmers were not able due to their limited financial conditions.*

*I have had close relationships with many of the entrepreneurs... I have used some of the practical technologies that I have observed from them. I leave aside what I think is not practical. I have also obtained information from EMBRAPA. I went to EMBRAPA as several of my friends did. The researchers provided good ideas on how to transform beef production with new technologies. In this way, I have improved my knowledge. I do not like to read I like to listen, to talk, to exchange ideas and to visit farms. I travel frequently because I am also a steer buyer. Travelling, I have seen advanced techniques. I have seen cross breeding which is able to reduce the age of slaughter to twenty months. This is very new for us, we did not believe at first, but now we have started to use this practice. The same happened in relation to pasture rotation. I personally did not believe it, and today I am convinced of the benefits. Pasture recovering, associated with practices to avoid erosion, was also a success in my farm. I learnt these good practices from agronomists and advanced farmers... many of them went to EMBRAPA. However, the majority of the farmers do not want to accept these new technologies.*

*I like very much to watch the rural programs shown on TV. However, EMBRAPA is a trusted institution that we can believe. I have realised that EMBRAPA is contributing to a big change for the days of today. EMBRAPA is right, we have to change, and the resistant farmers will not survive from the beef farming in the future. They will not continue in the system if they insist on selling steers of four or five years of age.”*

### 8.1.3 TP3 (trusted person of P1)

*"I grew up in the environment of extensive farming of beef cattle systems in Pantanal. My father came from the North of Mato Grosso to establish an extensive farm here. I started to learn early how to ride a horse, to rope cattle in the field, and cattle management. Early on I also became the owner of the farm because my father died... I was 19 years old. I had to make a partnership with an uncle to manage the farm because I was in the University.... I was studying for a lower career. My uncle managed the farm for twelve years... He used to explain why his decisions were made... My uncle also used to observe what the neighbouring farmers were doing... I learnt very much. Traditionally, the farmer trusts more in his neighbour's experience than in the information from a technician. In the past, this was more accentuated than now. The information runs fast from farmer to farmer in order to be adopted.*

*I did change my life completely to dedicate myself to farming. I gave up a professional career as a University teacher in Rio de Janeiro. However, when I took that decision I also made a compromise with myself to be the best farmer. From that point in time, I started to read books and rural magazines. I read about animal nutrition and pastures. Fortunately, I had financial conditions to invest in the farm, and in four years time the farm was complete full of cattle. Once I had the cattle herd, the next step was to study to be the best. In my learning process EMBRAPA has contributed very much. I also have intensively participated in the Rural Syndicate and ACRISUL (Livestock Farmer Association of Mato Grosso do Sul) over the last thirty years. I always looked for information. I use to go frequently to EMBRAPA since the institutional research started twenty years ago. I have followed the development of the research from the beginning. In that time EMBRAPA was very closed. Later, the relationship between EMBRAPA and ACRISUL improved, and the farmers were better attended.*

*Anyway, I am not the best farmer of all, as I would like to be. I still have doubts about some of the new things, but EMBRAPA is a very important source of information. I used to attend every field day promoted by EMBRAPA and I read all publications as well. For the majority of farm problems that I have, I go personally to EMBRAPA to ask for a solution. They helped me on pasture, endoparasites and weaning husbandry problems*

*I watch television, but in a very selective way. At present, I frequently visit farms because there are many farmers doing different experiments. These have grown up fast. This alternative of doing experiments in farms is an important instrument to divulge information. The farmers like to see this in farms because they can extrapolate to their own farms. In this way the information runs from mouth to mouth. Publications are less efficient... the farmers do not have the habit of reading... thus, the way to divulge information for farmers is to show live experience in the field.*

*The most successful experience that I had was the introduction of cultivated pasture in the Pantanal... I made this decision after having spoken with another farmer. He advised me that the cultivated pasture should be reserved to be used by cows with calf at foot during the flood period... I have done this up to now and the results are good. Mineral supplements and feed supply for young animals are good practices that I have also used. I obtained this information by reading and talking to technicians. I delayed my decision on cross breeding, but after I started to use it, the results that I have obtained are very satisfactory. I have tried different breeds but after I had been to the Clay Centre in the USA, I made up my mind on the way I should go. Nowadays I am crossing the breeds Aberdeen Angus and Hereford with Nelore breed in order to obtain Brangus and Braford.*

*I think that the most important information that I passed to you is that EMBRAPA must to be linked to the farmers in order to develop experiments in the farms. The farmer alone cannot be trusted, because the farmer only talks about the good results that he obtains. The majority of farmers like to talk about personal advantages, while EMBRAPA is neutral.”*

#### **8.1.4 TP4 (trusted person of P3)**

*“Firstly, I grew up in the rural environment as a member of a farm family. After I had studied Veterinary, I was hired by the Ministry of Agriculture to work on livestock research in Campo Grande. I was transferred to EMBRAPA just when EMBRAPA was created. After I had worked for four years in EMBRAPA, I decided to change to being a teacher of the Faculty of Veterinary. In the Faculty I had contacts with other colleagues to exchange information. I have always liked to read about beef cattle and my interest has been on extensive production. I am an observer of the extensive beef production systems ... Every time I identified a mistake in the herd management I used to offer and monitor alternatives to improve the management... in this way, I have obtained feed back to advise many farmers. When I did not have the solution I used to go to EMBRAPA. I am more concerned with animal husbandry and animal health for which my main source of information are the magazines. I have access to the Library of the University and to EMBRAPA publications. I like to watch rural programs on the television. However, I became a very critical observer because most of people defending their experiences tend to be very enthusiastic, overestimating the positive results. Moreover, EMBRAPA’s information is trustworthy. I think that EMBRAPA should implement demonstration fields in the farms in order to transfer technology... because the men like to imitate... in this way, the neighbouring farmers can see or even ask an employee to talk with employee of the farm where the experience is being developed. This occurs in relation to my neighbours. They used to go to my farm to see what I was doing. Later, I realised that the neighbouring farmers were using the same practices that I used in my farm. The farmers prefer to see in the field instead of reading. I believe that EMBRAPA should have demonstration fields located strategically in the leaders’ farm. I am saying leaders’ farm in order to guarantee more credibility to EMBRAPA results.”*

## Appendix 8.2

### How Much the Cases Reflect their Owns Clusters?

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#### 8.2.1 Case C1

There was strong evidence from the survey and in-depth interview that **C1** reflects the characteristics of the cluster 1 of Campo Grande. This is because **C1** is primarily interested in *applied technical information*, which is obtained mainly through informal communication with experienced farmers, sellers and veterinarians, and also through visiting and observing farms. *Selected technical information* was clearly not part of his information system. This is because **C1** does not like to read and he does not participate in technical meetings (seminars, field days, courses), or visit research institutions (EMBRAPA) and farm associations, where technical information are basically focused.

On the other hand, the findings shown that this case is very interested in *farm business* and *general information* obtained from cattle auction, commercial shops, television, and agricultural fairs. In addition, **C1** also reported to have close links with *farm family tradition*. The only aspect, which does not properly reflect the cluster, is that **C1** consults other farmers to take a decision, while this characteristic (*openness to take decision*) in the cluster is that probably other persons are not consulted to take decision.

#### 8.2.2 Case C2

**C2** demonstrated to be a representative case of the cluster 2 of Campo Grande, since he is very interested in *selected technical information* as well as in the majority of the available sources for *applied* and *general technical information*. In addition, the questionnaire answers confirm that this case is not so linked to *farm business information* or even he was supported on *farm business* as an important motivation to become a farmer. *Openness to take decision* was reflected in both the survey and in



the in-depth interview. The moderate positive *commitment with rural life* is confirmed in the questionnaire answers, but the findings from the in-depth interview led to the conclusion that the commitment in this case is high. The moderate negative link with *farm family tradition*, as a characteristic of the cluster 2, was not reflected in the questionnaire answers or in the in-depth interview. In fact, the in-depth interview shows that C2 is very tied up to the rural life and also became a farmer due to motivation from the farm family tradition. These slight distortions can be explained by the variance of the mean of the factor scores, since each cluster characteristic was interpreted taking into account the mean of the factor scores of all cases (farmers) within the cluster (see Chapter 7).

The conclusion is that such distortions were also likely to occur due to the dominance of some variables in the factor. For example, the factor *openness to take decision* is strongly related with the variables “consult technical advisers and other farmers to buy inputs”, which presented high correlation with this factor, .79 and .73 respectively, while the relationship with the variable “consult other farmers to take decision” is moderate, .55. In contrast, the findings from in-depth interviews demonstrate strong evidence that when a technical decision (farming practice) had to be made, all cases used to consult other farmers. In fact, this factor is much more related with openness to buy inputs than with an overall decision making process, thus giving space to a distortion. Perhaps, the factor should be restricted to the decisions to buy inputs. This experience is an indicative that the analyst must be aware of possible case distortions related to factor interpretation.

Another explanation is related with the variance of variables, and consequently with variance of the correspondent means of the factor scores within the cluster. This explanation was also accepted for some of the observed “distortions” in this research, since the original variables of a case study indicated a possible positive relationship with a particular cluster characteristics, while the mean of the factor scores, defining this characteristic within cluster, indicated negative relationship.

### 8.2.3 Case C3

The questionnaire answers and the majority of the findings from the in-depth interview of C3 reflected the characteristics of the cluster 3 of Campo Grande, which is marked by negative relationships with all factors. In fact, the questionnaire responses shown that, in this point in time, this case does not consider important those mechanisms included in the survey as his sources of information, except in relation to television. This characteristic was also confirmed from the in-depth interview, where most of the information is obtained and exchanged with his brothers, trusted people, television, and eventually from newspapers and rural magazines.

The questionnaire data also confirm the negative link with *commitment with rural life*, since C3 attributed low to moderate importance to the variables comprising this factor, except in relation to nature conservation which was considered important. The same was repeated in relation to the *farm business* and *openness to take decision*, the latter being more influenced by a low importance given to consulting “technical advisers” and “other farmers” in the process of buying inputs, as well as consulting “technical advisers” to take other decisions. However, there was evidence from the in-depth interview that this case was strongly influenced by a “trusted farmer” to take farming decisions and also rooted in *farm family tradition*.

### 8.2.4 Case P1

Similar conclusions are also found for the Pantanal region in the way that the representative cases reflect the clusters. P1 is very linked with the mechanisms for *selected technical* and *farm business information* and there were also marked evidences of the positive relations with *general information*. In addition, there were also evidences that this case is strongly linked to *openness to take decisions*, *commitment with rural life*, and *farm family tradition*, both in the survey and in the in-depth interview. Therefore, the conclusion is that P1 matches with the characteristics of cluster 1.

### 8.2.5 Case P2

The questionnaire answers and the in-depth interview of P2 also confirm this case as a representative of cluster 2. In this way, there was evidence of the low relation with *selected technical information* (field days, training courses, technical seminars, technical books, and EMBRAPA publications). Strong relations with *applied technical* and *general information* were also evidenced. However, there was a slight distortion in relation to the *farm business information*, because the data indicated that individually P2 is interested in such information, while the cluster as a whole is not. In relation to the *openness to take decisions*, the data from the survey confirm the moderate openness of the cluster characteristic, since P2 does not use to consult other persons to buy inputs.

As explained before, the variables related to “consult other people” to buy inputs have a strong influence in the factor *openness to take decisions*. However, the data, both from survey and from the in-depth interview, indicated that P2 consults other farmers, friends, relatives and professional colleagues when other decisions have to be made. On the other hand, the high and positive relation with *commitment with rural life, farm business, and farm family* of P2 reflected cluster 2 of Pantanal.

### 8.2.6 Case P3

The data from P3 also reflected the characteristics of its own cluster (cluster 3 of Panatanal), that similarly to the cluster 2, it is not linked to *selected technical information*, but presents positive relations with *applied practical information* obtained from observing other farms and talking with other farmers. The characteristic of negative relations with *general technical information* (rural magazines, rural newspapers, association bulletins) are reflected in the data from the survey and also confirmed in the in-depth interview. Evidence of the strong link with *farm business information* obtained from cattle auction, supplier shops and agricultural fairs are found in the questionnaire answers.

The characteristic of negative *openness to take decision* is also confirmed similarly to the cluster 2, since **P3** does not consult other persons to buy inputs, but he consults other people to take other sort of decisions, for example strategic decisions. However the moderate negative relation with *commitment with rural life* seemed to be not entirely reflected in this case. This is because the case data, in relation to the variables that define this factor, are not convergent with this characteristic. For example, the importance of the objectives “be recognised by nature conservation” and “transfer knowledge to children” are high, “run the business without risk” and “belong to rural community” are moderate, as well as “style of living” is moderately important to become a farmer. However, the moderate relation of the cluster with *farm family tradition* is reflected in the data from the survey in **P3**, but the in-depth interview demonstrated that **P3** has a strong link with this factor.